

Prepared by:

**CITY OF LARGO, FLORIDA
ENGINEERING SERVICES DEPARTMENT**



TRENCHLESS SANITARY AND STORM SEWER REHABILITATION SERVICES

Contract Number: 24-B-806

June 14, 2024

The proposed work specified in this contract is subject to City Commission approval; therefore, any, all, or part of the work specified herein may be increased, decreased, or deleted in accordance with City Commission direction.

All work within Pinellas County or FDOT jurisdiction shall be performed in accordance with Pinellas County and/or FDOT standards and utility license terms, provisions, and conditions.

All other work under this contract shall be governed by these specifications and by all applicable City of Largo standards.

All communications pertaining to this contract shall carry the reference "City Bid No. **24-B-806**".

Jerald Woloszynski
Jerald Woloszynski, P.E.
Director of Engineering Services

BIDDING DOCUMENTS FOR
TRENCHLESS SANITARY AND STORM SEWER REHABILITATION SERVICES
Contract No.: 24-B-806

BIDDING REQUIREMENTS

Advertisement (C-111)
Instructions to Bidders (C-200)
Bid Form (C-410)
Qualifications Statement (C-451)
Corporate Acknowledgment
Certificate as to Corporate Official
Debarment, Suspension Vendor Responsibility Certification Form
Non-Collusive Affidavit
Drug-Free Workplace Certification
Trench Safety Act
Exhibit F Foreign Countries of Concern Affidavit

CONTRACT DOCUMENTS

Agreement (C-520)*
General Conditions of the Construction Contract (C-700)
Supplementary Conditions (C-800)*
Contractor's Application for Payment (C-620)
Notice of Award (C-510)
Notice to Proceed (C-550)
Work Change Directive (C-940)
Change Order (C-941)
Field Order (C-942)
Certificate of Substantial Completion (C-625)
Notice of Acceptability of Work (C-626)

* **It is Owner's expectation that exceptions will be resolved through Addenda prior to bid submittal in order to expedite contract execution.**

TECHNICAL SPECIFICATIONS – CITY OF LARGO

DIVISION 1 - GENERAL REQUIREMENTS

01025	Measurement and Payment
01045	Execution of the Work
01050	Field Engineering
01090	References
01200	Project Meetings
01310	Construction Progress Schedules
01370	Schedule of Values
01410	Testing Laboratory Services
01510	Temporary Utilities
01530	Protection of Work and Property
01550	Contractor Access and Parking
01560	Temporary Controls
01570	Traffic Control
01610	Product Requirements and Options
01650	Product Delivery Requirements
01660	Product Storage and Protection Requirements

01670	Checkout and Startup Procedures
01730	Operation and Maintenance Data
01740	Cleaning and Waste Management
01782	Project Record Documents
01783	Spare Parts and Extra Material
01821	Instruction of Owner's Personnel

DIVISION 2 - SITEWORK

02010	Subsurface Investigation
02050	Demolition
02064	Modifications to Existing Structures
02100	Clearing and Grubbing
02200	Earthwork
02540	Site Grading
02550	Finish Grading
02604	Utility Structures
02607	Manhole Height Adjustment
02710	Underdrain System
02720	Segment Replacement (Pipe and Tap Connections)
02731	Television Inspection
02740	Cured-in-Place Pipe
02750	Chemical Grouting
02762	Sewer Service Lateral CIPP Lining
02934	Sodding
02944	Seeding

DIVISION 3 - CONCRETE

03400	Precast Concrete

DIVISION 7 - THERMAL AND MOISTURE PROTECTION

07900	Joint Fillers, Sealants, and Caulking

DIVISION 9 - FINISHES

09900	Painting

DIVISION 11 - EQUIPMENT

11000	Equipment - General
11100	Pumps – General
11115	Horizontal Centrifugal Self-Priming Pumps
11130	Submersible Solids-Handling Pumps
11170	Liquid Chemical Metering Pump Skid

DIVISION 15 - MECHANICAL CONSTRUCTION

15000	Basic Mechanical Requirements
15006	Ductile Iron Pipe and Fittings
15008	PVC Pipe
15030	Piping and Equipment Identification Systems
15095	Valves, General

15100	Valve Operators and Electric Valve Actuators
15101	Butterfly Valve
15104	Ball Valves
15105	Check Valves
15107	Fire Hydrants
15108	Gate Valves (Including Knife Gate Valves)
15109	Plug Valves
15114	Miscellaneous Valves
15140	Pipe Supports

DIVISION 16 - ELECTRICAL

16000	Basic Electrical Requirements
16111	Conduit
16123	Wire and Cable
16130	Boxes
16141	Wiring Devices
16170	Grounding and Bonding
16190	Supporting Devices
16195	Electrical Identification
16440	Disconnect Switches
16500	Lighting

DIVISION 17 - INSTRUMENTATION

17000	Instrumentation and Control, General
17500	Control Panel
17650	Pressure Gauges
17701	Electromagnetic Flow Meters
17749	Submersible Level (Pressure) Sensor
17760	Pressure Indicating Transmitters

**CITY OF LARGO
LARGO, FL**

**TRENCHLESS SANITARY AND STORM SEWER REHABILITATION SERVICES
CONTRACT NUMBER: 24-B-806**

ADVERTISEMENT FOR BIDS

Sealed Bids for the **Trenchless Sanitary and Storm Sewer Rehabilitation Services** will be received by the **City of Largo**, at the **Office of Performance and Budget**, until **4:30 PM** local time on July 26, 2024, at which time the Bids received will be **publicly** opened and read. The Project consists of **Trenchless Sanitary and Storm Sewer Rehabilitation, which includes: the rehabilitation of pipelines and conduit (8 inch through 84 inch and laterals) by various trenchless methods on an “as needed” basis; trenchless pipe rehabilitation work includes wastewater and stormwater pipe cleaning, inspection, grouting, and lining services. These rehabilitation methods may be used in a variety of gravity and pressure applications such as sanitary sewers, storm sewers, and force mains.**

The City reserves the right to award separate contracts for the various rehabilitation methods. The decision on which method will be used in any given situation will be made at the sole discretion of the City. The repairs assigned to the Contractor may require prioritization by the City. The Owner may order the Contractor to complete the awarded work in accordance with a specific chronological sequence.

The term of this engagement will be from the date of award through September 30, 2025. The City reserves the right to extend the Contract for one additional one-year extension with mutual agreement between Contractor and Owner. The estimated quantities identified in the Schedule of Bid Prices are for comparison only. The locations to be repaired will be as directed by the City of Largo designated representative. The Work shall be assigned on a Task Order basis as need arises.

Bids will be received for multiple blanket Contracts. Bids shall be on a unit price basis as indicated in the Bid Form.

The Issuing Office for the Bidding Documents is: **Office of Performance and Budget, 201 Highland Avenue, Largo, FL 33770. Direct questions concerning this Bid to Kezia Southern, Procurement Analyst, ksouthern@largo.com.** Prospective Bidders may obtain copies of the Bidding Documents from the Issuing Office as described below. **Deadline for questions is July 02, 2024.**

Bidding Documents may be downloaded from Demandstar.com, free of charge.

Bidders may elect to submit their response to this ITB by electronic submission through the free on-line services of DemandStar. All documents and attachments must be uploaded by the date and time indicated. Bidders who are e-bidding for the first time are strongly encouraged to contact DemandStar at 866-273-1863 or obtain assistance by e-mailing questions to Support@demandstar.com. Solicitation responses uploaded to DemandStar after the solicitation response due date and time shall not be considered. It is the sole responsibility of the bidder to ensure that its solicitation response is uploaded and submitted before such date and time. The City of Largo is not responsible for delays caused by power outages or internet failures. No exceptions will be made.

No Pre-bid conference will be held at this time.

IT IS THE BIDDER'S RESPONSIBILITY TO CHECK DEMANDSTAR FOR FINAL DOCUMENTS PRIOR TO SUBMITTAL

Owner: **City of Largo**

By: **Kezia Southern**

Title: **Procurement Analyst**

Date: **June 14, 2024**

+ + END OF ADVERTISEMENT FOR BIDS + +

SUGGESTED INSTRUCTIONS TO BIDDERS

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ARTICLE 1 – DEFINED TERMS

- 1.01 Terms used in these Instructions to Bidders have the meanings indicated in the General Conditions and Supplementary Conditions. Additional terms used in these Instructions to Bidders have the meanings indicated below:

A. *Issuing Office* – The office from which the Bidding Documents are to be issued.

ARTICLE 2 – COPIES OF BIDDING DOCUMENTS

- 2.01 Complete sets of the Bidding Documents may be obtained from the Issuing Office in the number and format stated in the advertisement or invitation to bid.
- 2.02 Complete sets of Bidding Documents shall be used in preparing Bids; neither Owner nor Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.
- 2.03 Owner, in making copies of Bidding Documents available on the above terms, do so only for the purpose of obtaining Bids for the Work and do not authorize or confer a license for any other use.

ARTICLE 3 – QUALIFICATIONS OF BIDDERS

- 3.01 To demonstrate Bidder's qualifications to perform the Work, Bidder shall submit with its Bid a completed Qualifications Statement, included with these Bidding Requirements.
- 3.02 A Bidder's failure to submit required qualification information within the times indicated may disqualify Bidder from receiving an award of the Contract.
- 3.03 No requirement in this Article 3 to submit information will prejudice the right of Owner to seek additional pertinent information regarding Bidder's qualifications.
- 3.04 Bidder is advised to carefully review those portions of the Bid Form requiring Bidder's representations and certifications.

ARTICLE 4 – SITE AND OTHER AREAS; EXISTING SITE CONDITIONS; EXAMINATION OF SITE; OWNER'S SAFETY PROGRAM; OTHER WORK AT THE SITE

The purpose of this solicitation is to award an annual purchasing agreement to one or more Bidders based on line item Bid Price as defined in article 14 and Bidder's qualifications for Task Order Work. Paragraphs 4.01 through 4.05 will apply when Owner issues a Task Order Request for quote to a Contractor (Successful Bidder).

4.01 *Site and Other Areas*

- A. The Site is identified in the Bidding Documents. By definition, the Site includes rights-of-way, easements, and other lands furnished by Owner for the use of the Contractor. Any additional lands required for temporary construction facilities, construction equipment, or storage of materials and equipment, and any access needed for such additional lands, are to be obtained and paid for by Contractor.

4.02 *Existing Site Conditions*

- A. Subsurface and Physical Conditions; Hazardous Environmental Conditions
1. The Order Requests for Quote will identify:

- a. those reports known to Owner of explorations and tests of subsurface conditions at or adjacent to the Site.
 - b. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities).
 - c. reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site.
 - d. Technical Data contained in such reports and drawings.
- 2. The reports and drawings referenced in the preceding subparagraph 1 are not part of the Contract Documents, but the Technical Data contained therein upon whose accuracy Contractor is entitled to rely, as provided in the General Conditions, shall be identified and established in the Task Order Request for quote. Contractor shall be responsible for any interpretation or conclusion Contractor draws from any Technical Data or any other data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings.
- 3. The default definition of Technical Data set forth in Article 1 of the General Conditions will apply to this Contract.
- B. Underground Facilities: Information and data with respect to existing Underground Facilities at or adjacent to the Site are set forth in the Task Order Request for Quote and are based upon information and data furnished to Owner and Engineer by owners of such Underground Facilities, including Owner, or others.
- C. Adequacy of Data: Provisions concerning responsibilities for the adequacy of data furnished to Contractors with respect to subsurface conditions, other physical conditions, and Underground Facilities, and possible changes in the Task Order Request for Quote due to differing or unanticipated subsurface or physical conditions appear in Paragraphs 5.03, 5.04, and 5.05 of the General Conditions. Provisions concerning responsibilities for the adequacy of data furnished to Contractors with respect to a Hazardous Environmental Condition at the Site, if any, and possible changes in the Contract Documents due to any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in the Task Order Request for Quote to be within the scope of the Work, appear in Paragraph 5.06 of the General Conditions.

4.03 *Site Visit and Testing by Bidders*

- A. Contractor shall conduct the required Site visit during normal working hours, and shall not disturb any ongoing operations at the Site.
- B. Contractor is not required to conduct any subsurface testing, or exhaustive investigations of Site conditions.
- C. On request, and to the extent Owner has control over the Site, and schedule permitting, the Owner will provide Contractor access to the Site to conduct such additional examinations, investigations, explorations, tests, and studies as Contractor deems necessary for preparing and submitting a successful Bid. Owner will not have any obligation to grant such access if doing so is not practical because of existing operations, security or safety concerns, or restraints on Owner's authority regarding the Site.
- D. Contractor shall comply with all applicable Laws and Regulations regarding excavation and location of utilities, obtain all permits, and comply with all terms and conditions established by Owner or by property owners or other entities controlling the Site with respect to

schedule, access, existing operations, security, liability insurance, and applicable safety programs.

- E. Contractor shall fill all holes and clean up and restore the Site to its former condition upon completion of such explorations, investigations, tests, and studies.

4.04 *Owner's Safety Program*

- A. Site visits and work at the Site may be governed by an Owner safety program. As the General Conditions indicate, if an Owner safety program exists, it will be noted in the Supplementary Conditions.

4.05 *Other Work at the Site*

- A. The Task Order Request for Quote will include identification of the general nature of other work of which Owner is aware (if any) that is to be performed at the Site by Owner or others (such as utilities and other prime contractors) and relates to the Work contemplated by these Bidding Documents. If Owner is party to a written contract for such other work, then on request, Owner will provide to each Bidder access to examine such contracts (other than portions thereof related to price and other confidential matters), if any.

ARTICLE 5 – BIDDER'S REPRESENTATIONS

5.01 It is the responsibility of each Bidder before submitting a Bid to:

- A. examine and carefully study the Bidding Documents, and any data and reference items identified in the Bidding Documents;
- B. become familiar with and satisfy itself as to all Laws and Regulations that may affect cost, progress, and performance of the Work;
- C. consider the information known to Bidder itself; information commonly known to contractors doing business in the locality; the Bidding Documents; and quantities and Specifications identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder; and (3) Bidder's safety precautions and programs;
- D. agree, based on the information and observations referred to in the preceding paragraph, that at the time of submitting its Bid no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of its Bid for performance of the Work at the price bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents;
- E. become aware of the general nature of the work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents;
- F. promptly give Owner written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder discovers in the Bidding Documents and confirm that the written resolution thereof by Owner is acceptable to Bidder;
- G. determine that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance and furnishing of the Work; and
- H. agree that the submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article, that without

exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

ARTICLE 6 – PRE-BID CONFERENCE

6.01 There will be no pre-bid conference for this advertisement.

ARTICLE 7 – INTERPRETATIONS AND ADDENDA

7.01 All questions about the meaning or intent of the Bidding Documents are to be submitted to Owner in writing. Interpretations or clarifications considered necessary by Owner in response to such questions will be issued by Addenda delivered to all parties recorded as having received the Bidding Documents. Questions received less than seven days prior to the date for opening of Bids may not be answered. Only questions answered by Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

7.02 Addenda may be issued to clarify, correct, supplement, or change the Bidding Documents.

ARTICLE 8 – BID SECURITY

8.01 No bid security is required for this advertisement.

ARTICLE 9 – CONTRACT TIMES

9.01 The number of days within which, or the dates by which, the Work is to be substantially completed, and completed and ready for final payment, are set forth in the Agreement.

ARTICLE 10 – LIQUIDATED DAMAGES

10.01 Provisions for liquidated damages, if any, for failure to timely attain a Milestone, Substantial Completion, or completion of the Work in readiness for final payment, are set forth in the Agreement.

ARTICLE 11 – SUBSTITUTE AND “OR-EQUAL” ITEMS

11.01 The Contract for the Work, as awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents without consideration during the bidding and Contract award process of possible substitute or “or-equal” items. In cases in which the Contract allows the Contractor to request that Owner authorize the use of a substitute or “or-equal” item of material or equipment, application for such acceptance may not be made to and will not be considered by Owner until after the Effective Date of the Contract.

11.02 All prices that Bidder sets forth in its Bid shall be based on the presumption that the Contractor will furnish the materials and equipment specified or described in the Bidding Documents, as supplemented by Addenda. Any assumptions regarding the possibility of post-Bid approvals of “or-equal” or substitution requests are made at Bidder’s sole risk.

ARTICLE 12 – SUBCONTRACTORS, SUPPLIERS, AND OTHERS

12.01 A Bidder shall be prepared to retain specific Subcontractors, Suppliers, or other individuals or entities for the performance of the Work if required by the Bidding Documents (most commonly in the Specifications) to do so. If a prospective Bidder objects to retaining any such

Subcontractor, Supplier, or other individual or entity, and the concern is not relieved by an Addendum, then the prospective Bidder should refrain from submitting a Bid.

- 12.02 Subsequent to the submittal of the Bid, Owner may not require the Successful Bidder or Contractor to retain any Subcontractor, Supplier, or other individual or entity against which Contractor has reasonable objection.

- 12.03 The apparent Successful Bidder, and any other Bidder so requested, shall within five days after Bid opening, submit to Owner a list of the Subcontractors or Suppliers proposed for the following portions of the Work: any phase of the Work not performed by Bidder.

If requested by Owner, such list shall be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor, Supplier, or other individual or entity. If Owner, after due investigation, has reasonable objection to any proposed Subcontractor, Supplier, individual, or entity, Owner may, before the Notice of Award is given, request apparent Successful Bidder to submit an acceptable substitute, in which case apparent Successful Bidder shall submit a substitute, Bidder's Bid price will be increased (or decreased) by the difference in cost occasioned by such substitution, and Owner may consider such price adjustment in evaluating Bids and making the Contract award.

- 12.04 If apparent Successful Bidder declines to make any such substitution, Owner may award the Contract to a Bidder that proposes to use acceptable Subcontractors, Suppliers, or other individuals or entities. Any Subcontractor, Supplier, individual, or entity so listed and against which Owner or Engineer makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to Owner and Engineer subject to subsequent revocation of such acceptance as provided in Paragraph 7.06 of the General Conditions.

ARTICLE 13 – PREPARATION OF BID

- 13.01 The Bid Form is included with the Bidding Documents.

- A. All blanks on the Bid Form shall be completed in ink and the Bid Form signed in ink. Erasures or alterations shall be initialed in ink by the person signing the Bid Form. A Bid price shall be indicated for each section, Bid item, alternate, adjustment unit price item, and unit price item listed therein.
- B. If the Bid Form expressly indicates that submitting pricing on a specific alternate item is optional, and Bidder elects to not furnish pricing for such optional alternate item, then Bidder may enter the words "No Bid" or "Not Applicable."

- 13.02 A Bid by a corporation shall be executed in the corporate name by a corporate officer (whose title must appear under the signature), accompanied by evidence of authority to sign. The corporate address and state of incorporation shall be shown.

- 13.03 A Bid by a partnership shall be executed in the partnership name and signed by a partner (whose title must appear under the signature), accompanied by evidence of authority to sign. The partnership's address for receiving notices shall be shown.

- 13.04 A Bid by a limited liability company shall be executed in the name of the firm by a member or other authorized person and accompanied by evidence of authority to sign. The state of formation of the firm and the firm's address for receiving notices shall be shown.

- 13.05 A Bid by an individual shall show the Bidder's name and address for receiving notices.

- 13.06 A Bid by a joint venture shall be executed by an authorized representative of each joint venturer in the manner indicated on the Bid Form. The joint venture's address for receiving notices shall be shown.
- 13.07 All names shall be printed in ink below the signatures.
- 13.08 The Bid shall contain an acknowledgment of receipt of all Addenda, the numbers of which shall be filled in on the Bid Form.
- 13.09 Postal and e-mail addresses and telephone number for communications regarding the Bid shall be shown.
- 13.10 The Bid shall contain evidence of Bidder's authority and qualification to do business in the state where the Project is located, or Bidder shall covenant in writing to obtain such authority and qualification prior to award of the Contract and attach such covenant to the Bid. Bidder's state contractor license number, if any, shall also be shown on the Bid Form.

ARTICLE 14 – BASIS OF BID

14.01 *Unit Price*

- A. Bidders shall submit a Bid on a unit price basis for each item of Work listed in the unit price section of the Bid Form.
- B. The "Bid Price" (sometimes referred to as the extended price) for each unit price Bid item will be the product of the "Estimated Quantity" (which Owner or its representative has set forth in the Bid Form) for the item and the corresponding "Bid Unit Price" offered by the Bidder. The total of all unit price Bid items will be the sum of these "Bid Prices"; such total will be used by Owner for Bid comparison purposes. The final quantities and Contract Price will be determined in accordance with Paragraph 13.03 of the General Conditions.
- C. Discrepancies between the multiplication of units of Work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.

14.02 *Allowances*

- A. For cash allowances the Bid price shall include such amounts as the Bidder deems proper for Contractor's overhead, costs, profit, and other expenses on account of cash allowances, if any, named in the Contract Documents, in accordance with Paragraph 13.02.B of the General Conditions.

ARTICLE 15 – SUBMITTAL OF BID

- 15.01 With each copy of the Bidding Documents, a Bidder is furnished one separate unbound copy of the Bid Form. The unbound copy of the Bid Form **and an electric copy of the Bid Form in XLSX file format on a USB port thumb drive** is to be completed and submitted and the other documents required to be submitted under the terms of Article 7 of the Bid Form.
- 15.02 A Bid shall be received no later than the date and time prescribed and at the place indicated in the advertisement or invitation to bid and shall be enclosed in a plainly marked package with the Project title (and, if applicable, the designated portion of the Project for which the Bid is submitted), the name and address of Bidder, and shall be accompanied by the other required documents. If a Bid is sent by mail or other delivery system, the sealed envelope containing the Bid shall be enclosed in a separate package plainly marked on the outside with the notation "BID

ENCLOSED.” A mailed Bid shall be addressed to the City of Largo, Office of Performance and Budget, 201 Highland Avenue NE, Largo, FL 33770, Attn: Kezia Southern, Procurement Analyst.

- 15.03 Bids received after the date and time prescribed for the opening of bids, or not submitted at the correct location or in the designated manner, will not be accepted and will be returned to the Bidder unopened.

ARTICLE 16 – MODIFICATION AND WITHDRAWAL OF BID

- 16.01 A Bid may be withdrawn by an appropriate document duly executed in the same manner that a Bid must be executed and delivered to the place where Bids are to be submitted prior to the date and time for the opening of Bids. Upon receipt of such notice, the unopened Bid will be returned to the Bidder.
- 16.02 If a Bidder wishes to modify its Bid prior to Bid opening, Bidder must withdraw its initial Bid in the manner specified in Paragraph 16.01 and submit a new Bid prior to the date and time for the opening of Bids.
- 16.03 If within 24 hours after Bids are opened any Bidder files a duly signed written notice with Owner and promptly thereafter demonstrates to the reasonable satisfaction of Owner that there was a material and substantial mistake in the preparation of its Bid, that Bidder may withdraw its Bid, and the Bid security will be returned. Thereafter, if the Work is rebid, that Bidder will be disqualified from further bidding on the Work.

ARTICLE 17 – OPENING OF BIDS

- 17.01 Bids will be opened at the time and place indicated in the advertisement or invitation to bid and, unless obviously non-responsive, read aloud publicly. An abstract of the amounts of the base Bids and major alternates, if any, will be made available to Bidders after the opening of Bids.

ARTICLE 18 – BIDS TO REMAIN SUBJECT TO ACCEPTANCE

- 18.01 All Bids will remain subject to acceptance for the period of time stated in the Bid Form.

ARTICLE 19 – EVALUATION OF BIDS AND AWARD OF CONTRACT

- 19.01 Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, unbalanced, or conditional Bids. Owner will reject the Bid of any Bidder that Owner finds, after reasonable inquiry and evaluation, to not be responsible. If Bidder purports to add terms or conditions to its Bid, takes exception to any provision of the Bidding Documents, or attempts to alter the contents of the Contract Documents for purposes of the Bid, then the Owner will reject the Bid as nonresponsive; provided that Owner also reserves the right to waive all minor informalities not involving price, time, or changes in the Work.
- 19.02 If Owner awards the contract for the Work, such award shall be to all qualified Bidders.
- 19.03 Evaluation of Bids
- A. In evaluating Bids, Owner will consider whether or not the Bids comply with the prescribed requirements, unit prices, and other data, as may be requested in the Bid Form or prior to the Notice of Award.
- 19.04 In evaluating whether a Bidder is responsible, Owner will consider the qualifications of the Bidder and may consider the qualifications and experience of Subcontractors and Suppliers

proposed for those portions of the Work for which the identity of Subcontractors and Suppliers must be submitted as provided in the Bidding Documents.

- 19.05 Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders and any proposed Subcontractors or Suppliers.

ARTICLE 20 – BONDS AND INSURANCE

- 20.01 Article 6 of the General Conditions, as may be modified by the Supplementary Conditions, sets forth Owner's requirements as to insurance. When the Successful Bidder delivers the Agreement (executed by Successful Bidder) to Owner, it shall be accompanied by required insurance documentation.

ARTICLE 21 – SIGNING OF AGREEMENT

- 21.01 When Owner issues a Notice of Award to the Successful Bidder, it shall be accompanied by the unexecuted counterparts of the Agreement along with the other Contract Documents as identified in the Agreement. Within 15 days thereafter, Successful Bidder shall execute and deliver the required number of counterparts of the Agreement (and any insurance documentation required to be delivered by the Contract Documents) to Owner. Within ten days thereafter, Owner shall deliver one fully executed counterpart of the Agreement to Successful Bidder, together with printed and electronic copies of the Contract Documents as stated in Paragraph 2.02 of the General Conditions.

BID FORM

TRENCHLESS SANITARY AND STORM SEWER REHABILITATION SERVICES

Contract No: 24-B-806

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ARTICLE 1 – BID RECIPIENT

1.01 This Bid is submitted to:

**City of Largo
Office of Performance and Budget
201 Highland Avenue NE
Largo, FL 33770
Attn: Kezia Southern, Procurement Analyst**

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

ARTICLE 2 – BIDDER'S ACKNOWLEDGEMENTS

2.01 Bidder accepts all of the terms and conditions of the Instructions to Bidders. This Bid will remain subject to acceptance for 60 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

ARTICLE 3 – BIDDER'S REPRESENTATIONS

3.01 In submitting this Bid, Bidder represents that:

A. Bidder has examined and carefully studied the Bidding Documents, and any data and reference items identified in the Bidding Documents, and hereby acknowledges receipt of the following Addenda:

<u>Addendum No.</u>	<u>Addendum, Date</u>
_____	_____
_____	_____
_____	_____
_____	_____

- B. Bidder has satisfied itself as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
- C. Bidder is familiar with and has satisfied itself as to all Laws and Regulations that may affect cost, progress, and performance of the Work.
- D. Bidder has considered the information known to Bidder itself; information commonly known to contractors doing business in the locality; and the Bidding Documents.
- E. Bidder agrees, based on the information and observations referred to in the preceding paragraph, that no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price bid, and in accordance with the other terms and conditions of the Bidding Documents.
- F. Bidder is aware of the general nature of work to be performed by Owner that relates to the Work as indicated in the Bidding Documents.

- G. Bidder has given Owner written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and confirms that the written resolution thereof by Owner is acceptable to Bidder.
- H. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance and furnishing of the Work.
- I. The submission of this Bid constitutes an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article, and that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

ARTICLE 4 – BIDDER’S CERTIFICATION

4.01 Bidder certifies that:

- A. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation;
- B. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid;
- C. Bidder has not solicited or induced any individual or entity to refrain from bidding; and
- D. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 4.01.D:
 - 1. “corrupt practice” means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the bidding process;
 - 2. “fraudulent practice” means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
 - 3. “collusive practice” means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels; and
 - 4. “coercive practice” means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

ARTICLE 5 – BASIS OF BID

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

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Bidder will complete the Work for the following prices:

SCHEDULE OF BID PRICES

Bid Number	Bid Item	Quantity	Unit	Unit Cost	Total Cost
Group 1	Cured-In-Place Pipe (CIPP) Main Line Lining				
1	8 in. x 6 mm CIPP	17,500	LF		
2	Cost for each 1.5 mm Increase in Thickness of 8 in. Liner	7,500	LF		
3	10 in. x 6 mm CIPP	3,750	LF		
4	Cost for each 1.5 mm Increase in Thickness of 10 in. Liner	2,500	LF		
5	12 in. x 6 mm CIPP	1,250	LF		
6	Cost for each 1.5 mm Increase in Thickness of 12 in. Liner	750	LF		
7	15 in. x 6 mm CIPP	500	LF		
8	Cost for each 1.5 mm Increase in Thickness of 15 in. Liner	250	LF		
9	18 in. x 6 mm CIPP	500	LF		
10	Cost for each 1.5 mm Increase in Thickness of 18 in. Liner	250	LF		
11	21 in. x 7.5 mm CIPP	125	LF		
12	Cost for each 1.5 mm Increase in Thickness of 21 in. Liner	75	LF		
13	24 in. x 7.5 mm CIPP	250	LF		
14	Cost for each 1.5 mm Increase in Thickness of 24 in. Liner	125	LF		
15	30 in. x 9 mm CIPP	250	LF		
16	Cost for each 1.5 mm Increase in Thickness of 30 in. Liner	125	LF		
17	36 in. x 10.5 mm CIPP	250	LF		
18	Cost for each 1.5 mm Increase in Thickness of 36 in. Liner	125	LF		
19	42 in. x 10.5 mm CIPP	200	LF		
20	Cost for each 1.5 mm Increase in Thickness of 42 in. Liner	100	LF		
21	48 in. x 12 mm CIPP	200	LF		
22	Cost for each 1.5 mm Increase in Thickness of 48 in. Liner	100	LF		
23	54 in. x 12 mm CIPP	150	LF		
24	Cost for each 1.5 mm Increase in Thickness of 54 in. Liner	100	LF		
25	60 in. x 12 mm CIPP	150	LF		
26	Cost for each 1.5 mm Increase in Thickness of 60 in. Liner	100	LF		
27	72 in. x 12 mm CIPP	150	LF		
28	Cost for each 1.5 mm Increase in Thickness of 72 in. Liner	100	LF		
29	84 in. x 12 mm CIPP	100	LF		
30	Cost for each 1.5 mm Increase in Thickness of 84 in. Liner	75	LF		
Group 1 Total Bid:					

SCHEDULE OF BID PRICES

Bid Number	Bid Item	Quantity	Unit	Unit Cost	Total Cost
Group 2	Cured-In-Place Pipe (CIPP) Service Lateral Lining				
31	Initial Service Lateral CCTV Inspection (4"-6") From Main, Up To 30 LF	250	EA		
32	Initial Service Lateral CCTV Inspection (4"-6"), From Main, Per LF, Beyond Initial 30 Ft.	2,500	LF		
33	Initial Service Lateral CCTV Inspection (4"-6") From Clean Out, Up To 30 LF	100	EA		
34	Initial Service Lateral CCTV Inspection (4"-6") From Clean Out, Per LF, Beyond Initial 30 Ft.	1,250	LF		
35	CIPP Lateral Liner, 4" - 6" Dia. Up To 30 LF, with Main/Lateral Connection System	125	EA		
36	CIPP Lateral Liner, 4" - 6" Dia. Per LF Beyond Initial 30 Ft.	1,875	LF		
37	Clean-Out Installation in Grass Area (Up to 5 ft. in depth)	50	EA		
38	Clean-Out Installation in Asphalt Area (Up to 5 ft. in depth)	5	EA		
39	Clean-Out Installation in Concrete Area (Up to 5 ft. in depth)	50	EA		
40	Clean-Out Installation (Beyond 5 ft. in depth)	75	VF		
Group 2 Total Bid:					
Group 3	Joint Sealing with Chemical Grout				
41	Test Joint - 8" Dia.	1,500	EA		
42	Test Joint - 10" Dia.	500	EA		
43	Test Joint - 12" Dia.	500	EA		
44	Grout Seal Failed Joints - 8" Dia	1,000	EA		
45	Grout Seal Failed Joints - 10" Dia	375	EA		
46	Grout Seal Failed Joints - 12" Dia	375	EA		
47	Seal Service Lateral Connections	125	EA		
Group 3 Total Bid:					
Group 4	Common Work Tasks				
48	Mobilization, </= 1,200 LF or </= 10 Lateral Liners per Task Order	5	EA		
49	Mobilization, > 1,200 LF or > 10 Lateral Liners per Task Order	10	EA		
50	Maintenance of Traffic, FDOT	5	DAY		
51	Maintenance of Traffic, City/County Arterial/Collector	15	DAY		
52	Maintenance of Traffic, City/County Minor/Residential	25	DAY		
53	Work in Rear Easements and/or Away From Travelways	15	EA		
54	Specialty Cleaning, 8" Dia. (Groups 1, and 2)	250	LF		
55	Specialty Cleaning, 10"- 18" Dia. (Groups 1, and 2)	250	LF		
56	Specialty Cleaning, 24"-36" Dia. (Group 1 Only)	150	LF		
57	Specialty Cleaning, 42"-54" Dia. (Group 1 Only)	150	LF		

SCHEDULE OF BID PRICES

Bid Number	Bid Item	Quantity	Unit	Unit Cost	Total Cost
58	Specialty Cleaning, 60"-84" Dia. (Group 1 Only)	100	LF		
59	Hammer Tap Removal	5	EA		
60	Lateral Reinstatement and Grouting (Groups 1, and 2)	250	EA		
61	Warranty Cleaning and CCTV Inspection	7,500	LF		
Group 4 Total Bid:					

Bidder acknowledges that (1) each Bid Unit Price includes an amount considered by Bidder to be adequate to cover Contractor's overhead and profit for each separately identified item, and (2) estimated quantities are not guaranteed, and solely for the purpose of comparison of Bids, and final payment for all unit price Bid items will be based on actual quantities, determined as provided in the Contract Documents.

ARTICLE 6 – TIME OF COMPLETION

6.01 The City and Contractor shall determine the number of days to substantial and final completion for each Task Order. Bidder agrees that Work for each Task Order shall be substantially completed within the amount of time set forth in each respective Task Order for substantial completion, after the Contract Times commence to run as provided in the respective Task Order. The Work shall be completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions within the amount of time set forth in each respective Task Order for final completion, after the Contract Times commence to run as provided in the respective Task Order.

ARTICLE 7 – ATTACHMENTS TO THIS BID

- 7.01 The following documents are submitted with and made a condition of this Bid:
- A. Evidence of authority to do business in the state of the Project; or a written covenant to obtain such license within the time for acceptance of Bids;
 - B. Provide proof of registration with PCCLB (Pinellas County Construction Licensing Board) by supplying a copy of your registration card.
 - C. Required Bidder Qualification Statement with supporting data;
 - D. Corporate acknowledgement;
 - E. Certificate as to corporate official;
 - F. Debarment, suspension vendor responsibility certification form;
 - G. Non-Collusive Affidavit;
 - H. Drug-free workplace certification; and
 - I. Trench safety act
 - J. Foreign Countries of Concern Affidavit

ARTICLE 8 – DEFINED TERMS

8.01 The terms used in this Bid with initial capital letters have the meanings stated in the Instructions to Bidders, the General Conditions, and the Supplementary Conditions.

ARTICLE 9 – BID SUBMITTAL

BIDDER: *[Indicate correct name of bidding entity]*

By:

[Signature]

[Printed name]

(If Bidder is a corporation, a limited liability company, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest:

[Signature]

[Printed name]

Title:

Submittal Date:

Address for giving notices:

Telephone Number:

Fax Number:

Contact Name and e-mail address:

Bidder's License No.:

(where applicable)

QUALIFICATIONS STATEMENT

THE INFORMATION SUPPLIED IN THIS DOCUMENT IS CONFIDENTIAL TO THE EXTENT
PERMITTED BY LAWS AND REGULATIONS

1. SUBMITTED BY:

Official Name of Firm:

Address:

2. SUBMITTED TO:

3. SUBMITTED FOR:

Owner:

City of Largo

Project Name:

Trenchless Sanitary and Storm Sewer Rehabilitation Services

TYPE OF WORK:

4. CONTRACTOR'S CONTACT INFORMATION

Contact Person:

Title:

Phone:

Email:

5. AFFILIATED COMPANIES:

Name:

Address:

6. TYPE OF ORGANIZATION:

☐ SOLE PROPRIETORSHIP

Name of Owner:

Doing Business As:

Date of Organization:

☐ PARTNERSHIP

Date of Organization:

Type of Partnership:

Name of General Partner(s):

☐ CORPORATION

State of Organization:

Date of Organization:

Executive Officers:

- President:

- Vice President(s):

- Treasurer:

- Secretary:

☐ LIMITED LIABILITY COMPANY

State of Organization:

Date of Organization:

Members:

☐ JOINT VENTURE

Sate of Organization:

Date of Organization:

Form of Organization:

Joint Venture Managing Partner

- Name:

- Address:

Joint Venture Managing Partner

- Name:

- Address:

Joint Venture Managing Partner

- Name:

- Address:

7. LICENSING

Jurisdiction:

Type of License:

License Number:

Jurisdiction:

Type of License:

License Number:

7a. PCCLB (Pinellas County Licensing Board)

Registration Number: _____

8. CERTIFICATIONS

CERTIFIED BY:

Disadvantage Business Enterprise: _____

Minority Business Enterprise: _____

Woman Owned Enterprise: _____

Small Business Enterprise: _____

Other (_____): _____

9. BONDING INFORMATION

Bonding Company: _____

Address: _____

Bonding Agent: _____

Address: _____

Contact Name: _____

Phone: _____

Aggregate Bonding Capacity: _____

Available Bonding Capacity as of date of this submittal: _____

10. CONSTRUCTION EXPERIENCE:

Current Experience:

List on **Schedule A** all uncompleted projects currently under contract (If Joint Venture list each participant's projects separately).

Previous Experience:

List on **Schedule B** all projects completed within the last 5 Years (If Joint Venture list each participant's projects separately).

Has firm listed in Section 1 ever failed to complete a construction contract awarded to it?

☐ YES ☐ NO

If YES, attach as an Attachment details including Project Owner's contact information.

Has any Corporate Officer, Partner, Joint Venture participant or Proprietor ever failed to complete a construction contract awarded to them in their name or when acting as a principal of another entity?

☐ YES ☐ NO

If YES, attach as an Attachment details including Project Owner's contact information.

Are there any judgments, claims, disputes or litigation pending or outstanding involving the firm listed in Section 1 or any of its officers (or any of its partners if a partnership or any of the individual entities if a joint venture)?

☐ YES ☐ NO

If YES, attach as an Attachment details including Project Owner's contact information.

11. SAFETY PROGRAM:

Name of Contractor's Safety Officer: _____

Include the following as attachments:

Provide as an Attachment Contractor's (and Contractor's proposed Subcontractors and Suppliers furnishing or performing Work having a value in excess of 10 percent of the total amount of the Bid) OSHA No. 300- Log & Summary of Occupational Injuries & Illnesses for the past 5 years.

Provide as an Attachment Contractor's (and Contractor's proposed Subcontractors and Suppliers furnishing or performing Work having a value in excess of 10 percent of the total amount of the Bid) list of all OSHA Citations & Notifications of Penalty (monetary or other) received within the last 5 years (indicate disposition as applicable) - IF NONE SO STATE.

Provide as an Attachment Contractor's (and Contractor's proposed Subcontractors and Suppliers furnishing or performing Work having a value in excess of 10 percent of the total amount of the Bid) list of all safety citations or violations under any state all received within the last 5 years (indicate disposition as applicable) - IF NONE SO STATE.

Provide the following for the firm listed in Section V (and for each proposed Subcontractor furnishing or performing Work having a value in excess of 10 percent of the total amount of the Bid) the following (attach additional sheets as necessary):

Workers' compensation Experience Modification Rate (EMR) for the last 5 years:

YEAR	_____	EMR	_____
YEAR	_____	EMR	_____
YEAR	_____	EMR	_____
YEAR	_____	EMR	_____
YEAR	_____	EMR	_____

Total Recordable Frequency Rate (TRFR) for the last 5 years:

YEAR	_____	TRFR	_____
YEAR	_____	TRFR	_____
YEAR	_____	TRFR	_____
YEAR	_____	TRFR	_____
YEAR	_____	TRFR	_____

Total number of man-hours worked for the last 5 Years:

YEAR	_____	TOTAL NUMBER OF MAN-HOURS	_____
YEAR	_____	TOTAL NUMBER OF MAN-HOURS	_____
YEAR	_____	TOTAL NUMBER OF MAN-HOURS	_____
YEAR	_____	TOTAL NUMBER OF MAN-HOURS	_____
YEAR	_____	TOTAL NUMBER OF MAN-HOURS	_____

Provide Contractor's (and Contractor's proposed Subcontractors and Suppliers furnishing or performing Work having a value in excess of 10 percent of the total amount of the Bid) Days Away From Work, Days of Restricted Work Activity or Job Transfer (DART) incidence rate for the particular industry or type of Work to be performed by Contractor and each of Contractor's proposed Subcontractors and Suppliers) for the last 5 years:

YEAR	_____	DART	_____
YEAR	_____	DART	_____
YEAR	_____	DART	_____
YEAR	_____	DART	_____
YEAR	_____	DART	_____

12. EQUIPMENT:

MAJOR EQUIPMENT:

List on **Schedule C** all pieces of major equipment available for use on Owner's Project.

I HEREBY CERTIFY THAT THE INFORMATION SUBMITTED HERewith, INCLUDING ANY ATTACHMENTS, IS TRUE TO THE BEST OF MY KNOWLEDGE AND BELIEF.

NAME OF ORGANIZATION: _____

BY: _____

TITLE: _____

DATED: _____

NOTARY ATTEST:

SUBSCRIBED AND SWORN TO BEFORE ME

THIS _____ DAY OF _____, 20____

NOTARY PUBLIC - STATE OF _____

MY COMMISSION EXPIRES: _____

REQUIRED ATTACHMENTS

1. Schedule A (Current Experience).
2. Schedule B (Previous Experience).
3. Schedule C (Major Equipment).
4. Audited balance sheet for each of the last 3 years for firm named in Section 1.
5. Evidence of authority for individuals listed in Section 7 to bind organization to an agreement.
6. Resumes of officers and key individuals (including Safety Officer) of firm named in Section 1.
7. Required safety program submittals listed in Section 13.
8. Additional items as pertinent.

SCHEDULE A

CURRENT EXPERIENCE

Project Name	Owner's Contact Person	Design Engineer	Contract Date	Type of Work	Status	Cost of Work
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				

	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				

	Name: Address: Telephone:	Name: Company: Telephone:				

SCHEDULE B

PREVIOUS EXPERIENCE (Include ALL Projects Completed within last 5 years)

Project Name	Owner's Contact Person	Design Engineer	Contract Date	Type of Work	Status	Cost of Work
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				

SCHEDULE B

PREVIOUS EXPERIENCE (Include ALL Projects Completed within last 5 years)

Project Name	Owner's Contact Person	Design Engineer	Contract Date	Type of Work	Status	Cost of Work
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				

SCHEDULE C - LIST OF MAJOR EQUIPMENT AVAILABLE

[illegible]

CORPORATE ACKNOWLEDGMENT

STATE OF _____

COUNTY OF _____

The foregoing instrument was acknowledged before me this _____ day of

_____, _____

by _____ (name of officer or agent, title of officer or agent),

of _____ (name of corporation

acknowledging), a _____ (state or place of

incorporation) corporation, on behalf of the corporation. He/She is (personally known to me) (or has

produced identification) _____ (type of identification) (as identification)

and (did/did not) take an oath.

Signature of Person Taking
Acknowledgment

Name of Acknowledger Typed,
Printed or Stamped

CERTIFICATE AS TO CORPORATE PRINCIPAL

STATE OF FLORIDA)
) SS
COUNTY OF)
_____)

I HEREBY CERTIFY that a meeting of the Board of Directors of _____, a corporation under the laws of the State of _____ held on _____, 20____ the following resolution was duly passed and adopted:

"RESOLVED", that _____,
as _____ President of the corporation, be he/she is hereby authorized to execute the Agreement dated _____, 20____, between the City of Largo, Florida and this Corporation, and that his/her execution thereof, attested by the Secretary of the Corporation and with corporate seal affixed, shall be the official act and deed of this Corporation".

I further certify that said resolution is now in full force and effect.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed the official seal of the Corporation this _____ day of _____, 20_____.

Signature of Secretary

(Print or Type)

(Seal)

Subscribed and sworn to before me
this _____ day of _____, 20_____

Notary Public

My Commission Expires: _____



Debarment, Suspension Vendor Responsibility Certification

The Proposer certifies that the Proposer and any person associated with the Proposer in the capacity of owner, partner, director, officer, principal, investigator, project director, manager, auditor, or position involving the administration of public funds:

- (a.) is not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from government transactions by any federal, state, or local governmental entity;
- (b.) has not within a three-year period preceding this certification been convicted of or had a civil judgment rendered against it for: commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a federal, state, or local government transaction or public contract; violation of federal or state antitrust statutes; or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;
- (c.) is not presently indicted for or otherwise criminally or civilly charged by a federal, state, or local governmental entity with commission of any of the offenses enumerated this certification; or
- (d.) has not within a three-year period preceding this certification had one or more federal, state, or local government public transactions terminated for cause or default.

By executing this Agreement and each and every renewal hereof (if renewal is separately provided for herein), pursuant to section 287.135, Florida Statutes, Contractor certifies, represents, and warrants that:

- (a.) it is not on the Scrutinized Companies with Activities in Sudan List,
- (b.) it is not on the Scrutinized Companies with Activities in the Iran Petroleum Energy Sector List,
- (c.) it is not on the Scrutinized Companies with Activities in Iran Terrorism Sectors List,
- (d.) that it does not have Business operations or is engaged in business in Cuba or Syria, and
- (e.) that it is not engaged or engaging in a Boycott of Israel, and that all such certifications were true at the time it submitted its bid or proposal for this Agreement, as of the Effective Date of this Agreement, and as of the effective date of any renewal of this Agreement.

The Proposer certifies that it shall not knowingly enter into any transaction with any subcontractor, material supplier, or vendor about which any of the foregoing paragraphs are not true.

Notwithstanding anything contained in this Agreement to the contrary, the City of Largo may terminate this Agreement immediately for cause if:

- 1) Contractor is found to have submitted a false certification regarding (a) – (d) above in accordance with section 287.135(5), Florida Statutes,
- 2) Contractor is found to have been placed on the Scrutinized Companies with Activities in Sudan List or the Scrutinized Companies with Activities in the Iran Petroleum Energy Sector List, or is or has been engaged in Business operations in Cuba or Syria or a Boycott of Israel, or
- 3) Contractor is found to have been placed on a list created pursuant to section 215.473, Florida Statutes, relating to scrutinized active business operations in Iran.

Such termination shall be in addition to any and all remedies available to the City of Largo at law or in equity. The terms "Boycott of Israel" and "Business operations" used in this section are defined as in Section 287.135, Florida Statutes. The Lists referred to in this section are those Lists in and maintained pursuant to section 287.135, Florida Statutes.

Proposer (Authorized Signature): _____ Date: _____

Representative Name & Title (typed or printed): _____

NON-COLLUSIVE AFFIDAVIT

STATE OF FLORIDA)
)SS
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, representative, employees or parties in interest, including this affidavit, have 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 have in any manner, directly or indirectly, sought by agreement or collusion, or communications, or conference with any Bidder, firm, or person to fix the price or prices in the attached Bid or any other Bidder, or to fix any overhead, profit, 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 Largo, or any person interested in the proposed Contract; and
- 5) The price of items quoted in the attached Bid are fair and proper and are not tainted by collusion, conspiracy, connivance, or unlawful agreement on the part of the Bidder or any other of its agents, representatives, owners, employees or parties in interest, including this affidavit.

(Signed)

(Title)

Subscribed and sworn to before me

this ____ day of _____, 20____

Notary Public

My Commission Expires:

DRUG FREE WORKPLACE CERTIFICATION

IDENTICAL TIE BIDS: Preference shall be given to businesses with drug-free workplace programs. Whenever two or more bids which are equal with respect to price, quantity, and service are received by the State or by any political subdivision for the procurement of commodities or contractual services, a bid received from a business that certifies that it has implemented a drug-free workplace program shall be given preference in the award process. Established procedures for processing tie bids will be followed if none of the tied vendors have a drug-free workplace program (Florida Statutes Section 287.087). In order to have a drug-free workplace program, a business shall:

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, and available drug counseling, rehabilitation, and employee assistance programs, and the penalties that may be imposed upon employees for drug abuse violations.
3. Give each employee engaged in providing the commodities or contractual services that are under bid a copy of the statement specified in subsection (1).
4. In the statement specified in subsection (1), notify the employees that, as a condition of working on the commodities or contractual services that are under bid, 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 of Chapter 893 or of any controlled substance law of the United States or any state, for a violation occurring in the workplace no later than five (5) days after such conviction.
5. Impose a 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.

As the person authorized to sign the statement, I certify that this firm complies fully with the above requirements.

Signature of Bidder

(Print or type)

TRENCH SAFETY ACT

Florida Statutes Section 553.60 et seq.

"Trench Safety Act" Compliance

Bidder acknowledges that the Florida Trench Safety Act, Section 553.60 et. seq., which became effective October 1, 1990, shall be in effect during the period of construction of the project. The Bidder by signing and submitting the bid is, in writing, assuring that it will perform any trench excavation in accordance with the applicable trench safety standards. The Bidder further identifies the following separate item of cost of compliance with the applicable trench safety standards as well as the method of compliance.

Method of Compliance

Cost

Bidder acknowledges that this cost is included in the applicable items of the Proposal and in the Grand Total Bid Price. Failure to complete the above may result in the bid being declared non-responsive.

The Bidder is, and the Owner and Engineer are not, responsible to review or assess City's safety precautions, programs or costs, or the means, methods, techniques or technique adequacy, reasonableness of cost, sequences or procedures of any safety precaution, program or cost, including but not limited to, compliance with any and all requirements of Florida Statute Section 553.60 et. seq. cited as the "Trench Safety Act". Bidder is, and the City and Engineer are not, responsible to determine if any safety or safety related standards apply to the project, including, but not limited to, the "Trench Safety Act".

Signature of Bidder

(Print or type)

AFFIDAVIT

Before me, a notary public, in and for the State of Florida – at large,
personally appeared, _____, and having first made due oath or affirmation,
states: (Write Name Here)

- 1. My name is _____
(Write Name Here)
- 2. I am the _____ of _____
(Insert Job Title) (Insert Company Name)
- 3. The Company was formed in _____ and is a _____
(Country and State) (List the Type of Entity (ex.: LLC, Inc., etc.))
- 4. I am duly authorized and empowered and have sufficient knowledge to execute and deliver this Affidavit.
- 5. I affirm that the Company is not:
 - a. Owned or controlled by the government of the People’s Republic of China, the Russian Federation, the Islamic Republic of Iran, the Democratic People’s Republic of Korea, the Republic of Cuba, the Venezuelan regime of Nicolás Maduro, or the Syrian Arab Republic (collectively and individually, a Foreign Country of Concern), including any agency of or any other entity of significant control of such Foreign Country of Concern. Where ‘controlled by’ means *having possession of the power to direct or cause the direction of the management or policies of a company, whether through ownership of securities, by contract, or otherwise; or a person or entity that directly or indirectly has the right to vote 25 percent or more of the voting interests of the company or that is entitled to 25 percent or more of its profits is presumed to control the foreign entity; or*
 - b. A partnership, association, corporation, organization, or other combination of persons organized under the laws of or having its principal place of business in a Foreign Country of Concern, or a subsidiary of such entity.

Under penalties of perjury, I declare that I have read the foregoing Affidavit and that the facts stated in it are true.

(Signature of Affiant)

The foregoing instrument was acknowledged before me this ____ day of _____,
(Insert Day) (Insert Month)
_____, by _____.
(Insert Year) (Insert Name of Affiant)

Personally known _____
OR Produced Identification _____
Type of Identification Provided _____

PRINT, TYPE OR STAMP NAME OF NOTARY

**EXHIBIT A – CONTRACTOR’S BID
(to be inserted)**

EXHIBIT B – INSURANCE CERTIFICATES
(to be inserted)

AGREEMENT
BETWEEN OWNER AND CONTRACTOR
FOR CONSTRUCTION CONTRACT (STIPULATED PRICE)

THIS AGREEMENT is by and between City of Largo (“Owner”) and
____ (“Contractor”).

Owner and Contractor hereby agree as follows:

ARTICLE 1 – WORK

- 1.01 Contractor shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows: **the rehabilitation of pipelines and conduits (8 inch through 84 inch, and laterals) by various trenchless methods on an “as needed” basis. The trenchless pipe rehabilitation work includes wastewater and stormwater pipe cleaning, inspection, grouting, and lining services. These rehabilitation methods may be used in a variety of gravity and pressure applications such as sanitary sewers, storm sewers, and force mains.**

This Work shall be assigned on a Task Order basis.

ARTICLE 2 – THE PROJECT

- 2.01 The Project, of which the Work under the Contract Documents is a part, is generally described as follows: **Trenchless Sanitary and Storm Sewer Rehabilitation Services Contract No. 24-B-806.**

ARTICLE 3 – ENGINEER

- 3.01 The part of the Project that pertains to the Work has been designed by the **City of Largo.**
- 3.02 Reference to ENGINEER in the Contract Documents shall be the OWNER, City of Largo Engineering Services Department. The OWNER will assume all duties and responsibilities, and will have the rights and authority assigned to Engineer in the Contract Documents in connection with the completion of the Work in accordance with the Contract Documents.

ARTICLE 4 – CONTRACT TIMES

- 4.01 *Time of the Essence*
- A. All time limits for Milestones, if any, Substantial Completion, and completion and readiness for final payment as stated in the Contract Documents are of the essence of the Contract.
- 4.02 *Contract Times: Days*
- A. The Work for each Task Order will be substantially completed within the amount of time set forth in each respective Task Order for substantial completion, after the Contract Times commence to run as provided in the respective Task Order. The Work will be completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions within the amount of time set forth in each respective Task Order for final completion, after the Contract Times commence to run as provided in the respective Task Order.

4.03 *Liquidated Damages*

- A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.01 above and that Owner will suffer financial and other losses if the Work is not completed and Milestones not achieved within the times specified in Paragraph 4.02 above, plus any extensions thereof allowed in accordance with the Contract. The parties also recognize the delays, expense, and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty):
1. Substantial Completion: Contractor shall pay Owner \$500 for each day that expires after the time (as duly adjusted pursuant to the Contract) specified in Paragraph 4.02.A above for Substantial Completion until the Work is substantially complete.
 2. Completion of Remaining Work: After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Times (as duly adjusted pursuant to the Contract) for completion and readiness for final payment, Contractor shall pay Owner \$500 for each day that expires after such time until the Work is completed and ready for final payment.
 3. Liquidated damages for failing to timely attain Substantial Completion and final completion are not additive and will not be imposed concurrently.

ARTICLE 5 – CONTRACT PRICE

- 5.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents the amounts that follow, subject to adjustment under the Contract:
- A. For all Unit Price Work, an amount equal to the sum of the extended prices (established for each separately identified item of Unit Price Work by multiplying the unit price times the actual quantity of that item):

REMAINDER OF PAGE INTENTIONALLY LEFT BLANK

The extended prices for Unit Price Work set forth as of the Effective Date of the Contract are based on estimated quantities. As provided in Paragraph 13.03 of the General Conditions, estimated quantities are not guaranteed, and determinations of actual quantities and classifications are to be made by Owner.

ARTICLE 6 – PAYMENT PROCEDURES

6.01 *Submittal and Processing of Payments*

- A. Contractor shall submit Applications for Payment in accordance with Article 15 of the General Conditions. Applications for Payment shall be submitted to Norm Shaw, City of Largo Construction Manager, by the last calendar day of the month. Applications for Payment will be processed by Owner as provided in the General Conditions. All payments shall be applied for and paid in accordance with the Florida Prompt Payment Act, as set forth in chapter 218, Florida Statutes.

6.02 *Progress Payments; Retainage*

- A. Owner shall make progress payments on account of the Task Order Price on the basis of Contractor's Applications for Payment in accordance with section 218.735, Florida Statutes (2018), during performance of the Work as provided in Paragraph 6.02.A.1 below, provided that such Applications for Payment have been submitted in a timely manner and otherwise meet the requirements of the Contract. All such payments will be measured by the Schedule of Values established as provided in the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no Schedule of Values, as provided elsewhere in the Contract.
 - 1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as Owner may withhold, including but not limited to liquidated damages, in accordance with the Contract
 - a. **95** percent of Work completed (with the balance being retainage) for the duration of the Project.
 - b. Upon Substantial Completion, Contractor may request release of retainage, which will not be unreasonably withheld by the Owner.

6.03 *Final Payment*

- A. Upon final completion and acceptance of the Work in accordance with Paragraph 15.06 of the General Conditions, Owner shall pay the remainder of the Task Order Price as recommended by OSR as provided in said Paragraph 15.06.

ARTICLE 7 – INTEREST

- 7.01 All amounts not paid when due shall bear interest at the rate of one percent per annum.

ARTICLE 8 – CONTRACTOR'S REPRESENTATIONS

- 8.01 In order to induce Owner to enter into this Contract, Contractor makes the following representations:
 - A. Contractor has examined and carefully studied the Contract Documents, and any data and reference items identified in the Contract Documents.

- B. For each Task Order, Contractor shall visit the Site, conduct a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
- C. Contractor is familiar with and is satisfied as to all Laws and Regulations that may affect cost, progress, and performance of the Work.
- D. For each Task Order, Contractor shall carefully study all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings, and (2) reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings.
- E. For each Task Order, Contractor shall consider the information known to Contractor itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Site-related reports and drawings identified in the Contract Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor; and (3) Contractor's safety precautions and programs.
- F. Based on the information and observations referred to in the preceding paragraph, Contractor shall satisfy itself that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.
- G. For each Task Order, Contractor shall be aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.
- H. Contractor has given Owner written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and the written resolution thereof by Owner is acceptable to Contractor.
- I. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.
- J. Contractor's entry into this Contract constitutes an incontrovertible representation by Contractor that without exception all prices in the Agreement are premised upon performing and furnishing the Work required by the Contract Documents.

ARTICLE 9 – CONTRACT DOCUMENTS

9.01 *Contents*

- A. The Contract Documents consist of the following:
 - 1. This Agreement.
 - 2. General Conditions.

3. Supplementary Conditions.
 4. Specifications as listed in the table of contents of the Project Manual.
 5. Addenda.
 6. Exhibits to this Agreement (enumerated as follows):
 - a. Contractor's Bid.
 - b. Insurance Certificates.
 7. The following which may be delivered or issued on or after the Effective Date of the Contract and are not attached hereto:
 - a. Task Orders.
 - b. Work Change Directives.
 - c. Change Orders.
 - d. Field Orders.
- B. There are no Contract Documents other than those listed above in this Article 9.
- C. The Contract Documents may only be amended, modified, or supplemented as provided in the General Conditions. In interpreting this Agreement and resolving any ambiguities or conflicts amongst the Contract Documents, this Agreement takes precedence over the other Contract Documents and any inconsistency between remaining Contract Documents will be resolved in the following order:
1. Specifications
 2. Addenda
 3. Supplementary Conditions
 4. General Conditions

ARTICLE 10 – MISCELLANEOUS

10.01 *Terms*

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

10.02 *Assignment of Contract*

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

10.03 *Successors and Assigns*

- A. Owner and Contractor each binds itself, its successors, assigns, and legal representatives to the other party hereto, its successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.

10.04 *Severability*

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

10.05 *Contractor's Certifications*

- A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 10.05:
 - 1. "corrupt practice" means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the bidding process or in the Contract execution;
 - 2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Owner, (b) to establish Bid or Contract prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
 - 3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and
 - 4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

10.06 *Other Provisions*

- A. Owner stipulates that if the General Conditions that are made a part of this Contract are based on EJCDC® C-700, Standard General Conditions for the Construction Contract, published by the Engineers Joint Contract Documents Committee®, and if Owner is the party that has furnished said General Conditions, then Owner has plainly shown all modifications to the standard wording of such published document to the Contractor, through a process such as highlighting or "track changes" (redline/strikeout), or in the Supplementary Conditions.

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement.

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

OWNER:

CONTRACTOR:

City of Largo

By: _____

By: _____

Title: _____

Title: _____

(If Contractor is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest: _____

Attest: _____

Title: _____

Title: _____

Risk Manager

Reviewed and Approved:

City Attorney

Address for giving notices:

John Curp, City Manager

201 Highland Avenue NE

Largo, FL 33770

Address for giving notices:

With required copy to:

Alan S. Zimmet, Esq.

Bryant Miller Olive, P.A.

One Tampa City Center, Suite 2700

Tampa, Florida 33602

License No.: _____

(where applicable)

**GENERAL CONDITIONS
OF THE CONSTRUCTION CONTRACT**

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ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.01 Defined Terms

- A. Wherever used in the Bidding Requirements or Contract Documents, a term printed with initial capital letters, including the term’s singular and plural forms, will have the meaning indicated in the definitions below. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.

1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which

clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.

2. *Agreement*—The written instrument, executed by Owner and Contractor, that sets forth the Contract Price and Contract Times, identifies the parties and the Engineer, and designates the specific items that are Contract Documents.
3. *Application for Payment*—The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.
4. *Bid*—The offer of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.
5. *Bidder*—An individual or entity that submits a Bid to Owner.
6. *Bidding Documents*—The Bidding Requirements, the proposed Contract Documents, and all Addenda.
7. *Bidding Requirements*—The advertisement or invitation to bid, Instructions to Bidders, Bid Bond or other Bid security, if any, the Bid Form, and the Bid with any attachments.
8. *Change Order*—A document which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, or other revision to the Contract, issued on or after the Effective Date of the Contract.
9. *Change Proposal*—A written request by Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times, or both; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-off against payments due; or seeking

other relief with respect to the terms of the Contract.

10. *Claim*—(a) A demand or assertion by Owner directly to Contractor, duly submitted in compliance with the procedural requirements set forth herein: seeking an adjustment of Contract Price or Contract Times, or both; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting Engineer's decision regarding a Change Proposal; seeking resolution of a contractual issue that Engineer has declined to address; or seeking other relief with respect to the terms of the Contract; or (b) a demand or assertion by Contractor directly to Owner, duly submitted in compliance with the procedural requirements set forth herein, contesting Engineer's decision regarding a Change Proposal; or seeking resolution of a contractual issue that Engineer has declined to address. A demand for money or services by a third party is not a Claim.
11. *Constituent of Concern*—Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to (a) the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. §§9601 et seq. ("CERCLA"); (b) the Hazardous Materials Transportation Act, 49 U.S.C. §§5101 et seq.; (c) the Resource Conservation and Recovery Act, 42 U.S.C. §§6901 et seq. ("RCRA"); (d) the Toxic Substances Control Act, 15 U.S.C. §§2601 et seq.; (e) the Clean Water Act, 33 U.S.C. §§1251 et seq.; (f) the Clean Air Act, 42 U.S.C. §§7401 et seq.; or (g) any other federal, state, or local statute, law, rule, regulation, ordinance, resolution, code, order, or decree regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.
12. *Contract*—The entire and integrated written contract between the Owner and Contractor concerning the Work.
13. *Contract Documents*—Those items so designated in the Agreement, and which together comprise the Contract.
14. *Contract Price*—The money that Owner has agreed to pay Contractor for completion of the Work in accordance with the Contract Documents. .
15. *Contract Times*—The number of days or the dates by which Contractor shall: (a) achieve Milestones, if any; (b) achieve Substantial Completion; and (c) complete the Work.
16. *Contractor*—The individual or entity with which Owner has contracted for performance of the Work.
17. *Cost of the Work*—See Paragraph 13.01 for definition.
18. *Drawings*—The part of the Contract that graphically shows the scope, extent, and character of the Work to be performed by Contractor.
19. *Effective Date of the Contract*—The date, indicated in the Agreement, on which the Contract becomes effective.
20. *Engineer*—The individual or entity named as such in the Agreement.
21. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but does not change the Contract Price or the Contract Times.
22. *Hazardous Environmental Condition*—The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated in the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, does not establish a Hazardous Environmental Condition.

23. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.
24. *Liens*—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property. Liens are prohibited on Owner's real property.
25. *Milestone*—A principal event in the performance of the Work that the Contract requires Contractor to achieve by an intermediate completion date or by a time prior to Substantial Completion of all the Work.
26. *Notice of Award*—The written notice by Owner to a Bidder of Owner's acceptance of the Bid.
27. *Notice to Proceed*—A written notice by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work.
28. *Owner*—The individual or entity with which Contractor has contracted regarding the Work, and which has agreed to pay Contractor for the performance of the Work, pursuant to the terms of the Contract.
29. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor's plan to accomplish the Work within the Contract Times.
30. *Project*—The total undertaking to be accomplished for Owner by engineers, contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Work to be performed under the Contract Documents is a part.
31. *Project Manual*—The written documents prepared for, or made available for, procuring and constructing the Work, including but not limited to the Bidding Documents or other construction procurement documents, geotechnical and existing conditions information, the Agreement, bond forms, General Conditions, Supplementary Conditions, and Specifications. The contents of the Project Manual may be bound in one or more volumes.
32. *Resident Project Representative*—The authorized representative of Engineer assigned to assist Engineer and Owner at the Site. As used herein, the term Resident Project Representative or "RPR" includes any assistants or field staff of Resident Project Representative.
33. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and that establish the standards by which such portion of the Work will be judged.
34. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer's review of the submittals and the performance of related construction activities.
35. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.
36. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents.
37. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements, and such other lands furnished by Owner which are designated for the use of Contractor.

38. *Specifications*—The part of the Contract that consists of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable to the Work.
39. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work.
40. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms “substantially complete” and “substantially completed” as applied to all or part of the Work refer to Substantial Completion thereof.
41. *Successful Bidder*—The Bidder whose Bid the Owner accepts, and to which the Owner makes an award of contract, subject to stated conditions.
42. *Supplementary Conditions*—The part of the Contract that amends or supplements these General Conditions.
43. *Supplier*—A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or a Subcontractor.
44. *Technical Data*—Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (a) subsurface conditions at the Site, or physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) or (b) Hazardous Environmental Conditions at the Site. If no such express identifications of Technical Data have been made with

respect to conditions at the Site, then the data contained in boring logs, recorded measurements of subsurface water levels, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical or environmental report prepared for the Project and made available to Contractor are hereby defined as Technical Data with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06.

45. *Underground Facilities*—All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including but not limited to those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, fiber optic transmissions, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.
46. *Unit Price Work*—Work to be paid for on the basis of unit prices.
47. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction; furnishing, installing, and incorporating all materials and equipment into such construction; and may include related services such as testing, start-up, and commissioning, all as required by the Contract Documents.
48. *Work Change Directive*—A written directive to Contractor issued on or after the Effective Date of the Contract, signed by Owner and recommended by Engineer, ordering an addition, deletion, or revision in the Work.

1.02 Terminology

- A. The words and terms discussed in the following paragraphs are not defined but, when used in

the Bidding Requirements or Contract Documents, have the indicated meaning.

B. *Intent of Certain Terms or Adjectives:*

1. The Contract Documents include the terms “as allowed,” “as approved,” “as ordered,” “as directed” or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives “reasonable,” “suitable,” “acceptable,” “proper,” “satisfactory,” or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Article 10 or any other provision of the Contract Documents.

C. *Day:*

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

D. *Defective:*

1. The word “defective,” when modifying the word “Work,” refers to Work that is unsatisfactory, faulty, or deficient in that it:
 - a. does not conform to the Contract Documents; or
 - b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or
 - c. has been damaged prior to Engineer’s recommendation of final payment (unless responsibility for the protection

thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 15.03 or 15.04).

E. *Furnish, Install, Perform, Provide:*

1. The word “furnish,” when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.
2. The word “install,” when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.
3. The words “perform” or “provide,” when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.
4. If the Contract Documents establish an obligation of Contractor with respect to specific services, materials, or equipment, but do not expressly use any of the four words “furnish,” “install,” “perform,” or “provide,” then Contractor shall furnish and install said services, materials, or equipment complete and ready for intended use.

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

ARTICLE 2 – PRELIMINARY MATTERS

2.01 *Delivery of Bonds and Evidence of Insurance*

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

B. *Evidence of Contractor's Insurance:* When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each named insured and additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract), the certificates and other evidence of insurance required to be provided by Contractor in accordance with Article 6.

C. *Evidence of Owner's Insurance:* [Deleted.]

2.02 *Copies of Documents*

- A. Owner shall furnish to Contractor four printed copies of the Contract (including one fully executed counterpart of the Agreement), and one copy in electronic portable document format (PDF). Additional printed copies will be furnished upon request at the cost of reproduction.
- B. Owner shall maintain and safeguard at least one original printed record version of the Contract, including Drawings and Specifications signed and sealed by Engineer and other design professionals. Owner shall make such original printed record version of the Contract available to Contractor for review. Owner may delegate the responsibilities under this provision to Engineer.

2.03 *Before Starting Construction*

- A. *Preliminary Schedules:* Within 10 days after the Effective Date of the Contract (or as otherwise specifically required by the Contract Documents), Contractor shall submit to Engineer for timely review:
1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract;
 2. a preliminary Schedule of Submittals; and
 3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate

amount of overhead and profit applicable to each item of Work.

2.04 *Preconstruction Conference; Designation of Authorized Representatives*

- A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in Paragraph 2.03.A, procedures for handling Shop Drawings, Samples, and other submittals, processing Applications for Payment, electronic or digital transmittals, and maintaining required records.
- B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit and receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party; provided, however, that the Owner's representative will not have the authority to approve a Change Proposal, execute a Change Order without City Commission approval, or otherwise agree to a change in the Contract Price or the Contract Times.

2.05 *Initial Acceptance of Schedules*

- A. At least 10 days before submission of the first Application for Payment a conference, attended by Contractor, Engineer, and others as appropriate, will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.03.A. Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.
1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor

interfere with or relieve Contractor from Contractor's full responsibility therefor.

2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.
3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to the component parts of the Work.

2.06 *Electronic Transmittals*

- A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may transmit, and shall accept, Project-related correspondence, text, data, documents, drawings, information, and graphics, including but not limited to Shop Drawings and other submittals, in electronic media or digital format, either directly, or through access to a secure Project website.
- B. If the Contract does not establish protocols for electronic or digital transmittals, then Owner, Engineer, and Contractor shall jointly develop such protocols.
- C. When transmitting items in electronic media or digital format, the transmitting party makes no representations as to long term compatibility, usability, or readability of the items resulting from the recipient's use of software application packages, operating systems, or computer hardware differing from those used in the drafting or transmittal of the items, or from those established in applicable transmittal protocols.

ARTICLE 3 – DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 *Intent*

- A. The Contract Documents are complementary; what is required by one is as binding as if required by all.
- B. It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents.

- C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic or digital versions of the Contract Documents (including any printed copies derived from such electronic or digital versions) and the printed record version, the printed record version shall govern.
- D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.
- E. Engineer will issue clarifications and interpretations of the Contract Documents as provided herein.

3.02 *Reference Standards*

- A. Standards Specifications, Codes, Laws and Regulations
 1. Reference in the Contract Documents to standard specifications, manuals, reference standards, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard specification, manual, reference standard, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Contract if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.
 2. No provision of any such standard specification, manual, reference standard, or code, or any instruction of a Supplier, shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees, from those set forth in the part of the Contract Documents prepared by or for Engineer. No such provision or instruction shall be effective to assign to Owner, Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the part of the Contract Documents prepared by or for Engineer.

3.03 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies:*

1. *Contractor's Verification of Figures and Field Measurements:* Before undertaking each part of the Work, Contractor shall carefully study the Contract Documents, and check and verify pertinent figures and dimensions therein, particularly with respect to applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy that Contractor discovers, or has actual knowledge of, and shall not proceed with any Work affected thereby until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract Documents issued pursuant to Paragraph 11.01.
2. *Contractor's Review of Contract Documents:* If, before or during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) actual field conditions, (c) any standard specification, manual, reference standard, or code, or (d) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 7.15) until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract Documents issued pursuant to Paragraph 11.01.
3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. *Resolving Discrepancies:*

1. Except as may be otherwise specifically stated in the Contract Documents, the

provisions of the part of the Contract Documents prepared by or for Engineer shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between such provisions of the Contract Documents and:

- a. the provisions of any standard specification, manual, reference standard, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference as a Contract Document); or
- b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Requirements of the Contract Documents*

- A. During the performance of the Work and until final payment, Contractor and Owner shall submit to the Engineer all matters in question concerning the requirements of the Contract Documents (sometimes referred to as requests for information or interpretation—RFIs), or relating to the acceptability of the Work under the Contract Documents, as soon as possible after such matters arise. Engineer will be the initial interpreter of the requirements of the Contract Documents, and judge of the acceptability of the Work thereunder.
- B. Engineer will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract Documents. Engineer's written clarification, interpretation, or decision will be final and binding on Contractor, unless it appeals by submitting a Change Proposal, and on Owner, unless it appeals by filing a Claim.
- C. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work under the Contract Documents, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly give written notice to

Owner and Contractor that Engineer is unable to provide a decision or interpretation. If Owner and Contractor are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in Article 12.

3.05 *Reuse of Documents*

- A. Contractor and its Subcontractors and Suppliers shall not:
1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media editions, or reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer; or
 2. have or acquire any title or ownership rights in any other Contract Documents, reuse any such Contract Documents for any purpose without Owner's express written consent, or violate any copyrights pertaining to such Contract Documents.
- B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein shall preclude Contractor from retaining copies of the Contract Documents for record purposes.

ARTICLE 4 – COMMENCEMENT AND PROGRESS OF THE WORK

4.01 *Commencement of Contract Times; Notice to Proceed*

- A. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Contract or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Contract. ~~In no event will the Contract Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Contract, whichever date is earlier.~~

4.02 *Starting the Work*

- A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work shall be done at the Site prior to such date.

4.03 *Reference Points*

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

4.04 *Progress Schedule*

- A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.05 as it may be adjusted from time to time as provided below.
1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.05) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times.
 2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 11.
- B. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, or during any appeal process, except as permitted by Paragraph 16.04, or as Owner and Contractor may otherwise agree in writing.

4.05 *Delays in Contractor's Progress*

- A. If Owner, Engineer, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Times ~~and Contract Price~~. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times. Paragraph 11.05 governs changes in the Contract Times. A CHANGE IN THE CONTRACT TIMES SHALL CONSTITUTE CONTRACTOR'S SOLE REMEDY OR EXCUSE WITH RESPECT TO DELAY. Contractor shall not be entitled to an increase in the Contract Price or payment of any kind from Owner for direct, indirect, consequential, impact or other costs, expenses or damages, including but not limited to costs of acceleration or inefficiency, arising because of delay, disruption, interference, or hindrance from any cause whatsoever, including any delays or hindrances caused by Owner, Engineer, or anyone for whom Owner is responsible.
- B. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of Contractor. Delay, disruption, and interference attributable to and within the control of a Subcontractor or Supplier shall be deemed to be within the control of Contractor.
- C. If Contractor's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault of and beyond the control of Owner, Contractor, and those for which they are responsible, then Contractor shall be entitled to an equitable adjustment in Contract Times. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include but are not limited to the following:

1. severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;
2. abnormal weather conditions;
3. acts or failures to act of utility owners (other than those performing other work at or adjacent to the Site by arrangement with the Owner, as contemplated in Article 8); and
4. acts of war or terrorism.

- D. Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by Article 5.
- E. Paragraph 8.03 governs delays, disruption, and interference to the performance or progress of the Work resulting from the performance of certain other work at or adjacent to the Site.
- F. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor.
- G. Contractor must submit any Change Proposal seeking an adjustment in Contract Price or Contract Times under this paragraph within 10 ~~30~~ days of the commencement of the delaying, disrupting, or interfering event.

ARTICLE 5 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

5.01 *Availability of Lands*

- A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work.
- ~~B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of~~

~~record legal title and legal description of the lands upon which permanent improvements are to be made and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.~~

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

5.02 *Use of Site and Other Areas*

A. *Limitation on Use of Site and Other Areas:*

1. Contractor shall confine construction equipment, temporary construction facilities, the storage of materials and equipment, and the operations of workers to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and such other adjacent areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for (a) damage to the Site; (b) damage to any such other adjacent areas used for Contractor's operations; (c) damage to any other adjacent land or areas; and (d) for injuries and losses sustained by the owners or occupants of any such land or areas; provided that such damage or injuries result from the performance of the Work or from other actions or conduct of the Contractor or those for which Contractor is responsible.
2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.12, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with such owner or occupant, or otherwise resolve

the claim by arbitration or other dispute resolution proceeding, or at law; and (c) to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claim, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused directly or indirectly, in whole or in part by, or based upon, Contractor's performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible.

- B. *Removal of Debris During Performance of the Work:* During the progress of the Work the Contractor shall keep the Site and other adjacent areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.
- C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site and adjacent areas all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.
- D. *Loading of Structures:* Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent structures or land to stresses or pressures that will endanger them.

5.03 *Subsurface and Physical Conditions*

- A. *Reports and Drawings:* The Supplementary Conditions identify:
1. those reports known to Owner of explorations and tests of subsurface conditions at or adjacent to the Site;
 2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities); and
 3. Technical Data contained in such reports and drawings.
- B. *Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely upon the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:
1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or
 2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or
 3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions, or information.

5.04 *Differing Subsurface or Physical Conditions*

- A. *Notice by Contractor:* If Contractor believes that any subsurface or physical condition that is uncovered or revealed at the Site either:
1. is of such a nature as to establish that any Technical Data on which Contractor is entitled to rely as provided in Paragraph 5.03 is materially inaccurate; or
 2. is of such a nature as to require a change in the Drawings or Specifications; or
 3. differs materially from that shown or indicated in the Contract Documents; or
 4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof (but in no event later than 10 days) and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except with respect to an emergency) until receipt of a written statement permitting Contractor to do so. Contractor's written notice must indicate, in conspicuous bold type on the face of the notice, **NOTICE OF DIFFERING CONDITIONS**. The notice must describe the nature of the differing conditions, including all relevant facts. Contractor shall be deemed to have waived any Claim arising from or relating to differing conditions if Contractor fails to provide notice in compliance with this Paragraph 5.04.A. Any changes in the Work or the Contract will be processed in accordance with Article 11. Any Claim arising from or relating to differing conditions must comply with Article 12.

- B. *Engineer's Review:* After receipt of written notice as required by the preceding paragraph, Engineer will promptly review the subsurface or physical condition in question; determine the necessity of Owner's obtaining additional exploration or tests with respect to the

condition; conclude whether the condition falls within any one or more of the differing site condition categories in Paragraph 5.04.A above; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise Owner in writing of Engineer's findings, conclusions, and recommendations.

C. *Owner's Statement to Contractor Regarding Site Condition:* After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations, in whole or in part.

D. *Possible Price and Times Adjustments:*

1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, or both, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

- a. such condition must fall within any one or more of the categories described in Paragraph 5.04.A;
- b. with respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03; and,
- c. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.

2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:

- a. Contractor knew of the existence of such condition at the time Contractor made a commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract, or otherwise; or
- b. the existence of such condition reasonably could have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas expressly required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such commitment; or
- c. Contractor failed to give the written notice as required by Paragraph 5.04.A.

3. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.

4. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the subsurface or physical condition in question.

5.05 *Underground Facilities*

A. *Contractor's Responsibilities:* The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or adjacent to the Site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities, including Owner, or by

others. Unless it is otherwise expressly provided in the Supplementary Conditions:

1. Owner and Engineer do not warrant or guarantee the accuracy or completeness of any such information or data provided by others; and
 2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:
 - a. reviewing and checking all information and data regarding existing Underground Facilities at the Site;
 - b. locating all Underground Facilities shown or indicated in the Contract Documents as being at the Site;
 - c. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and
 - d. the safety and protection of all existing Underground Facilities at the Site, and repairing any damage thereto resulting from the Work.
- B. *Notice by Contractor:* If Contractor believes that an Underground Facility that is uncovered or revealed at the Site was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, then Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer. Contractor's notice to Owner must comply with the deadlines and format requirements set forth in Paragraph 5.04.A.
- C. *Engineer's Review:* Engineer will promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection

with the Underground Facility in question; determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Underground Facility; and advise Owner in writing of Engineer's findings, conclusions, and recommendations. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

- D. *Owner's Statement to Contractor Regarding Underground Facility:* After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the Underground Facility in question, addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations in whole or in part.
- E. *Possible Price and Times Adjustments:*
1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, or both, to the extent that any existing Underground Facility at the Site that was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:
 - a. Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated the existence or actual location of the Underground Facility in question;
 - b. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03;
 - c. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being

essential to Contractor's ability to complete the Work within the Contract Times; and

d. Contractor gave the notice required in Paragraph 5.05.B.

2. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.
3. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.

5.06 *Hazardous Environmental Conditions at Site*

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

1. those reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; and
2. Technical Data contained in such reports and drawings.

B. *Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely on the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:

1. the completeness of such reports and drawings for Contractor's purposes,

including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or
3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions or information.

C. Contractor shall not be responsible for removing or remediating any Hazardous Environmental Condition encountered, uncovered, or revealed at the Site unless such removal or remediation is expressly identified in the Contract Documents to be within the scope of the Work.

D. Contractor shall be responsible for controlling, containing, and duly removing all Constituents of Concern brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible, and for any associated costs; and for the costs of removing and remediating any Hazardous Environmental Condition created by the presence of any such Constituents of Concern.

E. If Contractor encounters, uncovers, or reveals a Hazardous Environmental Condition whose removal or remediation is not expressly identified in the Contract Documents as being within the scope of the Work, or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, then Contractor shall immediately: (1) secure or otherwise isolate such condition; (2) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 7.15); and (3) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to

timely obtain required permits and provide Contractor the written notice required by Paragraph 5.06.F. If Contractor or anyone for whom Contractor is responsible created the Hazardous Environmental Condition in question, then Owner may remove and remediate the Hazardous Environmental Condition, and impose a set-off against payments to account for the associated costs.

- F. Contractor shall not resume Work in connection with such Hazardous Environmental Condition or in any affected area until after Owner has obtained any required permits related thereto, and delivered written notice to Contractor either (1) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (2) specifying any special conditions under which such Work may be resumed safely.
- G. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, then within 30 days of Owner's written notice regarding the resumption of Work, Contractor may submit a Change Proposal, or Owner may impose a set-off.
- H. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work, following the contractual change procedures in Article 11. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 8.
- I. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other

professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition (1) was not shown or indicated in the Drawings, Specifications, or other Contract Documents, identified as Technical Data entitled to limited reliance pursuant to Paragraph 5.06.B, or identified in the Contract Documents to be included within the scope of the Work, and (2) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.I shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

- J. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.J shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- K. The provisions of Paragraphs 5.03, 5.04, and 5.05 do not apply to the presence of Constituents of Concern or to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 6 – BONDS AND INSURANCE

6.01 *Performance, Payment, and Other Bonds*

- A. Contractor shall furnish a performance bond and a payment bond, each in an amount at least equal to the Contract Price, or a combined Public Construction Bond in the amount of the Contract

Price, as security for the faithful performance and payment of all of Contractor's obligations under the Contract. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 15.08, whichever is later, except as provided otherwise by Laws or Regulations, the Supplementary Conditions, or other specific provisions of the Contract. Contractor shall also furnish such other bonds as are required by the Supplementary Conditions or other specific provisions of the Contract.

- B. All bonds shall be in the form prescribed by the Contract except as provided otherwise by Laws or Regulations, including section 255.05, Florida Statutes (2018), and shall be executed by such sureties as are named in "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (as amended and supplemented) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. A bond signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority shall show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.
- C. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds in the required amounts.
- D. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or its right to do business is terminated in any state or jurisdiction where any part of the Project is located, or the surety ceases to meet the requirements above, then Contractor shall promptly notify Owner and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the bond and surety requirements above.
- E. If Contractor has failed to obtain a required bond, Owner may exclude the Contractor from

the Site and exercise Owner's termination rights under Article 16.

- F. Upon request, Owner shall provide a copy of the payment bond to any Subcontractor, Supplier, or other person or entity claiming to have furnished labor or materials used in the performance of the Work.

6.02 Insurance—General Provisions

- A. ~~Owner and~~ Contractor shall obtain and maintain insurance as required in this Article and in the Supplementary Conditions.
- B. All insurance required by the Contract to be purchased and maintained by ~~Owner or~~ Contractor shall be obtained from insurance companies that are duly licensed or authorized, in the state or jurisdiction in which the Project is located, to issue insurance policies for the required limits and coverages. Unless a different standard is indicated in the Supplementary Conditions, all companies that provide insurance policies required under this Contract shall have an A.M. Best rating of A-VII or better.
- C. Contractor shall deliver to Owner, with copies to each named insured and additional insured (as identified in this Article, in the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Contractor has obtained and is maintaining the policies, coverages, and endorsements required by the Contract. Upon request by Owner or any other insured, Contractor shall also furnish other evidence of such required insurance, including but not limited to copies of policies and endorsements, and documentation of applicable self-insured retentions and deductibles. Contractor may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.
- D. ~~Owner shall deliver to Contractor, with copies to each named insured and additional insured (as identified in this Article, the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Owner has obtained and is maintaining the policies, coverages, and endorsements required of Owner by the Contract (if any). Upon request by Contractor or any other insured, Owner shall~~

~~also provide other evidence of such required insurance (if any), including but not limited to copies of policies and endorsements, and documentation of applicable self-insured retentions and deductibles. Owner may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.~~

6.03

Contractor's Insurance

- E. Failure of Owner ~~or Contractor~~ to demand such certificates or other evidence of Contractor's ~~the other party's~~ full compliance with these insurance requirements, or failure of Owner ~~or Contractor~~ to identify a deficiency in compliance from the evidence provided, shall not be construed as a waiver of Contractor's ~~the other party's~~ obligation to obtain and maintain such insurance.
- F. If Contractor ~~either party~~ does not purchase or maintain all of the insurance required of Contractor ~~such party~~ by the Contract, Contractor ~~such party~~ shall notify Owner ~~the other party~~ in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage.
- G. If Contractor has failed to obtain and maintain required insurance, Owner may exclude the Contractor from the Site, impose an appropriate set-off against payment, and exercise Owner's termination rights under Article 16.
- H. Without prejudice to any other right or remedy, if Contractor ~~a party~~ has failed to obtain required insurance, Owner ~~the other party~~ may elect to obtain equivalent insurance to protect Owner's ~~such other party's~~ interests at the expense of Contractor ~~the party who was required to provide such coverage~~, and the Contract Price shall be adjusted accordingly.
- I. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests.
- J. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner and other individuals and entities in the Contract.

- A. *Workers' Compensation:* Contractor shall purchase and maintain workers' compensation and employer's liability insurance for:
 - 1. claims under workers' compensation, disability benefits, and other similar employee benefit acts.
 - 2. United States Longshoreman and Harbor Workers' Compensation Act and Jones Act coverage (if applicable).
 - 3. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees (by stop-gap endorsement in monopolist worker's compensation states).
 - 4. Foreign voluntary worker compensation (if applicable).
- B. *Commercial General Liability—Claims Covered:* Contractor shall purchase and maintain commercial general liability insurance, covering all operations by or on behalf of Contractor, on an occurrence basis, against:
 - 1. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees.
 - 2. claims for damages insured by reasonably available personal injury liability coverage.
 - 3. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom.
- C. *Commercial General Liability—Form and Content:* Contractor's commercial liability policy shall be written on a 1996 (or later) ISO commercial general liability form (occurrence form) and include the following coverages and endorsements:
 - 1. Products and completed operations coverage:
 - a. Such insurance shall be maintained for three years after final payment.
 - b. Contractor shall furnish Owner and each other additional insured (as identified in the Supplementary Conditions or elsewhere in the

Contract) evidence of continuation of such insurance at final payment and three years thereafter.

2. Blanket contractual liability coverage, to the extent permitted by law, including but not limited to coverage of Contractor's contractual indemnity obligations in Paragraphs 5.02, 5.05, and 7.18.
 3. Broad form property damage coverage.
 4. Severability of interest.
 5. Underground, explosion, and collapse coverage.
 6. Personal injury coverage.
 7. Additional insured endorsements that include both ongoing operations and products and completed operations coverage through ISO Endorsements CG 20 10 10 01 and CG 20 37 10 01 (together); or CG 20 10 07 04 and CG 20 37 07 04 (together); or their equivalent.
 8. For design professional additional insureds, ISO Endorsement CG 20 32 07 04, "Additional Insured—Engineers, Architects or Surveyors Not Engaged by the Named Insured" or its equivalent.
- D. *Automobile liability*: Contractor shall purchase and maintain automobile liability insurance against 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. The automobile liability policy shall be written on an occurrence basis.
- E. *Umbrella or excess liability*: Contractor shall purchase and maintain umbrella or excess liability insurance written over the underlying employer's liability, commercial general liability, and automobile liability insurance described in the paragraphs above. Subject to industry-standard exclusions, the coverage afforded shall follow form as to each and every one of the underlying policies.
- F. *Contractor's pollution liability insurance*: Contractor shall purchase and maintain a policy covering third-party injury and property damage claims, including clean-up costs, as a result of pollution conditions arising from Contractor's operations and completed operations. This insurance shall be maintained for no less than three years after final completion.
- G. *Additional insureds*: The Contractor's commercial general liability, automobile liability, umbrella or excess, and pollution liability policies shall include and list as additional insureds Owner and Engineer, and any individuals or entities identified in the Supplementary Conditions; include coverage for the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of all such additional insureds; and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby (including as applicable those arising from both ongoing and completed operations) on a non-contributory basis. Contractor shall obtain all necessary endorsements to support these requirements.
- H. *Contractor's professional liability insurance*: If Contractor will provide or furnish professional services under this Contract, through a delegation of professional design services or otherwise, then Contractor shall be responsible for purchasing and maintaining applicable professional liability insurance. This insurance shall provide protection against claims arising out of performance of professional design or related services, and caused by a negligent error, omission, or act for which the insured party is legally liable. It shall be maintained throughout the duration of the Contract and for a minimum of two years after Substantial Completion. If such professional design services are performed by a Subcontractor, and not by Contractor itself, then the requirements of this paragraph may be satisfied through the purchasing and maintenance of such insurance by such Subcontractor.
- I. *General provisions*: The policies of insurance required by this Paragraph 6.03 shall:
1. include at least the specific coverages provided in this Article.
 2. be written for not less than the limits of liability provided in this Article and in the

Supplementary Conditions, or required by Laws or Regulations, whichever is greater.

3. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed, or renewal refused until at least 10 days prior written notice has been given to Contractor. Within three days of receipt of any such written notice, Contractor shall provide a copy of the notice to Owner, Engineer, and each other insured under the policy.
4. remain in effect at least until final payment (and longer if expressly required in this Article) and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work as a warranty or correction obligation, or otherwise, or returning to the Site to conduct other tasks arising from the Contract Documents.
5. be appropriate for the Work being performed and provide protection from claims that may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable.

- J. The coverage requirements for specific policies of insurance must be met by such policies, and not by reference to excess or umbrella insurance provided in other policies.

6.04 ~~Owner's Liability Insurance~~ [Deleted.]

6.05 *Property Insurance*

- A. *Builder's Risk*: Unless otherwise provided in the Supplementary Conditions, Contractor shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the full insurable replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:

1. include the Owner and Contractor as named insureds, and all Subcontractors, and any individuals or entities required by the Supplementary Conditions to be insured under such builder's risk policy, as insureds or named insureds. For purposes of the remainder of this Paragraph 6.05, Paragraphs 6.06 and 6.07, and any corresponding Supplementary Conditions, the parties required to be insured shall collectively be referred to as "insureds."
2. be written on a builder's risk "all risk" policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire; lightning; windstorm; riot; civil commotion; terrorism; vehicle impact; aircraft; smoke; theft; vandalism and malicious mischief; mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; flood; collapse; explosion; debris removal; demolition occasioned by enforcement of Laws and Regulations; water damage (other than that caused by flood); and such other perils or causes of loss as may be specifically required by the Supplementary Conditions. If insurance against mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; or flood, are not commercially available under builder's risk policies, by endorsement or otherwise, such insurance may be provided through other insurance policies acceptable to Owner and Contractor.
3. cover, as insured property, at least the following: (a) the Work and all materials, supplies, machinery, apparatus, equipment, fixtures, and other property of a similar nature that are to be incorporated into or used in the preparation, fabrication, construction, erection, or completion of the Work, including Owner-furnished or assigned property; (b) spare parts inventory required within the scope of the Contract;

and (c) temporary works which are not intended to form part of the permanent constructed Work but which are intended to provide working access to the Site, or to the Work under construction, or which are intended to provide temporary support for the Work under construction, including scaffolding, form work, fences, shoring, falsework, and temporary structures.

4. cover expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects).
5. extend to cover damage or loss to insured property while in temporary storage at the Site or in a storage location outside the Site (but not including property stored at the premises of a manufacturer or Supplier).
6. extend to cover damage or loss to insured property while in transit.
7. allow for partial occupation or use of the Work by Owner, such that those portions of the Work that are not yet occupied or used by Owner shall remain covered by the builder's risk insurance.
- ~~8. allow for the waiver of the insurer's subrogation rights, as set forth below.~~
9. provide primary coverage for all losses and damages caused by the perils or causes of loss covered.
10. not include a co-insurance clause.
11. include an exception for ensuing losses from physical damage or loss with respect to any defective workmanship, design, or materials exclusions.
12. include performance/hot testing and start-up.
13. be maintained in effect, subject to the provisions herein regarding Substantial Completion and partial occupancy or use of the Work by Owner, until the Work is complete.

B. *Notice of Cancellation or Change:* All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with this Paragraph

6.05 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 10 days prior written notice has been given to the purchasing policyholder. Within three days of receipt of any such written notice, the purchasing policyholder shall provide a copy of the notice to each other insured.

- C. *Deductibles:* The purchaser of any required builder's risk or property insurance shall pay for costs not covered because of the application of a policy deductible.
- D. *Partial Occupancy or Use by Owner:* If Owner will occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 15.04, then Owner (directly, if it is the purchaser of the builder's risk policy, or through Contractor) will provide notice of such occupancy or use to the builder's risk insurer. The builder's risk insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy; rather, those portions of the Work that are occupied or used by Owner may come off the builder's risk policy, while those portions of the Work not yet occupied or used by Owner shall remain covered by the builder's risk insurance.
- E. *Additional Insurance:* If Contractor elects to obtain other special insurance to be included in or supplement the builder's risk or property insurance policies provided under this Paragraph 6.05, it may do so at Contractor's expense.
- F. *Insurance of Other Property:* If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, such as tools, construction equipment, or other personal property owned by Contractor, a Subcontractor, or an employee of Contractor or a Subcontractor, then the entity or individual owning such property item will be responsible for deciding whether to insure it, and if so in what amount.

6.06 ~~Waiver of Rights~~ [Deleted.]

6.07 *Receipt and Application of Property Insurance Proceeds*

- A. Any insured loss under the builder's risk and other policies of insurance required by Paragraph 6.05 will be adjusted and settled with

the named insured that purchased the policy. Such named insured shall act as fiduciary for the other insureds, and give notice to such other insureds that adjustment and settlement of a claim is in progress. Any other insured may state its position regarding a claim for insured loss in writing within 15 days after notice of such claim.

- B. Proceeds for such insured losses may be made payable by the insurer either jointly to multiple insureds, or to the named insured that purchased the policy in its own right and as fiduciary for other insureds, subject to the requirements of any applicable mortgage clause. A named insured receiving insurance proceeds under the builder's risk and other policies of insurance required by Paragraph 6.05 shall distribute such proceeds in accordance with such agreement as the parties in interest may reach, or as otherwise required under the dispute resolution provisions of this Contract or applicable Laws and Regulations.
- C. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the money so received applied on account thereof, and the Work and the cost thereof covered by Change Order, if needed.

ARTICLE 7 – CONTRACTOR'S RESPONSIBILITIES

7.01 *Supervision and Superintendence*

- A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.
- B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

7.02 *Labor; Working Hours*

- A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all

times maintain good discipline and order at the Site.

- B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours, Monday through Friday. Contractor will not perform Work on a Saturday, Sunday, or any legal holiday. Contractor may perform Work outside regular working hours or on Saturdays, Sundays, or legal holidays only with Owner's written consent, which will not be unreasonably withheld.

7.03 *Services, Materials, and Equipment*

- A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start up, and completion of the Work, whether or not such items are specifically called for in the Contract Documents.
- B. All materials and equipment incorporated into the Work shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.
- C. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

7.04 *"Or Equals"*

- A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the

Contract Price has been based upon Contractor furnishing such item as specified. The specification or description of such an item is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or equal" item is permitted, Contractor may request that Engineer authorize the use of other items of material or equipment, or items from other proposed suppliers under the circumstances described below.

1. If Engineer in its sole discretion determines that an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, Engineer shall deem it an "or equal" item. For the purposes of this paragraph, a proposed item of material or equipment will be considered functionally equal to an item so named if:

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

- 1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;
- 2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole;
- 3) it has a proven record of performance and availability of responsive service; and
- 4) it is not objectionable to Owner.

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

- 1) there will be no increase in cost to the Owner or increase in Contract Times; and
- 2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.

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

C. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each "or-equal" request. Engineer may require Contractor to furnish additional data about the proposed "or-equal" item. Engineer will be the sole judge of acceptability. No "or-equal" item will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an "or-equal", which will be evidenced by an approved Shop Drawing or other written communication. Engineer will advise Contractor in writing of any negative determination.

D. *Effect of Engineer's Determination*: Neither approval nor denial of an "or-equal" request shall result in any change in Contract Price. The Engineer's denial of an "or-equal" request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents.

E. *Treatment as a Substitution Request*: If Engineer determines that an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer consider the proposed item as a substitute pursuant to Paragraph 7.05.

7.05 Substitutes

A. Unless the specification or description of an item of material or equipment required to be furnished under the Contract Documents contains or is followed by words reading that no substitution is permitted, Contractor may request that Engineer authorize the use of other items of material or equipment under the circumstances described below. To the extent possible such requests shall be made before commencement of related construction at the Site.

1. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is functionally equivalent to that named and an acceptable substitute therefor. Engineer will not accept requests for review of

proposed substitute items of material or equipment from anyone other than Contractor.

2. The requirements for review by Engineer will be as set forth in Paragraph 7.05.B, as supplemented by the Specifications, and as Engineer may decide is appropriate under the circumstances.
3. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:
 - a. shall certify that the proposed substitute item will:
 - 1) perform adequately the functions and achieve the results called for by the general design,
 - 2) be similar in substance to that specified, and
 - 3) be suited to the same use as that specified.
 - b. will state:
 - 1) the extent, if any, to which the use of the proposed substitute item will necessitate a change in Contract Times,
 - 2) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item, and
 - 3) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty.
 - c. will identify:
 - 1) all variations of the proposed substitute item from that specified, and

2) available engineering, sales, maintenance, repair, and replacement services.

- d. shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including but not limited to changes in Contract Price, shared savings, costs of redesign, and claims of other contractors affected by any resulting change.

- B. *Engineer's Evaluation and Determination:* Engineer will be allowed a reasonable time to evaluate each substitute request, and to obtain comments and direction from Owner. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No substitute will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an acceptable substitute. Engineer's determination will be evidenced by a Field Order or a proposed Change Order accounting for the substitution itself and all related impacts, including changes in Contract Price or Contract Times. Engineer will advise Contractor in writing of any negative determination.
- C. *Special Guarantee:* Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.
- D. *Reimbursement of Engineer's Cost:* Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.

- E. *Contractor's Expense*: Contractor shall provide all data in support of any proposed substitute at Contractor's expense.
- F. *Effect of Engineer's Determination*: If Engineer approves the substitution request, Contractor shall execute the proposed Change Order and proceed with the substitution. The Engineer's denial of a substitution request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.05.D, by timely submittal of a Change Proposal.

7.06 *Concerning Subcontractors, Suppliers, and Others*

- A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner.
- B. Contractor shall retain specific Subcontractors, Suppliers, or other individuals or entities for the performance of designated parts of the Work if required by the Contract to do so.
- C. Subsequent to the submittal of Contractor's Bid or final negotiation of the terms of the Contract, Owner may not require Contractor to retain any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against which Contractor has reasonable objection.
- D. Prior to entry into any binding subcontract or purchase order, Contractor shall submit to Owner the identity of the proposed Subcontractor or Supplier (unless Owner has already deemed such proposed Subcontractor or Supplier acceptable, during the bidding process or otherwise). Such proposed Subcontractor or Supplier shall be deemed acceptable to Owner unless Owner raises a substantive, reasonable objection within five days.
- E. Owner may require the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work. Owner also may require Contractor to retain specific replacements; provided, however, that Owner may not require a replacement to which Contractor has a reasonable objection. If Contractor has

submitted the identity of certain Subcontractors, Suppliers, or other individuals or entities for acceptance by Owner, and Owner has accepted it (either in writing or by failing to make written objection thereto), then Owner may subsequently revoke the acceptance of any such Subcontractor, Supplier, or other individual or entity so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity.

- F. If Owner requires the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, or both, with respect to the replacement; and Contractor shall initiate a Change Proposal for such adjustment within 30 days of Owner's requirement of replacement.
- G. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of the right of Owner to the completion of the Work in accordance with the Contract Documents.
- H. On a monthly basis Contractor shall submit to Engineer a complete list of all Subcontractors and Suppliers having a direct contract with Contractor, and of all other Subcontractors and Suppliers known to Contractor at the time of submittal.
- I. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions.
- J. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors, Suppliers, and all other individuals or entities performing or furnishing any of the Work.
- K. Contractor shall restrict all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work from

communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed herein.

- L. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.
- M. All Work performed for Contractor by a Subcontractor or Supplier shall be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer.
- N. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor on account of Work performed for Contractor by the particular Subcontractor or Supplier.
- O. Nothing in the Contract Documents:
 - 1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier, or other individual or entity; nor
 - 2. shall create any obligation on the part of Owner or Engineer to pay or to see to the payment of any money due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.

7.07 *Patent Fees and Royalties*

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

others, the existence of such rights shall be disclosed by Owner in the Contract Documents.

- B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights. Notwithstanding anything stated herein to the contrary, this Paragraph 7.07.B is not intended to and shall not be construed to waive any immunity from or limitation of liability that Owner is entitled to under the doctrine of sovereign immunity or section 768.28, Florida Statutes.
- C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

7.08 *Permits*

- A. Unless otherwise provided in the Contract Documents, Contractor shall obtain and pay for all construction permits and licenses. Owner shall assist Contractor, when necessary, in

obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of the submission of Contractor's Bid (or when Contractor became bound under a negotiated contract). Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

7.09 *Taxes*

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

7.10 *Laws and Regulations*

- A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.
- B. If Contractor performs any Work or takes any other action knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all resulting costs and losses, and shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work or other action. It shall not be Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.
- C. Owner or Contractor may give notice to the other party of any changes after the submission of Contractor's Bid (or after the date when Contractor became bound under a negotiated

contract) in Laws or Regulations having an effect on the cost or time of performance of the Work, including but not limited to changes in Laws or Regulations having an effect on procuring permits and on sales, use, value-added, consumption, and other similar taxes. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

7.11 *Record Documents*

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

7.12 *Safety and Protection*

- A. Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury, or loss to:
 - 1. all persons on the Site or who may be affected by the Work;
 - 2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and
 - 3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, other work in progress, utilities, and

Underground Facilities not designated for removal, relocation, or replacement in the course of construction.

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

- C. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. The Supplementary Conditions identify any Owner's safety programs that are applicable to the Work.

- D. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.

- E. All damage, injury, or loss to any property referred to in Paragraph 7.12.A.2 or 7.12.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor at its expense (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

- F. Contractor's duties and responsibilities for safety and protection shall continue until such time as all the Work is completed and Engineer has

issued a notice to Owner and Contractor in accordance with Paragraph 15.06.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

- G. Contractor's duties and responsibilities for safety and protection shall resume whenever Contractor or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

7.13 *Safety Representative*

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

7.14 *Hazard Communication Programs*

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

7.15 *Emergencies*

- A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent threatened damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are required as a result thereof. If Engineer determines that a change in the Contract Documents is required because of the action taken by Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued.

7.16 *Shop Drawings, Samples, and Other Submittals*

- A. *Shop Drawing and Sample Submittal Requirements:*

1. Before submitting a Shop Drawing or Sample, Contractor shall have:
 - a. reviewed and coordinated the Shop Drawing or Sample with other Shop

Drawings and Samples and with the requirements of the Work and the Contract Documents;

- b. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;
 - c. determined and verified the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and
 - d. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.
2. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that submittal, and that Contractor approves the submittal.
 3. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be set forth in a written communication separate from the Shop Drawings or Sample submittal; and, in addition, in the case of Shop Drawings by a specific notation made on each Shop Drawing submitted to Engineer for review and approval of each such variation.

B. *Submittal Procedures for Shop Drawings and Samples:* Contractor shall submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals. Each submittal will be identified as Engineer may require.

1. *Shop Drawings:*

- a. Contractor shall submit the number of copies required in the Specifications.
- b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide and to enable Engineer to review the information for the limited purposes required by Paragraph 7.16.D.

2. *Samples:*

- a. Contractor shall submit the number of Samples required in the Specifications.
- b. Contractor shall clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the submittal for the limited purposes required by Paragraph 7.16.D.

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

C. *Other Submittals:* Contractor shall submit other submittals to Engineer in accordance with the accepted Schedule of Submittals, and pursuant to the applicable terms of the Specifications.

D. *Engineer's Review:*

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed

Project as a functioning whole as indicated by the Contract Documents.

2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction or to safety precautions or programs incident thereto.
3. Engineer's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.
4. Engineer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 7.16.A.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will document any such approved variation from the requirements of the Contract Documents in a Field Order.
5. Engineer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 7.16.A and B.
6. Engineer's review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, shall not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.
7. Neither Engineer's receipt, review, acceptance or approval of a Shop Drawing, Sample, or other submittal shall result in such item becoming a Contract Document.
8. Contractor shall perform the Work in compliance with the requirements and commitments set forth in approved Shop Drawings and Samples, subject to the provisions of Paragraph 7.16.D.4.

E. *Resubmittal Procedures:*

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.
2. Contractor shall furnish required submittals with sufficient information and accuracy to obtain required approval of an item with no more than three submittals. Engineer will record Engineer's time for reviewing a fourth or subsequent submittal of a Shop Drawings, sample, or other item requiring approval, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges.
3. If Contractor requests a change of a previously approved submittal item, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

7.17 *Contractor's General Warranty and Guarantee*

- A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its officers, directors, members, partners, employees, agents, consultants, and subcontractors shall be entitled to rely on Contractor's warranty and guarantee.
- B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
 1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or
 2. normal wear and tear under normal usage.

- C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:
1. observations by Engineer;
 2. recommendation by Engineer or payment by Owner of any progress or final payment;
 3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;
 4. use or occupancy of the Work or any part thereof by Owner;
 5. any review and approval of a Shop Drawing or Sample submittal;
 6. the issuance of a notice of acceptability by Engineer;
 7. any inspection, test, or approval by Owner, Owner's representatives, or others; or
 8. any correction of defective Work by Owner.
- D. If the Contract requires the Contractor to accept the assignment of a contract entered into by Owner, then the specific warranties, guarantees, and correction obligations contained in the assigned contract shall govern with respect to Contractor's performance obligations to Owner for the Work described in the assigned contract.

7.18 Indemnification

- A. To the fullest extent permitted by law, Contractor shall indemnify, defend, and hold harmless the City, its elected officials, officers, and employees, from any and all liabilities, damages, losses and costs, including but not limited to reasonable attorney's fees, to the extent caused by the negligence, recklessness, or intentionally wrongful conduct of Contractor, its employees, agents, officers, subcontractors and other persons employed or utilized by Contractor in the performance of this Agreement. It is further the specific intent and agreement of the parties that all the contract documents of any project for which Contractor provided services be hereby amended to include

the foregoing indemnification. Contractor expressly agrees that it will not claim, and waives any claim, that this article violates section 725.06, Florida Statutes, or is unenforceable pursuant to section 725.06, Florida Statutes. This indemnification obligation shall not be construed to negate, abridge, or otherwise reduce any other right or obligation of indemnity which would otherwise exist as to any party or person described in this section. This indemnification provision shall include claims made by an employee of Contractor or any subcontractor against the City and Contractor waives any entitlement to immunity under section 440.11, Florida Statutes. Nothing contained herein shall be construed as a waiver of any immunity or limitation of liability the City may be entitled to under the doctrine of sovereign immunity or section 768.28, Florida Statutes. This indemnification provision shall survive the termination of this Agreement however terminated. Contractor's obligation to indemnify, defend, and hold harmless shall not be limited by the amount of any insurance required to be obtained or maintained under the Contract Documents. Notwithstanding the foregoing, the Contractor's obligations to indemnify, defend and hold harmless shall be limited to one million dollars (\$1,000,000) or the Contract Price, whichever is greater, in accordance with section 725.06, Florida Statutes. Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of

~~them to perform any of the Work or anyone for whose acts any of them may be liable.~~

- B. In any and all claims against Owner or Engineer or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 7.18.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.
- C. The indemnification obligations of Contractor under Paragraph 7.18.A shall not extend to the liability of Engineer and Engineer's officers, directors, members, partners, employees, agents, consultants and subcontractors arising out of:
 - 1. the preparation or approval of, or the failure to prepare or approve maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or
 - 2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

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

- C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, or approvals performed by such design professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.
- D. Pursuant to this paragraph, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 7.16.D.1.
- E. Contractor shall not be responsible for the adequacy of the performance or design criteria specified by Owner or Engineer.

7.19 *Delegation of Professional Design Services*

- A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable Laws and Regulations.
- B. If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of Contractor by the Contract Documents,

ARTICLE 8 – OTHER WORK AT THE SITE

8.01 *Other Work*

- A. In addition to and apart from the Work under the Contract Documents, the Owner may perform other work at or adjacent to the Site. Such other work may be performed by Owner's employees, or through contracts between the Owner and third parties. Owner may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.
- B. If Owner performs other work at or adjacent to the Site with Owner's employees, or through contracts for such other work, then Owner shall

give Contractor written notice thereof prior to starting any such other work. If Owner has advance information regarding the start of any utility work at or adjacent to the Site, Owner shall provide such information to Contractor.

- C. Contractor shall afford each other contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected.
- D. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 8, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

8.02 Coordination

- A. If Owner intends to contract with others for the performance of other work at or adjacent to the Site, to perform other work at or adjacent to the Site with Owner's employees, or to arrange to have utility owners perform work at or adjacent to the Site, the following will be set forth in the Supplementary Conditions or provided to Contractor prior to the start of any such other work:

1. the identity of the individual or entity that will have authority and responsibility for coordination of the activities among the various contractors;
2. an itemization of the specific matters to be covered by such authority and responsibility; and
3. the extent of such authority and responsibilities.

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

8.03 Legal Relationships

- A. If, in the course of performing other work at or adjacent to the Site for Owner, the Owner's employees, any other contractor working for Owner, or any utility owner for whom the Owner is responsible causes damage to the Work or to the property of Contractor or its Subcontractors, or delays, disrupts, interferes with, or increases the scope or cost of the performance of the Work, through actions or inaction, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times, or both. Contractor must submit any Change Proposal seeking an equitable adjustment in the Contract Price or the Contract Times under this paragraph within 30 days of the damaging, delaying, disrupting, or interfering event. The entitlement to, and extent of, any such equitable adjustment shall take into account information (if any) regarding such other work that was provided to Contractor in the Contract Documents prior to the submittal of the Bid or the final negotiation of the terms of the Contract. When applicable, any such equitable adjustment in Contract Price shall be conditioned on Contractor assigning to Owner all Contractor's rights against such other contractor or utility owner with respect to the damage, delay, disruption, or interference that is the subject of the adjustment. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.

- B. Contractor shall take reasonable and customary measures to avoid damaging, delaying,

disrupting, or interfering with the work of Owner, any other contractor, or any utility owner performing other work at or adjacent to the Site. If Contractor fails to take such measures and as a result damages, delays, disrupts, or interferes with the work of any such other contractor or utility owner, then Owner may impose a set-off against payments due to Contractor, and assign to such other contractor or utility owner the Owner's contractual rights against Contractor with respect to the breach of the obligations set forth in this paragraph.

- C. When Owner is performing other work at or adjacent to the Site with Owner's employees, Contractor shall be liable to Owner for damage to such other work, and for the reasonable direct delay, disruption, and interference costs incurred by Owner as a result of Contractor's failure to take reasonable and customary measures with respect to Owner's other work. In response to such damage, delay, disruption, or interference, Owner may impose a set-off against payments due to Contractor.
- D. If Contractor damages, delays, disrupts, or interferes with the work of any other contractor, or any utility owner performing other work at or adjacent to the Site, through Contractor's failure to take reasonable and customary measures to avoid such impacts, or if any claim arising out of Contractor's actions, inactions, or negligence in performance of the Work at or adjacent to the Site is made by any such other contractor or utility owner against Contractor, Owner, or Engineer, then Contractor shall (1) promptly attempt to settle the claim as to all parties through negotiations with such other contractor or utility owner, or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law, and (2) indemnify, defend, and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claims, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such damage, delay, disruption, or interference.

ARTICLE 9 – OWNER'S RESPONSIBILITIES

9.01 *Communications to Contractor*

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

9.02 *Replacement of Engineer*

- A. Owner may at its discretion appoint an engineer to replace Engineer, provided Contractor makes no reasonable objection to the replacement engineer. The replacement engineer's status under the Contract Documents shall be that of the former Engineer.

9.03 *Furnish Data*

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

9.04 *Pay When Due*

- A. Owner shall make payments to Contractor when they are due as provided in the Agreement.

9.05 *Lands and Easements; Reports, Tests, and Drawings*

- A. Owner's duties with respect to providing lands and easements are set forth in Paragraph 5.01.
- B. Owner's duties with respect to providing engineering surveys to establish reference points are set forth in Paragraph 4.03.
- C. Article 5 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of conditions at the Site, and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

9.06 *~~Insurance~~* [Deleted.]

9.07 *Change Orders*

- A. Owner's responsibilities with respect to Change Orders are set forth in Article 11.

9.08 *Inspections, Tests, and Approvals*

- A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 14.02.B.

9.09 *Limitations on Owner's Responsibilities*

- A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for,

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

9.10 *Undisclosed Hazardous Environmental Condition*

- A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 5.06.

9.11 *Evidence of Financial Arrangements*

- A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents (including obligations under proposed changes in the Work).

9.12 *Safety Programs*

- A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed.
- B. Owner shall furnish copies of any applicable Owner safety programs to Contractor.

ARTICLE 10 – ENGINEER'S STATUS DURING CONSTRUCTION

10.01 *Owner's Representative*

- A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract.

10.02 *Visits to Site*

- A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner,

will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.

- B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 10.08. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

10.03 *Project Representative*

- A. If Owner and Engineer have agreed that Engineer will furnish a Resident Project Representative to represent Engineer at the Site and assist Engineer in observing the progress and quality of the Work, then the authority and responsibilities of any such Resident Project Representative will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in Paragraph 10.08. If Owner designates another representative or agent to represent Owner at the Site who is not Engineer's consultant, agent, or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the Supplementary Conditions.

10.04 *Rejecting Defective Work*

- A. Engineer has the authority to reject Work in accordance with Article 14.

10.05 *Shop Drawings, Change Orders and Payments*

- A. Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, are set forth in Paragraph 7.16.
- B. Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, are set forth in Paragraph 7.19.
- C. Engineer's authority as to Change Orders is set forth in Article 11.
- D. Engineer's authority as to Applications for Payment is set forth in Article 15.

10.06 *Determinations for Unit Price Work*

- A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor as set forth in Paragraph 13.03.

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

- A. Engineer will render decisions regarding the requirements of the Contract Documents, and judge the acceptability of the Work, pursuant to the specific procedures set forth herein for initial interpretations, Change Proposals, and acceptance of the Work. In rendering such decisions and judgments, Engineer will not show partiality to Owner or Contractor, and will not be liable to Owner, Contractor, or others in connection with any proceedings, interpretations, decisions, or judgments conducted or rendered in good faith.

10.08 *Limitations on Engineer's Authority and Responsibilities*

- A. Neither Engineer's authority or responsibility under this Article 10 or under any other provision of the Contract, nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer, shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

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

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

- D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 15.06.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals, that the results certified indicate compliance with the Contract Documents.

- E. The limitations upon authority and responsibility set forth in this Paragraph 10.08 shall also apply to the Resident Project Representative, if any.

10.09 *Compliance with Safety Program*

- A. While at the Site, Engineer's employees and representatives will comply with the specific applicable requirements of Owner's and Contractor's safety programs (if any) of which Engineer has been informed.

ARTICLE 11 – AMENDING THE CONTRACT DOCUMENTS; CHANGES IN THE WORK

11.01 *Amending and Supplementing Contract Documents*

- A. The Contract Documents may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.
 - 1. *Change Orders:*
 - a. If an amendment or supplement to the Contract Documents includes a change

in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order. A Change Order also may be used to establish amendments and supplements of the Contract Documents that do not affect the Contract Price or Contract Times.

- b. Owner and Contractor may amend those terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, without the recommendation of the Engineer. Such an amendment shall be set forth in a Change Order.
2. *Work Change Directives:* A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including Paragraph 11.04 regarding change of Contract Price. Contractor must submit any Change Proposal seeking an adjustment of the Contract Price or the Contract Times, or both, no later than 30 days after the completion of the Work set out in the Work Change Directive. Owner must submit any Claim seeking an adjustment of the Contract Price or the Contract Times, or both, no later than 60 days after issuance of the Work Change Directive.
3. *Field Orders:* Engineer may authorize minor changes in the Work if the changes do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed

Project as a functioning whole as indicated by the Contract Documents. Such changes will be accomplished by a Field Order and will be binding on Owner and also on Contractor, which shall perform the Work involved promptly. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

11.02 *Owner-Authorized Changes in the Work*

- A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work. Such changes shall be supported by Engineer's recommendation, to the extent the change involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters. Such changes may be accomplished by a Change Order, if Owner and Contractor have agreed as to the effect, if any, of the changes on Contract Times or Contract Price; or by a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work shall be performed under the applicable conditions of the Contract Documents. Nothing in this paragraph shall obligate Contractor to undertake work that Contractor reasonably concludes cannot be performed in a manner consistent with Contractor's safety obligations under the Contract Documents or Laws and Regulations.

11.03 *Unauthorized Changes in the Work*

- A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents, as amended, modified, or supplemented, except in the case of an emergency as provided in Paragraph 7.15 or in the case of uncovering Work as provided in Paragraph 14.05.

11.04 *Change of Contract Price*

- A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment of Contract Price shall comply with the provisions of Article 12.
- B. An adjustment in the Contract Price will be determined as follows:
1. where the Work involved is covered by unit prices contained in the Contract Documents, then by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 13.03); or
 2. where the Work involved is not covered by unit prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.04.C.2); or
 3. where the Work involved is not covered by unit prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on the basis of the Cost of the Work (determined as provided in Paragraph 13.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 11.04.C).
- C. *Contractor's Fee:* When applicable, the Contractor's fee for overhead and profit shall be determined as follows:
1. a mutually acceptable fixed fee; or
 2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:
 - a. for costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2, the Contractor's fee shall be 10 ~~15~~ percent;
 - b. for costs incurred under Paragraph 13.01.B.3, the Contractor's fee shall be five percent;
 - c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is

agreed upon, the intent of Paragraphs 11.04.C.2.a and 11.04.C.2.b is that the Contractor's fee shall be based on: (1) a fee of 10 ~~15~~ percent of the costs incurred under Paragraphs 13.01.A.1 and 13.01.A.2 by the Subcontractor that actually performs the Work, at whatever tier, and (2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of five percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor; provided, however, that for any such subcontracted work the maximum total fee to be paid by Owner shall be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the work;

- d. no fee shall be payable on the basis of costs itemized under Paragraphs 13.01.B.4, 13.01.B.5, and 13.01.C;
- e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and
- f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 11.04.C.2.a through 11.04.C.2.e, inclusive.

11.05 *Change of Contract Times*

- A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment in the Contract Times shall comply with the provisions of Article 12.
- B. An adjustment of the Contract Times shall be subject to the limitations set forth in Paragraph 4.05, concerning delays in Contractor's progress.

11.06 *Change Proposals*

A. Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; appeal an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; contest a set-off against payment due; or seek other relief under the Contract. The Change Proposal shall specify any proposed change in Contract Times or Contract Price, or both, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents.

1. *Procedures:* Contractor shall submit each Change Proposal to Engineer promptly (but in no event later than 30 days) after the start of the event giving rise thereto, or after such initial decision. The Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Times (if any), to the Engineer and Owner within 15 days after the submittal of the Change Proposal. The supporting data shall be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event. Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal. If Contractor proceeds with additional work prior to approval of a Change Proposal and execution of a Change Order, or without providing the notice required strictly in accordance with the terms of this Paragraph 11.06, Contractor shall not receive any compensation for such work.

2. *Engineer's Action:* Engineer will review each Change Proposal and, within 30 days after receipt of the Contractor's supporting data, either deny the Change Proposal in whole, approve it in whole, or deny it in part and approve it in part. Such actions shall be in writing, with a copy provided to Owner and

Contractor. If Engineer does not take action on the Change Proposal within 30 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of Engineer's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under Article 12.

3. *Binding Decision:* Engineer's decision will be final and binding upon ~~Owner and Contractor~~, unless ~~Owner or Contractor~~ appeals the decision by filing a Claim under Article 12. Owner's City Commission is the ultimate binding authority on any changes to the Contract Price.

B. *Resolution of Certain Change Proposals:* If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then Engineer will notify the parties that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice shall be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.

11.07 *Execution of Change Orders*

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

1. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive;
2. changes in Contract Price resulting from an Owner set-off, unless Contractor has duly contested such set-off;
3. changes in the Work which are: (a) ordered by Owner pursuant to Paragraph 11.02, (b) required because of Owner's acceptance of defective Work under Paragraph 14.04 or Owner's correction of defective Work under Paragraph 14.07, or (c) agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Work involves the design (as set forth in the

Drawings, Specifications, or otherwise), or other engineering or technical matters; and

4. changes in the Contract Price or Contract Times, or other changes, which embody the substance of any final and binding results under Paragraph 11.06, or Article 12.

- B. Owner's City Commission possesses sole authority to approve a change to the Contract Price. Regardless of whether it is signed by Owner or Owner's representative, no Change Order affecting the Contract Price is legally binding on Owner unless it has been approved by City Commission. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of this Paragraph 11.07, it shall be deemed to be of full force and effect, as if fully executed.

11.08 Notification to Surety

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

ARTICLE 12 – CLAIMS

12.01 Claims

- A. *Claims Process:* The following disputes between Owner and Contractor shall be submitted to the Claims process set forth in this Article:
 1. Appeals by Owner or Contractor of Engineer's decisions regarding Change Proposals;
 2. Owner demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents; and
 3. Disputes that Engineer has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters.

- B. *Submittal of Claim:* The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 10 30 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 10 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to the Engineer, for its information only. The responsibility to substantiate a Claim shall rest with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, or both, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor's knowledge and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled. Any Claim by Contractor must indicate **CLAIM** in conspicuous bold type on the first page and must indicate whether Contractor is seeking a change in the Contract Price, the Contract Times, or both. Contractor's Claim must describe the nature of the Claim, including all relevant facts. Contractor shall provide to Owner any documentation supporting Contractor's Claim within 30 days of providing the Claim. Further, Contractor is not entitled to any additional compensation, or to a change in the Contract Price or in the Contract Times, unless and until approved by Owner's City Commission at a duly noticed public meeting. If Contractor proceeds with any work without said approval or without complying strictly with the procedures set forth in this Paragraph 12.01, Contractor does so at its own risk. Strict compliance with this Paragraph 12.01 and City Commission approval are absolute conditions precedent to any changes in the Contract Price or Contract Times and to any other additional compensation.

- C. *Review and Resolution:* The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim shall be stated in writing and submitted to the other party, with a copy to Engineer.

D. *Mediation:*

1. At any time after initiation of a Claim, Owner and Contractor may mutually agree to mediation of the underlying dispute. The agreement to mediate shall stay the Claim submittal and response process.
2. If Owner and Contractor agree to mediation, then after 60 days from such agreement, either Owner or Contractor may unilaterally terminate the mediation process, and the Claim submittal and decision process shall resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim submittal and decision process shall resume as of the date of the conclusion of the mediation, as determined by the mediator.
3. Owner and Contractor shall each pay one-half of the mediator's fees and costs.

E. *Partial Approval:* If the party receiving a Claim approves the Claim in part and denies it in part, such action shall be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 17 for final resolution of disputes.

F. *Denial of Claim:* If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of the inaction, the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim shall be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 17 for the final resolution of disputes.

G. *Final and Binding Results:* If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the agreement or action on the Claim shall be incorporated in a Change Order to the extent they affect the

Contract, including the Work, the Contract Times, or the Contract Price.

ARTICLE 13 – COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

13.01 *Cost of the Work*

A. *Purposes for Determination of Cost of the Work:* The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this Paragraph 13.01 are used for two distinct purposes:

1. To determine Cost of the Work when Cost of the Work is a component of the Contract Price, under cost-plus-fee, time-and-materials, or other cost-based terms; or
2. To determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.

B. *Costs Included:* Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work shall be in amounts no higher than those prevailing in the locality of the Project, shall not include any of the costs itemized in Paragraph 13.01.C, and shall include only the following items:

1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation,

- health and retirement benefits, bonuses, sick leave, and vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.
2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.
 3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 13.01.
 4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.
 5. Supplemental costs including the following:
 - a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.
 - b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.
 - c. Rentals of all construction equipment and machinery, and the parts thereof, whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.
 - d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.
 - e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.
 - f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 6.05), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or

for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.

- g. The cost of utilities, fuel, and sanitary facilities at the Site.
- h. Minor expenses such as communication service at the Site, express and courier services, and similar petty cash items in connection with the Work.
- i. The costs of premiums for all bonds and insurance that Contractor is required by the Contract Documents to purchase and maintain.

C. *Costs Excluded:* The term Cost of the Work shall not include any of the following items:

- 1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 13.01.B.1 or specifically covered by Paragraph 13.01.B.4. The payroll costs and other compensation excluded here are to be considered administrative costs covered by the Contractor's fee.
- 2. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.
- 3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.

4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.

5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraph 13.01.B.

D. *Contractor's Fee:* When the Work as a whole is performed on the basis of cost-plus, Contractor's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor's fee shall be determined as set forth in Paragraph 11.04.C.

E. *Documentation:* Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 13, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

13.02 Allowances

A. It is understood that Contractor ~~has included in the Contract Price all allowances so named in the Contract Documents and~~ shall cause the Work ~~to be covered by any allowances so named in the Contract Documents~~ to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.

B. *Cash Allowances:* Contractor agrees that:

- 1. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and
- 2. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have

been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.

- C. *Contingency Allowance*: Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.

~~D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.~~

13.03 *Unit Price Work*

- A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.
- B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Payments to Contractor for Unit Price Work will be based on actual quantities.
- C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.
- D. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of the following paragraph.
- E. Within 30 days of Engineer's written decision under the preceding paragraph, Contractor may

submit a Change Proposal in accordance with Paragraph 11.06, or Owner may file a Claim, seeking an adjustment in the Contract Price if:

1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement;
2. there is no corresponding adjustment with respect to any other item of Work; and
3. Contractor believes that it is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price, and the parties are unable to agree as to the amount of any such increase or decrease.

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

14.01 *Access to Work*

- A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and authorities having jurisdiction will have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply therewith as applicable.

14.02 *Tests, Inspections, and Approvals*

- A. Contractor shall give Engineer timely notice of readiness of the Work (or specific parts thereof) for all required inspections and tests, and shall cooperate with inspection and testing personnel to facilitate required inspections and tests.
- B. Owner shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished and paid for by Owner, except that costs incurred in connection with tests or inspections of covered Work shall be governed by the provisions of Paragraph 14.05.

- C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.
- D. Contractor shall be responsible for arranging, obtaining, and paying for all inspections and tests required:
 - 1. by the Contract Documents, unless the Contract Documents expressly allocate responsibility for a specific inspection or test to Owner;
 - 2. to attain Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work;
 - 3. by manufacturers of equipment furnished under the Contract Documents;
 - 4. for testing, adjusting, and balancing of mechanical, electrical, and other equipment to be incorporated into the Work; and
 - 5. for acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

Such inspections and tests shall be performed by independent inspectors, testing laboratories, or other qualified individuals or entities acceptable to Owner and Engineer.

- E. If the Contract Documents require the Work (or part thereof) to be approved by Owner, Engineer, or another designated individual or entity, then Contractor shall assume full responsibility for arranging and obtaining such approvals.
- F. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation. Such uncovering shall be at Contractor's expense unless Contractor had given Engineer timely notice of Contractor's intention to cover the same and Engineer had not acted with

reasonable promptness in response to such notice.

14.03 Defective Work

- A. *Contractor's Obligation:* It is Contractor's obligation to assure that the Work is not defective.
- B. *Engineer's Authority:* Engineer has the authority to determine whether Work is defective, and to reject defective Work.
- C. *Notice of Defects:* Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor.
- D. *Correction, or Removal and Replacement:* Promptly after receipt of written notice of defective Work, Contractor shall correct all such defective Work, whether or not fabricated, installed, or completed, or, if Engineer has rejected the defective Work, remove it from the Project and replace it with Work that is not defective.
- E. *Preservation of Warranties:* When correcting defective Work, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.
- F. *Costs and Damages:* In addition to its correction, removal, and replacement obligations with respect to defective Work, Contractor shall pay all claims, costs, losses, and damages arising out of or relating to defective Work, including but not limited to the cost of the inspection, testing, correction, removal, replacement, or reconstruction of such defective Work, fines levied against Owner by governmental authorities because the Work is defective, and the costs of repair or replacement of work of others resulting from defective Work. Prior to final payment, if Owner and Contractor are unable to agree as to the measure of such claims, costs, losses, and damages resulting from defective Work, then Owner may impose a reasonable set-off against payments due under Article 15.

14.04 Acceptance of Defective Work

- A. If, instead of requiring correction or removal and replacement of defective Work, Owner prefers to accept it, Owner may do so (subject, if such

acceptance occurs prior to final payment, to Engineer's confirmation that such acceptance is in general accord with the design intent and applicable engineering principles, and will not endanger public safety). Contractor shall pay all claims, costs, losses, and damages attributable to Owner's evaluation of and determination to accept such defective Work ~~(such costs to be approved by Engineer as to reasonableness)~~, and for the diminished value of the Work to the extent not otherwise paid by Contractor. If any such acceptance occurs prior to final payment, the necessary revisions in the Contract Documents with respect to the Work shall be incorporated in a Change Order. If the parties are unable to agree as to the decrease in the Contract Price, reflecting the diminished value of Work so accepted, then Owner may impose a reasonable set-off against payments due under Article 15. If the acceptance of defective Work occurs after final payment, Contractor shall pay an appropriate amount to Owner.

14.05 Uncovering Work

- A. Engineer has the authority to require additional inspection or testing of the Work, whether or not the Work is fabricated, installed, or completed.
- B. If any Work is covered contrary to the written request of Engineer, then Contractor shall, if requested by Engineer, uncover such Work for Engineer's observation, and then replace the covering, all at Contractor's expense.
- C. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, then Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, and provide all necessary labor, material, and equipment.
 1. If it is found that the uncovered Work is defective, Contractor shall be responsible for all claims, costs, losses, and damages arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to

all costs of repair or replacement of work of others); and pending Contractor's full discharge of this responsibility the Owner shall be entitled to impose a reasonable set-off against payments due under Article 15.

2. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, then Contractor may submit a Change Proposal within 30 days of the determination that the Work is not defective.

14.06 Owner May Stop the Work

- A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, then Owner may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work shall not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

14.07 Owner May Correct Defective Work

- A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace rejected Work as required by Engineer, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, then Owner may, after seven days written notice to Contractor, correct or remedy any such deficiency.
- B. In exercising the rights and remedies under this Paragraph 14.07, Owner shall proceed promptly ~~expeditiously~~. In connection with such corrective or remedial action, Owner may exclude

Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this paragraph.

- C. All claims, costs, losses, and damages incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 14.07 will be charged against Contractor as set-offs against payments due under Article 15. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.
- D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 14.07.

ARTICLE 15 – PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

15.01 Progress Payments

- A. *Basis for Progress Payments:* The Schedule of Values established as provided in Article 2 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed during the pay period, as determined under the provisions of Paragraph 13.03. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period.
- B. *Applications for Payments:*
 - 1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer

(or to Engineer's designee identified in writing by Engineer) for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens, and evidence that the materials and equipment are covered by appropriate property insurance, a warehouse bond, or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner. Each application for payment shall be accompanied by a release and affidavit in a form approved by Owner showing that all materials, labor, equipment, and other bills associated with that portion of the Work have been paid in full. Owner shall not be required to make any payment until all such information requested by Owner has been provided.

- 2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.
- 3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

C. Review of Applications:

- 1. Engineer will, within 10 days after receipt of each Application for Payment, including each resubmittal, either indicate in writing a recommendation of payment and present the Application to Owner, or return the Application to Contractor indicating in

writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.

2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:
 - a. the Work has progressed to the point indicated;
 - b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 13.03, and any other qualifications stated in the recommendation); and
 - c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.
3. By recommending any such payment Engineer will not thereby be deemed to have represented that:
 - a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract; or
 - b. there may not be other matters or issues between the parties that might entitle Contractor to be paid

additionally by Owner or entitle Owner to withhold payment to Contractor.

4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:
 - a. to supervise, direct, or control the Work, or
 - b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or
 - c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or
 - d. to make any examination to ascertain how or for what purposes Contractor has used the money paid on account of the Contract Price, or
 - e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.
5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 15.01.C.2.
6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer's opinion to protect Owner from loss because:
 - a. the Work is defective, requiring correction or replacement;
 - b. the Contract Price has been reduced by Change Orders;
 - c. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
 - d. Owner has been required to remove or remediate a Hazardous Environmental

Condition for which Contractor is responsible; or

- e. Engineer has actual knowledge of the occurrence of any of the events that would constitute a default by Contractor and therefore justify termination for cause under the Contract Documents.

D. *Payment Becomes Due:*

- 1. Payment becomes due as provided in section 218.735, Florida Statutes (2018). ~~Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended (subject to any Owner set-offs) will become due, and when due will be paid by Owner to Contractor.~~

E. *Reductions in Payment by Owner:*

- 1. In addition to any reductions in payment (set-offs) recommended by Engineer, Owner is entitled to impose a set-off against payment based on any of the following:
 - a. claims have been made against Owner on account of Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages on account of Contractor's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;
 - b. Contractor has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site;
 - c. Contractor has failed to provide and maintain required bonds or insurance;
 - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;

- e. Owner has incurred extra charges or engineering costs related to submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;
 - f. the Work is defective, requiring correction or replacement;
 - g. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
 - h. the Contract Price has been reduced by Change Orders;
 - i. an event that would constitute a default by Contractor and therefore justify a termination for cause has occurred;
 - j. liquidated damages have accrued as a result of Contractor's failure to achieve Milestones, Substantial Completion, or final completion of the Work;
 - k. ~~Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;~~
 - l. there are other items entitling Owner to a set off against the amount recommended.
- 2. If Owner imposes any set-off against payment, whether based on its own knowledge or on the written recommendations of Engineer, Owner will give Contractor prompt ~~immediate~~ written notice (with a copy to Engineer) stating the reasons for such action and the specific amount of the reduction, and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, if Contractor remedies the reasons for such action. The reduction imposed shall be

binding on Contractor unless it duly submits a Change Proposal contesting the reduction.

3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 15.01.C.1 and subject to interest as provided in the Agreement.

15.02 *Contractor's Warranty of Title*

- A. Contractor warrants and guarantees that title to all Work, materials, and equipment furnished under the Contract will pass to Owner free and clear of (1) all Liens and other title defects, and (2) all patent, licensing, copyright, or royalty obligations, no later than seven days after the time of payment by Owner.

15.03 *Substantial Completion*

- A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete and request that Engineer issue a certificate of Substantial Completion. Contractor shall at the same time submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.
- B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.
- C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a preliminary certificate of Substantial Completion which shall fix the date of Substantial Completion. Engineer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Owner shall have seven days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of

the preliminary certificate to Owner, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefor. If Owner does not object to the provisions of the certificate, or if despite consideration of Owner's objections Engineer concludes that the Work is substantially complete, then Engineer will, within said 14 days, execute and deliver to Owner and Contractor a final certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Engineer believes justified after consideration of any objections from Owner.

- D. At the time of receipt of the preliminary certificate of Substantial Completion, Owner and Contractor will confer regarding Owner's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by Owner. Unless Owner and Contractor agree otherwise in writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner's use or occupancy of the Work.
- E. After Substantial Completion the Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.
- F. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the punch list.

15.04 *Partial Use or Occupancy*

- A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and

Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:

1. At any time Owner may request in writing that Contractor permit Owner to use or occupy any such part of the Work that Owner believes to be substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 15.03.A through E for that part of the Work.
2. At any time Contractor may notify Owner and Engineer in writing that Contractor considers any such part of the Work substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.
3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 15.03 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.
4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 6.05 regarding builder's risk or other property insurance.

15.05 Final Inspection

- A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work, or

agreed portion thereof, is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

15.06 Final Payment

A. Application for Payment:

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, annotated record documents (as provided in Paragraph 7.11), and other documents, Contractor may make application for final payment.
2. As a condition precedent to final payment, ~~the final Application for Payment shall be accompanied (except as previously delivered) by:~~
 - a. all documentation called for in the Contract Documents;
 - b. consent of the surety, if any, to final payment;
 - c. satisfactory evidence that all title issues have been resolved such that title to all Work, materials, and equipment has passed to Owner free and clear of any Liens or other title defects, or will so pass upon final payment.
 - d. a list of all disputes that Contractor believes are unsettled; and
 - e. complete and legally effective releases or waivers (satisfactory to Owner) of all claims ~~Lien rights~~ arising out of the Work beyond those listed per Paragraph 15.06.A.2.d., and of Liens filed in connection with the Work.
3. In lieu of the releases or waivers of Liens specified in Paragraph 15.06.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and

receipts include all labor, services, material, and equipment for which a Claim Lien could be filed; and (b) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any claim by a Subcontractor or Supplier, Lien, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.

B. *Engineer's Review of Application and Acceptance:*

1. If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the Application for Payment to Owner for payment. Such recommendation shall account for any set-offs against payment that are necessary in Engineer's opinion to protect Owner from loss for the reasons stated above with respect to progress payments. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to the provisions of Paragraph 15.07. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

C. *Completion of Work:* The Work is complete (subject to surviving obligations) when it is ready for final payment as established by the Engineer's written recommendation of final payment.

D. *Payment Becomes Due:* Payment becomes due as provided in section 218.735, Florida Statutes (2018), for Thirty days after the presentation to Owner of the final Application for Payment and accompanying documentation, the amount recommended by Engineer (less any further sum Owner is entitled to set off against Engineer's recommendation, including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions above with respect to progress payments) ~~will become due~~ and shall be paid by Owner to Contractor.

15.07 *Waiver of Claims*

- A. The making of final payment will not constitute a waiver by Owner of claims or rights against Contractor. Owner expressly reserves claims and rights arising from unsettled claims Liens, from defective Work appearing after final inspection pursuant to Paragraph 15.05, from Contractor's failure to comply with the Contract Documents or the terms of any special guarantees specified therein, from any latent defects in the Work, from outstanding Claims by Owner, or from Contractor's continuing obligations under the Contract Documents.
- B. The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against Owner other than those pending matters that have been duly submitted or appealed under the provisions of Article 17.

15.08 *Correction Period*

- A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents, or by any specific provision of the Contract Documents), any Work is found to be defective, or if the repair of any damages to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas used by Contractor as permitted by Laws and

Regulations, is found to be defective, then Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:

1. correct the defective repairs to the Site or such other adjacent areas;
 2. correct such defective Work;
 3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and
 4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting therefrom.
- B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others).
- C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.
- D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.
- E. Contractor's obligations under this paragraph are in addition to all other obligations and

warranties. The provisions of this paragraph shall not be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

ARTICLE 16 – SUSPENSION OF WORK AND TERMINATION

16.01 Owner May Suspend Work

- A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by written notice to Contractor and Engineer. Such notice will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be entitled to an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension. Any Change Proposal seeking such adjustments shall be submitted no later than 30 days after the date fixed for resumption of Work.

16.02 Owner May Terminate for Cause

- A. The occurrence of any one or more of the following events will constitute a default by Contractor and justify termination for cause:
1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule);
 2. Failure of Contractor to perform or otherwise to comply with a material term of the Contract Documents;
 3. Contractor's disregard of Laws or Regulations of any public body having jurisdiction; or
 4. Contractor's repeated disregard of the authority of Owner or Engineer.
- B. If one or more of the events identified in Paragraph 16.02.A occurs, then after giving Contractor (and any surety) ten days written notice that Owner is considering a declaration that Contractor is in default and termination of the contract, Owner may proceed to:

1. declare Contractor to be in default, and give Contractor (and any surety) notice that the Contract is terminated; and
 2. enforce the rights available to Owner under any applicable performance bond.
- C. Subject to the terms and operation of any applicable performance bond, if Owner has terminated the Contract for cause, Owner may exclude Contractor from the Site, take possession of the Work, incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and complete the Work as Owner may deem expedient.
- D. Owner may not proceed with termination of the Contract under Paragraph 16.02.B if Contractor within seven days of receipt of notice of intent to terminate begins to correct its failure to perform and proceeds diligently to cure such failure.
- E. If Owner proceeds as provided in Paragraph 16.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds the cost to complete the Work, including all related claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals) sustained by Owner, such excess will be paid to Contractor. If the cost to complete the Work including such related claims, costs, losses, and damages exceeds such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this paragraph, Owner shall not be required to obtain the lowest price for the Work performed.
- F. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue, or any rights or remedies of Owner against Contractor or any surety under any payment bond or performance bond. Any

retention or payment of money due Contractor by Owner will not release Contractor from liability.

- G. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 6.01.A, the provisions of that bond shall govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

16.03 *Owner May Terminate For Convenience*

- A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):
1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;
 2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses; and
 3. other reasonable expenses directly attributable to termination, including costs incurred to prepare a termination for convenience cost proposal.
- B. Contractor shall not be paid on account of loss of anticipated overhead, profits, or revenue, or other economic loss arising out of or resulting from such termination.

16.04 *Contractor May Stop Work or Terminate*

- A. If, through no act or fault of Contractor, ~~(1) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (2) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (3) Owner fails for 30 days to pay Contractor any sum finally determined to be due,~~ then Contractor may, upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do

not remedy such suspension or failure within that time, terminate the contract and recover from Owner payment on the same terms as provided in Paragraph 16.03.

the other party of the intent to submit the dispute to a court of competent jurisdiction.

ARTICLE 18 – MISCELLANEOUS

~~B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this paragraph are not intended to preclude Contractor from submitting a Change Proposal for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this paragraph.~~

18.01 Giving Notice

- A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:
1. delivered in person, by a commercial courier service or otherwise, to the individual or to a member of the firm or to an officer of the corporation for which it is intended; or
 2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the sender of the notice.

18.02 Computation of Times

- A. When any period of time is referred to in the Contract by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

18.03 Cumulative Remedies

- A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract. The provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

18.04 Limitation of Damages

- A. With respect to any and all Change Proposals, Claims, disputes subject to final resolution, and other matters at issue, neither Owner nor Engineer, nor any of their officers, directors, members, partners, employees, agents,

ARTICLE 17 – FINAL RESOLUTION OF DISPUTES

17.01 Methods and Procedures

- A. *Disputes Subject to Final Resolution:* The following disputed matters are subject to final resolution under the provisions of this Article:
1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full; and
 2. Disputes between Owner and Contractor concerning the Work or obligations under the Contract Documents, and arising after final payment has been made.
- B. *Final Resolution of Disputes:* For any dispute subject to resolution under this Article, Owner or Contractor may:
1. elect in writing to invoke the dispute resolution process provided for in the Supplementary Conditions; or
 2. agree with the other party to submit the dispute to another dispute resolution process; or
 3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, give written notice to

consultants, or subcontractors, shall be liable to Contractor for any claims, costs, losses, or damages sustained by Contractor on or in connection with any other project or anticipated project.

18.05 *No Waiver*

- A. A party's non-enforcement of any provision shall not constitute a waiver of that provision, nor shall it affect the enforceability of that provision or of the remainder of this Contract.

18.06 *Survival of Obligations*

- A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract, as well as all continuing obligations indicated in the Contract, will survive final payment, completion, and acceptance of the Work or termination or completion of the Contract or termination of the services of Contractor.

18.07 *Controlling Law*

- A. This Contract shall be governed by, construed and interpreted in accordance with the laws of the State of Florida. Contractor and Owner consent to jurisdiction over them and agree that venue for any state court action shall lie solely in the Sixth Judicial Circuit in and for Pinellas County, Florida, and venue for any federal court action shall lie solely in the U.S. District Court for the Middle District of Florida, Tampa Division. This Contract is to be governed by the law of the state in which the Project is located.

18.08 *Headings*

- A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

18.09 *Counterparts*

- A. This Contract may be executed in one or more counterparts, any one of which need not contain the signatures of more than one party, but all such counterparts taken together will constitute one and the same instrument.

18.10 *No Third-Party Beneficiaries*

- A. This Contract is entered into solely for the benefit of Owner and Contractor and shall not be construed as a benefit to any third parties,

including but not limited to the general public, nor shall it be construed as enforceable by third parties.

18.11 *Severability*

- A. If any one or more of the provisions of the Contract Documents shall be held to be invalid, illegal, or unenforceable in any respect by a court of competent jurisdiction, the validity, legality and enforceability of the remaining provisions of the Contract Documents shall not in any way be affected or impaired and the Contract Documents shall be treated as though that portion had never been a part thereof.

18.12 *Copyright*

- A. This document is a MODIFIED version of EJCDC® C-700 (Rev. 1), Copyright © 2013 by the National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers, or is based in part on excerpts from copyrighted EJCDC documents. Those portions of the text that originated in copyrighted EJCDC documents remain subject to the copyright.

Supplementary Conditions

These Supplementary Conditions amend or supplement the City of Largo General Conditions of the Construction Contract. All provisions that are not so amended or supplemented remain in full force and effect. In case of conflict, the Supplementary Conditions take precedence over the General Conditions.

The terms used in these Supplementary Conditions have the meanings stated in the General Conditions. Additional terms used in these Supplementary Conditions have the meanings stated below, which are applicable to both the singular and plural thereof.

The address system used in these Supplementary Conditions is the same as the address system used in the General Conditions, with the prefix "SC" added thereto.

ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

SC-1.01 *Defined Terms*

SC-1.01.A.1 Add to the list of definitions in Paragraph 1.01.A by inserting the following as numbered items in their proper alphabetical positions:

Construction Documents—The construction plans and specifications developed for Owner.

Construction Phase Services—The portion of the Contractor's Work following Owner's acceptance and approval of the Construction Documents.

Master Project Schedule—The schedule prepared and maintained by Contractor that includes all activities of the Construction Phase Services as well as the Design Professional's activities under the Design Agreement.

Owner's Site Representative—The authorized representative of Owner assigned to assist Owner at the Site and assist Owner in observing the progress and quality of the Work.

Project Management Information System ("PMIS")—The Contractor's overall process for effectively managing the Project, which shall be documented and delivered in accordance with the Supplementary Conditions.

Project Management Plan—The Contractor's overall plan for effectively managing the Project, which shall be documented and delivered in accordance with the Supplementary Conditions.

SC-1.02 *Terminology*

SC-1.02.E Add the following new paragraphs immediately after Paragraph 1.02.E:

1. Any work, materials or equipment that may reasonably be inferred from the Contract Documents as being required to produce the intended result shall be supplied whether or not specifically called for in the Contract Documents.
2. Drawings are intended to show general arrangements, design and extent of Work and are not intended to serve as shop drawings. Specifications are separated into divisions for convenience of reference only and shall not be interpreted as establishing divisions for the Work, trades, subcontracts, or extent of any part of the Work. In the event of a discrepancy between or among the drawings, specifications or other Contract Document provisions, Contractor shall be required to comply with the provision which is the more

restrictive or stringent requirement upon Contractor, as determined by Design Professional.

ARTICLE 2 – PRELIMINARY MATTERS

SC-2.03 *Before Starting Construction*

SC-2.03.A Add the following new paragraphs immediately after Paragraph 2.03.A.3:

4. a preliminary Project Management Plan; and
5. a preliminary description of the Project Management Information System.

SC-2.04 *Preconstruction Conference; Designation of Authorized Representatives*

SC-2.04.B Add the following new language to the end of Paragraph 2.04.B:

Contractor's authorized representative shall be a competent resident Project manager, whom Contractor shall not later replace, except under extraordinary circumstances, without advance written notice to, and approval by, Owner and Engineer, which will not be unreasonably withheld. The Contractor's resident Project manager must have the full authority to act on behalf of the Contractor. All communications given to the Contractor's resident Project manager shall be as binding as if given to the Contractor.

SC-2.04.C Add the following new paragraphs immediately after Paragraph 2.04.B:

- C. At this conference Owner and Contractor will review Contractor's preliminary Project Management Plan, which Contractor shall prepare in accordance with the following requirements:
 1. The Project Management Plan will guide the Contractor's performance of Work. The Project Management Plan will provide a plan for the control, direction, coordination and evaluation of the Work performed throughout the Project; the Project organization including identification of key personnel, responsibilities of the Contractor, Owner and Design Professional; Work flow diagrams; and strategy for bidding and subcontracting the Work. Owner shall have the right to review the Project Management Plan and to approve its content and format. Within ten (10) days both parties have executed this Agreement, Contractor will prepare the Project Management Plan to include Construction Phase Services and submit it to Owner for review and approval. The Project Management Plan may otherwise be updated as necessary throughout the Construction Phase, but Contractor may not make material changes without Owner's prior written concurrence. Any conflicts between the Project Management Plan and the Contract Documents shall be governed by the latter.
 2. The Project Management Plan shall describe in detail the procedures for executing the Work and the organizations participating. The Project Management Plan shall include, as a minimum, the following sections:
 - a. Project Definition: The known characteristics of the Project and sub-projects shall be described in general terms which will provide the participants a basic understanding of the Project and sub-projects.

- b. Project Goals: The schedule, budget, physical, technical and other objectives for the Project shall be defined.
 - c. Project Strategy: A narrative description of the Project delivery methods which shall be utilized to accomplish the Project goals.
 - d. Project Work Plan: A matrix display of the Work to be performed by Contractor, as well as the services and items to be furnished by the Design Professional and the Owner during each phase of the Project.
 - e. Project Organization: A summary organization chart showing the interrelationships between Owner, Contractor and Design Professional, and other supporting organizations and permitting review agencies. Detailed charts, one each for Contractor and Design Professional, showing organizational elements participating in the Project, shall be included.
 - f. Responsibility Performance Chart: A detailed matrix showing the specific responsibilities and interrelationships of Owner, Design Professional, and Contractor. The chart shall indicate major responsibility, and minor responsibility, for each specific task required to deliver the Project. Contractor shall develop a similar chart for the personnel within its own organization who are assigned to the Project, as well as for the Design Professional's and Owner's personnel assigned to the Project from data supplied by them.
 - g. Flow Diagrams: A display of the flow of information and the decision process for the review and approval of shop drawings and submittals, progress, and change orders.
 - h. Communication Procedures: A narrative description or depiction of how to manage, control, and coordinate necessary communications among Contractor, Design Professional, and Owner throughout the Project, e.g., correspondence, minutes, reports, inspections, team meetings, technical reviews, design reviews, etc.
3. The Project Management Plan for Construction Phase Services must be completed by Contractor and approved by Owner as a condition precedent to payment of any compensation for Construction Phase Services under the Agreement.
- D. At this conference Owner and Contractor will review Contractor's preliminary Project Management Information System ("PMIS"), which system shall be in place for the Construction Phase services to be provided by Contractor, and which Contractor shall prepare in accordance with the following requirements:
- 1. General:
 - a. Contractor shall implement and shall utilize throughout the life of this Project all subsystems of the PMIS.
 - b. The reports, documents, and data to be provided shall represent an accurate assessment of the current status of the Project and of the Work remaining to be accomplished and it shall provide a sound basis for identifying variances and problems and for making management decisions.

- c. If requested by Owner, Contractor shall conduct a comprehensive workshop for participants designated by Owner and additional seminars as required to provide instruction with respect to the PMIS. This workshop and the seminars shall facilitate each participant's use and understanding of the PMIS.
 - d. The PMIS shall be described in terms of the following major subsystems:
 - 1) Narrative Reporting;
 - 2) Schedule Control;
 - 3) Cost Control and Estimating;
 - 4) Project Accounting;
 - 5) Accounting and Payment; and
 - 6) Action Reports.
 - e. The above reports shall be submitted at least on a monthly basis and shall accompany each monthly Application for Payment.
2. Narrative Reporting Subsystem
- a. Contractor shall prepare written reports as described hereunder. All reports shall be in 8 1/2" x 11" format.
 - b. The Narrative Reporting Subsystem shall include the following reports:
 - 1) A Monthly Executive Summary which provides an overview of current issues and pending decisions, future developments and expected achievements, and any problems or delays, including code violations found by any permitting authority.
 - 2) A Monthly Cost Narrative describing the current construction cost estimate status of the Project.
 - 3) A Monthly Scheduling Narrative summarizing the current status of the overall Master Project Schedule. This report shall include an analysis of the various Project sub-schedules, a description of the critical path, and other analyses as necessary to compare planned performance with actual performance.
 - 4) A Monthly Accounting Narrative describing the current cost and payment status for the entire Project. This report shall relate current encumbrances and expenditures to the budget allocations.
 - 5) Monthly Construction Progress Report during the Construction Phase summarizing the Work of the various subcontractors. This report shall include information from the weekly job site meetings as applicable such as general conditions, long lead supplies, current deliveries, safety and labor relations, programs, permits, construction problems and recommendations, and plans for the succeeding month.
 - 6) A Daily Construction Diary during the Construction Phase describing events and conditions on the site.

- c. The reports outlined above shall be bound with applicable computer reports and submitted monthly during the Design Phase and the Construction Phase and shall be current through the end of the preceding month. Copies shall be delivered to Owner and Design Professional. A bound copy of the complete diary shall be submitted to Owner at the conclusion of the Project.
- 3. Schedule Control Subsystem
 - a. Construction Schedule: Within ten (10) calendar days after both parties have executed this Agreement, the Contractor shall prepare and submit to the Owner and Design Professional, for their review and approval, a Construction Schedule. This schedule shall conform to the format outlined below. Within ten (10) calendar days of Contractor's submittal, Owner and Design Professional shall review the schedule and provide Contractor a written list of corrections needed to approve the schedule. Contractor must make all corrections and resolve all comments within ten (10) calendar days of receipt of corrections and comments from Owner and Design Professional. If the schedule is not approved within ten (10) calendar days of the Construction Phase Commencement Date, Owner and Design Professional will withhold all Contract payments until the schedule is approved. The Construction Schedule shall be integrated into the Master Project Schedule. Failure of Contractor to develop and submit a Construction Schedule as aforesaid shall be sufficient grounds for Owner to find Contractor in substantial default hereunder and that sufficient cause exists to terminate the Agreement or to withhold any payment.
 - 1) Following development and submittal of the Construction Schedule, Contractor shall, at the end of each calendar month occurring thereafter during the period of time required to finally complete the Project, or at such earlier intervals as circumstances may require, update and/or revise the Construction Schedule which shall be submitted to Owner in duplicate. No additional compensation will be due Contractor for making such updates. Failure of Contractor to update, revise, and submit the Construction Schedule as aforesaid shall be sufficient grounds for the Owner to find Contractor in substantial default hereunder and that sufficient cause exists to terminate the Agreement or to withhold payment to Contractor until a schedule or schedule update acceptable to Owner is submitted.
 - c. Contractor shall prepare and incorporate and incorporate into the schedule database, at the required intervals, the following schedules:
 - 1) Pre-Bid Schedules (Subnetworks): Contractor shall prepare a construction schedule for Work encompassed in each bid package. The schedule shall be sufficiently detailed as to be suitable for inclusion in the bid package as a framework for subcontract completion by the successful bidder. It shall show the interrelationships between the Work of the successful bidder and that of other subcontractors, and shall establish milestones keyed to the Project Schedule.

- 2) Subcontractor Construction Schedules (Subnetworks): Upon the award of each subcontract, Contractor shall jointly with the subcontractor, develop a schedule which is more detailed than the pre-bid schedule included in the bid packages, taking into account the Work schedule of the other subcontractors. The construction schedule shall include as many activities as necessary to make the schedule an effective tool for construction planning and for monitoring the performance of the subcontractor. The construction schedule also shall show pertinent activities for material purchase orders, manpower supply, shop drawing schedules and material delivery schedules.
- d. Schedule Format: The Master Project Schedule and the Construction Schedule shall be planned and recorded with a Critical Path Method (CPM) schedule in the form of an activity-on-node diagram. All activity on-node diagrams shall include the Activity Identification, Activity Description, and the type of relationship between activities, including any lead or lag time.
- 1) No activity shall have a duration greater than fourteen (14) work days or less than one (1) work day. If requested by Owner or Design Professional, Contractor shall furnish any information needed to justify the reasonableness of activity durations. Such information shall include, but not be limited to, estimated activity manpower, anticipated quantities, and production rates.
 - 2) Procurement shall be identified with at least two (2) activities: fabrication and delivery. Ensure that all work activities that require a submittal are preceded by submittal and approval activities.
 - 3) Only contractual constraints shall be shown in the schedule logic. No other restraints are allowed unless approved by the Owner or Design Professional. The disallowance of constraints includes the use of activity mandatory start and finish dates.
 - 4) Activities shall be identified by codes to reflect the responsible party for the accomplishment of each activity (only one party per activity), the Phase/Stage of the Project for each activity, and the Area/Location of each activity
 - 5) The construction time for the entire Project, or any milestone, shall not exceed the specified Contract time. Logic or activity durations shall be revised in the event that any milestone or Contract completion date is exceeded in the schedule.
 - 6) "Float" is defined as the amount of time between when an activity "can start" (the early start) and when an activity "must start" (the late start). It is understood by the Owner and the Contractor that float is a shared commodity, not for the exclusive use or financial benefit of either party. Either party has the full use of the float until it is depleted.
 - 7) The CPM schedules must be compatible with Primavera software (Oracle) or an as-equal system approved by Owner.

8) Initial Schedule Submittal Requirements:

- i) Predecessor/Successor Sort
Total Float/Early Start Sort
Responsibility/Early Start Sort
Area/Early Start Sort
- ii) Logic Diagram: Produce diagram with not more than 100 activities per ANSI D (24-inch x 36-inch) size sheet. Ensure each sheet includes title, match data or diagram correlation, and key to identify all components used in the diagram.
- iii) Narrative discussing general approach to completion of the work.
- iv) CD in Primavera format.

9) Schedule Update Requirements: The Contractor shall update the schedules monthly to show actual, current progress. The submission date of the updates shall be determined by Owner, as outlined above. The schedule updates shall be submitted within seven (7) calendar days of the data dates. Owner may require submission of the updated schedule on CD prior to submission of the full update package. Should Contractor fail to provide an update, Owner may withhold payment of the current monthly progress estimate until the monthly scheduled update is submitted. The updates shall include:

- i) Dates of activities' actual starts and completions.
- ii) Percent of work remaining for activities started but not completed as of the update date.
- iii) Narrative report including a listing of monthly progress, the activities that define the critical path and any changes to the path of critical activities from the previous update, sources of delay, any potential problems, requested logic changes, and work planned for the next month.
- iv) Predecessor/Successor Sort
- v) Total Float/Early Start Sort
- vi) Responsibility/Early Start Sort
- vii) Area/Early Start Sort
- viii) CD in Primavera format
- ix) Fragnet of logic diagram for all requested logic changes.
- x) Updated logic diagram as required by Owner. At a minimum, Owner shall require a final logic diagram at the end of the Project showing the planned and actual starts and completions.
- xi) A bar chart comparison of the updated schedule to the initial schedule. This diagram shall show actual and planned performance dates for all completed activities.
- xii) All update information shall be an accurate representation of the actual Project progress.

- d. Recovery Schedule: If the initial schedule or current updates fail to reflect the Project's actual plan or method of operation, or a contractual milestone date is more than thirty (30) days behind, Owner may require that a recovery schedule for completion of the remaining Contract work be submitted. The Recovery Schedule must be submitted within seven (7) calendar days of Owner's request. The Recovery Schedule shall describe in detail Contractor's plan to complete the remaining Contract work by the Contract milestone date. The Recovery Schedule submitted shall meet the same requirements as the Initial Schedule. The narrative submitted with the Recovery Schedule should describe in detail all changes that have been made to meet the Contract milestone date.
 - e. Change Orders: When a Change Order is proposed, Contractor must identify all logic changes as a result of the Change Order. Contractor shall include, as part of each Change Order proposal, a sketch showing all schedule logic revisions, duration changes, and the relationships to other activities in the approved Initial Schedule. This sketch shall be known as the fragnet for the change. Upon acceptance of the fragnet, Contractor will revise the Initial Schedule or current update. The logic changes required by the Change Order will be considered incidental to Contractor's work. No separate payment will be made.
 - f. Schedule Revisions to Utility Work: Contractor shall provide owners of Underground Facilities ten (10) days' notice when revisions in the schedule of work affect operations of an Underground Facility unless previous arrangements have been made with the company involved.
- 4. Cost Control subsystem: The operation of this subsystem shall provide Sufficient timely cos data and detail to permit Contractor to control and adjust the Project requirements, needs, materials, equipment and systems by building and site elements so that the Work will be completed at a cost which, together with all other Project costs, will not exceed the Contract Price.
 - 5. Project Accounting Subsystem: This subsystem shall enable Contractor to Plan effectively and Owner to monitor and control the funds available for the Project, cashflow, costs, Change Orders, payments, and other major financial factors by comparison of budget, estimate, total commitment, amounts invoices, and amounts payable, and also enable Owner to stay informed as to the overall Project status. All reports to be generated as part of this subsystem shall be consistent with the Project Funding Schedule. This subsystem will be produced and updated monthly and includes the following reports:
 - a. A Costs Status Report representing the budget, estimate, and base commitment (awarded subcontracts and purchase orders) for any given subcontract or budget line item. It shall show approved Change Orders for each subcontract or budget line item. It shall show approved Change Orders for each subcontract which when added to the base commitment will become the total commitment. Pending Change Orders also will be shown to produce the total estimated probable cost to complete the Work.

- b. A Payment Status Report showing the value in place (both current and cumulative), the amount invoiced (both current and cumulative), and the balance remaining. A summary of this report shall accompany each pay request.
- c. A Detailed Status Report showing the complete activity history of each item in the Project accounting structure. It shall include the budget, estimate, and base commitment figures for each subcontract. It shall give the Change Order history, including Change Order numbers, description, proposed and approved dollar amounts. It also shall show all pending or rejected Change Orders.
- d. A Cash Flow Diagram showing the projected accumulation of cash payments against the Project. Cash flow projections shall be generated for anticipated monthly payments as well as cumulative payments.
- e. A Job Ledger shall be maintained as necessary to supplement the operation of the Project accounting subsystem. The job ledger will be used to provide construction cost accountability for general conditions work, on-site reimbursable expenses, and costs requiring accounting needs.

ARTICLE 4 – COMMENCEMENT AND PROGRESS OF THE WORK

SC-4.02 Starting the Work

SC-4.02.B Add the following new paragraphs immediately after Paragraph 4.02.A:

- B. Contractor shall have the sole responsibility of satisfying itself concerning the nature and location of the Work and the general and local conditions, and particularly, but without limitation, with respect to the following: those affecting transportation, access, legal disposal, handling and storage of materials; availability and quality of labor; water and electric power; availability and condition of roads; work area; living facilities; climatic conditions and seasons; physical conditions at the Site and the Project area as a whole; topography and ground surface conditions; nature and quantity of the surface materials to be encountered; subsurface conditions; equipment and facilities needed preliminary to and during performance of the Work; and all other costs associated with such performance. The failure of Contractor to acquaint itself with any applicable conditions shall not relieve Contractor from any of its responsibilities to perform under the Contract Documents, nor shall it be considered the basis for any claim for additional time or compensation.

ARTICLE 5 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

SC-5.03 *Subsurface and Physical Conditions*

SC-5.05F Add the following new paragraph immediately after Paragraph 5.05.E:

- F. If during the performance of the Work, Contractor or any subcontractor, sub-subcontractor, agent, employee or anyone else for whom Contractor is legally liable, causes a disruption of utility service to other facilities or customers within and immediately surrounding the Project area, Contractor shall take all actions necessary and required to immediately restore such utility service. If Contractor fails to take such immediate actions Owner shall have the right to take whatever actions it deems necessary and required to immediately restore the disrupted utilities, and all costs incurred by Owner as a result thereof shall be reimbursed to Owner by Contractor within five (5) business days of written demand for same from Owner.

SC-5.06 *Hazardous Environmental Conditions*

SC 5.06 Delete Paragraphs 5.06.A and 5.06.B in their entirety and insert the following:

- A. No reports or drawings related to Hazardous Environmental Conditions at the Site are known to Owner.
- B. Not Used.

ARTICLE 6 – BONDS AND INSURANCE

SC-6.03 *Contractor's Insurance*

SC 6.03K Add the following new paragraphs immediately after Paragraph 6.03.J:

- K. The limits of liability for the insurance required by Paragraph 6.03 of the General Conditions shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations:
1. Workers' Compensation, and related coverages under Paragraphs 6.03.A.1 and A.2 of the General Conditions:

State:	<u>Ch. 440, Fla. Stat.</u>
Federal, if applicable (e.g., Longshoreman's):	<u>N/A</u>
Jones Act coverage, if applicable:	
Bodily injury by accident, each accident	\$ <u>N/A</u>
Bodily injury by disease, aggregate	\$ <u>N/A</u>
Employer's Liability:	
Bodily injury, each accident	\$ <u>100,000</u>
Bodily injury by disease, each employee	\$ <u>100,000</u>
Bodily injury/disease aggregate	\$ <u>500,000</u>

2. Contractor's Commercial General Liability under Paragraphs 6.03.B and 6.03.C of the General Conditions:

General Aggregate	\$ <u>2,000,000</u>
Products - Completed Operations Aggregate	\$ <u>2,000,000</u>
Personal and Advertising Injury	\$ <u>1,000,000</u>
Each Occurrence (Bodily Injury and Property Damage)	\$ <u>1,000,000</u>

3. Automobile Liability under Paragraph 6.03.D. of the General Conditions:

Bodily Injury:

Each person	\$ <u>1,000,000</u>
Each accident	\$ <u>1,000,000</u>

Property Damage:

Combined Single Limit of	\$ <u>1,000,000</u>

4. Excess or Umbrella Liability:

Per Occurrence	\$ <u>1,000,000</u>
General Aggregate	\$ <u>1,000,000</u>

5. Contractor's Pollution Liability:

Each Occurrence	\$ <u>N/A</u>
General Aggregate	\$ <u>N/A</u>



If box is checked, Contractor is not required to provide Contractor's Pollution Liability insurance under this Contract

6. Additional Insureds: In addition to Owner and Engineer, include as additional insureds the following: None.

7. Contractor's Professional Liability:

Each Claim	\$ _____
Annual Aggregate	\$ _____

- L. Promptly after written Notice of Award is issued by Owner, the insurance coverages and limits required must be evidenced by properly executed Certificates of Insurance on the form which is attached hereto and made a part hereof as Exhibit A. The certificates must be personally, manually signed by the Authorized

Representatives of the insurance company/companies shown on the certificates with proof that he/she is an authorized representative thereof. In addition, certified, true and exact copies of all insurance policies required shall be provided to Owner, on a timely basis, if requested by Owner. These certificates and policies shall contain provisions that thirty (30) days written notice by registered or certified mail shall be given the Owner of any cancellation, intent not to renew, or reduction in the policies' coverages, except in the application of the Aggregate Limits Provisions. Contractor also shall notify Owner, in a like manner, within twenty-four (24) hours after receipt, of any notices of expiration, cancellation, non-renewal or material change in coverages or limits received by Contractor from its insurer, and nothing contained herein shall relieve Contractor of this requirement to provide notice. In the event of a reduction in the aggregate limit of any policy, the Contractor shall immediately take steps to have the aggregate limit reinstated to the full extent permitted under such policy.

- M. All insurance policies required by this Agreement shall include the following provisions and conditions by endorsement to the policies:
1. The term "City of Largo, Florida" shall include City of Largo, Florida, a Florida municipal corporation, and all Authorities, Boards, Bureaus, Commissions, Divisions, Departments and offices thereof and individual members, employees, elected officials, volunteers, representatives, agents and attorneys, thereof in their official capacity, and/or while acting on behalf of the City of Largo, Florida.
 2. All insurance policies, other than the Professional Liability policy and the Workers Compensation policy, provided by Contractor to meet the requirements of this Agreement shall name City of Largo, Florida, as that name is defined in subparagraph 1. above, as an additional insured as to the operations of the Contractor under the Contract Documents and shall contain a severability of interests provision.
 3. Companies issuing the insurance policy or policies shall have no recourse against Owner for payment of premiums or assessments for any deductibles which all are at the sole responsibility and risk of Contractor.
 4. All insurance coverages of the Contractor shall be primary to any insurance or self-insurance program carried by the Owner applicable to this Project, and the "Other Insurance" provisions of any policies obtained by Contractor shall not apply to any insurance or self-insurance program carried by Owner applicable to this Project.
- N. The acceptance by Owner of any Certificate of Insurance for this Project evidencing the insurance coverages and limits required in the Agreement does not constitute approval or agreement by Owner that the insurance requirements have been met or that the insurance policies shown on the Certificates of Insurance are in compliance with the requirements of the Agreement.
- O. No work shall commence at the Site unless and until the required Certificates of Insurance are received and the written Notice to Proceed is issued to Contractor by Owner.
- P. Before starting and until acceptance of the work by Owner, Contractor shall procure and maintain insurance of the types and to the limits specified in Article 6 of the General Conditions and related Supplementary Conditions. Contractor shall require

each of its Subcontractors to procure and maintain, until the completion of that Subcontractor's work, insurance of the same types and the limits, unless such insurance requirement for the Subcontractor is expressly waived in writing by the Owner. Subcontractors performing Work on the Project costing an amount equal to or exceeding \$400,000 shall be obligated to maintain a minimum of \$1,000,000 in umbrella liability coverage/excess liability coverage. This provision shall not affect any other types or amounts of insurance required to be obtained and/or maintained by the Contractor or any subcontractor performing the Work.

- Q. If any insurance provided pursuant to this Agreement expires prior to the completion of the Work, renewal Certificates of Insurance and, if requested by Owner, certified, true copies of the renewal policies, shall be furnished to Owner prior to the date of expiration.
- R. Should at any time Contractor not maintain the insurance coverages required in this Agreement, Owner may cancel the Agreement or at its sole discretion shall be authorized to purchase such coverages and charge Contractor for such coverages purchased. If Contractor fails to reimburse Owner for such costs within thirty (30) days after demand, Owner has the right to offset these costs from any amount due Contractor under this Agreement. Owner shall be under no obligation to purchase such insurance, nor shall it be responsible for the coverages purchased or the insurance company/companies used. The decision of Owner to purchase such insurance coverages shall in no way be construed to be a waiver of its rights under this Agreement.
- S. Contractor shall immediately submit to Owner and Design Professional a copy of all accident reports arising out of any injuries to its employees or those of any firm or individual to whom it may have subcontracted a portion of the Work, or any personal injuries or property damages arising or alleged to have arisen on account of any work by Contractor under the Contract Documents.
- T. The Owner shall be exempt from, and in no way liable for, any sums of money that may represent a deductible in any insurance policy except deductibles as agreed to by Owner in obtaining Builder's Risk Property Insurance. The payment of any deductible, with the exception of the aforementioned deductible to obtain Builder's Risk Property Insurance for the Project, shall be the sole responsibility of Contractor and/or Subcontractor providing such insurance.

SC-6.05 Property Insurance

- SC-6.05.A. Delete Paragraph 6.05.A of the General Conditions and substitute the following new language in its place:

Contractor shall provide and maintain installation floater insurance for property under the care, custody, or control of Contractor. The installation floater insurance shall be a broad form or "all risk" policy providing coverage for all materials, supplies, machinery, fixtures, and equipment that will be incorporated into the Work. Coverage under the Contractor's installation floater will include:

- 1. any loss to property while in transit,
- 2. any loss at the Site, and
- 3. any loss while in storage, both on-site and off-site.

Coverage cannot be contingent on an external cause or risk, or limited to property for which the Contractor is legally liable. The Contractor will be solely responsible for any deductible carried under this coverage and claims on materials, supplies, machinery, fixture, and equipment that will be incorporated into the Work while in transit or in storage. This policy will include a waiver of subrogation applicable to Owner, Contractor, Engineer, all Subcontractors, and the officers, directors, partners, employees, agents and other consultants and subcontractors of any of them.

ARTICLE 7 – CONTRACTOR’S RESPONSIBILITIES

SC-7.02 Labor; Working Hours

SC-7.02.B. Delete Paragraph 7.02.B of the General Conditions and substitute the following new language in its place:

Except as otherwise required for the safety or protection of persons or the Work or property at the Site adjacent thereto, all Work at the Site shall be performed during regular working hours, 8:00 a.m. through 5:00 p.m. Contractor will not perform Work on a Saturday, Sunday, or any City holiday; New Year’s Day, ML King Day, Presidents’ Day, Memorial Day, Independence Day, Labor Day, Veterans Day, Thanksgiving Day and following day, Christmas Eve, and Christmas Day. In its sole and absolute discretion, Owner may in writing authorize Contractor to perform work outside regular working hours, in which case Contractor must use equipment engine silencers approved by Owner.

SC-7.02.C. Add the following new paragraph immediately after Paragraph 7.02.B:

- C. Contractor shall be responsible for the cost of any overtime pay or other expense incurred by the Owner for Engineer’s services (including those of the Resident Project Representative, if any), Owner's representative, and construction observation services, occasioned by the performance of Work on Saturday, Sunday, any legal holiday, or as overtime on any regular work day. If Contractor is responsible but does not pay, or if the parties are unable to agree as to the amount owed, then Owner may impose a reasonable set-off against payments due under Article 15.
 - 1. For purposes of administering the foregoing requirement, additional overtime costs are defined as \$500 per day for Owner’s inspectors plus actual cost of any third-party Owner’s representative or other providers of services.

SC-7.05 Substitutes

SC-7.05G Add the following new paragraphs immediately after Paragraph 7.05.F:

- G. If a specific means, method, technique, sequence or procedure of construction is indicated in or required by Contract Documents, Contractor may furnish or utilize a substitute means, method, technique, sequence or procedure of construction acceptable to Design Professional, if Contractor submits sufficient information to allow Design Professional to determine that the substitute proposed is equivalent to that indicated or required by the Contract Documents. The procedures for submission to and review by Design Professional shall be the same as those provided herein for substitute materials or equipment, except as provided immediately below.

SC-7.06 Concerning Subcontractors, Suppliers, and Others

SC-7.06A Add the following new paragraphs immediately after Paragraph 7.06.A:

1. Subcontractor or subcontractor's supervisory personnel must have successfully completed no less than two (2) projects of similar size and complexity within the last five (5) years.
2. Subcontractor must agree to perform no less than 15% of the subcontracted Work utilizing its own employees.
3. Contractor shall not subcontract with the civil engineering firm of record to perform any survey work that is required under the terms of the Contract.
4. Contractor shall not subcontract with any person or affiliate prohibited from working on a public project pursuant to sections 287.133 (convicted vendor), 287.134 (discriminatory vendor), or 287.135 (scrutinized company) of the Florida Statutes.

SC-7.06K Add the following new paragraphs immediately after Paragraph 7.06.K:

1. Contractor shall negotiate all Change Orders, field orders and request for proposals, with all affected Subcontractors and shall review the costs of those proposals and advise Owner and Design Professional of their validity and reasonableness, acting in Owner's best interest, prior to requesting approval of each Change Order from Owner. Before any Work is begun on any Change Order, a written authorization from Owner must be issued. However, when there is an eminent threat to health and safety, and Owner's concurrence is impractical, Contractor shall act immediately to remove the threats to health and safety and shall subsequently fully inform Owner of all such action taken.
2. Contractor shall carefully review all shop drawings and then forward the same to Design Professional for review and actions. Design Professional will transmit them back to the Contractor who will then issue the shop drawings to the affected Subcontractor for fabrication or revision. Contractor shall maintain a suspense control system to promote expeditious handling. Contractor shall request Design Professional to make interpretations of the drawings or specifications requested of him by the subcontractors and shall maintain a suspense control system to promote timely response. Contractor shall advise Design Professional in writing which shop drawings or requests for clarification have the greatest urgency; the purpose being to enable Design Professional to prioritize requests coming from the Contractor. The Contractor shall advise Owner and Design Professional in writing when timely response is not occurring on any of the above.

SC-7.06M Add the following new paragraphs immediately after Paragraph 7.06.M:

1. Subcontracts between the Contractor and Subcontractors shall
 - a. require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by the terms of the Contract Documents, and to assume towards Contractor all the

obligations and responsibilities which Contractor, by the Contract Documents, assumes towards Owner and Design Professional, and

- b. provide for the assignment of those subcontracts from Contractor to Owner at the election of Owner upon termination of Contractor.
2. Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract, copies of the Contract Documents to which Subcontractor will be bound and identify to the Subcontractor any terms and conditions of the proposed subcontract which may be at variance with the Contract Documents. Each Subcontractor shall similarly make copies of such documents available to its Subcontractors.
3. On all subcontracts where the bid exceeds \$100,000, Subcontractor must provide a 100% performance bond and a 100% labor and material payment bond from a surety company authorized to do business in the State of Florida by the Department of Financial Services. Owner shall be identified as an Obligee on all Performance Bonds. If Contractor wishes to award subcontracts to Subcontractors unable to supply this bonding, it may request special authorization from Owner to do so.
4. All subcontracts shall provide:
 - a. Subcontractor's exclusive remedy for delays in the performance of the contract caused by events beyond its control, including delays claimed to be caused by Owner or Design Professional or attributable to Owner or Design Professional and including claims based on breach of contract or negligence, shall be an extension of its contract time (see General Condition 4.05). The subcontract shall require the Subcontractor expressly to agree that the foregoing constitutes its sole and exclusive remedies for delays and changes in the work and thus eliminate any other remedies for claim for increase in the contract price, damages, losses or additional compensation.
 - b. In the event of a change in the Work approved by Owner in accordance with General Condition Article 11, Subcontractor's claim for adjustments is limited exclusively to its actual costs for such changes plus no more than 10% for overhead and profit and bond costs. Subcontractor is not entitled to any additional payments for any changes not approved by Owner in accordance with General Condition Article 11.
 - c. Each subcontract shall require that any claims by Subcontractor for delay or additional cost must be submitted to Contractor within the time and in the manner in which Contractor must submit such claims to Owner under General Condition Article 11, and that failure to comply with the conditions for giving notice and submitting claims shall result in the waiver of such claims.
 - d. Subcontractor must agree to provide field (onsite) supervision through a named superintendent for each trade (i.e. general concrete forming and placement, masonry, mechanical, etc.) included in the subcontract. In addition, Subcontractor shall assign and name a qualified employee for scheduling direction for its work. The supervisory employees of Subcontractor (including field superintendent, foreman and schedulers at all levels) must have been employed in a supervisory (leadership)

capacity of substantially equivalent level on a similar project for at least two (2) years within the last five (5) years. Subcontractor shall include a resume of experience for each employee identified by Subcontractor to supervise and schedule the subcontracted work.

SC-7.12 Safety and Protection

SC-7.12 A.4 – Add the following new paragraph immediately after Paragraph 7.12 A.3

4. Contractor shall provide safe access slash egress for business owners and operators, there are customers, and any other person visiting a business affected by sidewalk reconstruction.

SC-7.18 Indemnification

SC-7.18D Add the following new paragraphs immediately after Paragraph 7.18.C:

- D. The obligations contained in Paragraph 7.18 shall survive termination of this Agreement and shall not be limited by the amount of any insurance required to be obtained or maintained under this Agreement. Notwithstanding the foregoing, this indemnification shall be limited to one million dollars (\$1,000,000) or the Contract amount, whichever is greater, in accordance with section 725.06, Florida Statutes.
- E. Subject to the limitations set forth in this Section, Contractor shall assume control of the defense of any claim asserted by a third party against Owner and, in connection with such defense, shall appoint lead counsel, in each case at Contractor's expense. Owner shall have the right, at its option, to participate in the defense of any third party claim, without relieving Contractor of any of its obligations hereunder. If Contractor assumes control of the defense of any third party claim in accordance with this paragraph, Contractor shall obtain the prior written consent of Owner before entering into any settlement of such claim. Notwithstanding anything to the contrary in Paragraph 7.18, Contractor shall not assume or maintain control of the defense of any third party claim, but shall pay the fees of counsel retained by Owner and all expenses, including experts' fees, if (i) an adverse determination with respect to the third party claim would, in good faith judgment of Owner, be detrimental in any material respect to Owner's reputation; (ii) the third party claim seeks an injunction or equitable relief against Owner; or (iii) Contractor has failed or is failing to prosecute or defend vigorously the third party claim. Each party shall cooperate, and cause its agents to cooperate, in the defense or prosecution of any third party claim and shall furnish or cause to be furnished such records and information, and attend such conferences, discovery proceedings, hearings, trials, or appeals, as may be reasonably requested in connection therewith.

SC-7.20 Review and Commentary Services

SC-7.20 Add the following new paragraph immediately after Paragraph 7.19:

7.20 Review and Commentary Services

- A. Contractor shall arrange for all job site facilities as required by Owner and necessary to enable Contractor and Design Professional to perform their respective duties and to accommodate any representatives of Owner which Owner may choose to have present on the job. Tangible personal property, otherwise referred to as job site facilities, include, but are not limited to such things as

trailers, toilets, typewriters, computers and any other equipment necessary to carry on the Project.

1. The method of acquiring any such job site facilities, which are planned to become the property of Owner at the conclusion of the Project, shall be evaluated based on cost over the life of the Project. Owning versus leasing shall be considered by Contractor obtaining at least three (3) proposals for leasing and at least three (3) proposals for purchasing and then analyzing which is least expensive over the usage life of the item. Contractor shall present its evaluation with recommendation to Owner for approval.
 2. When Contractor wishes to supply job site facilities from its own equipment pool, Contractor shall first evaluate buy versus lease as discussed in the paragraph above. If leasing is found to be the least expensive approach, then Contractor may lease such job-site facilities from its own equipment pool at a price not greater than the lowest of the three (3) lease proposals obtained.
 3. For all such job site facilities purchased, which may become the property of Owner at the conclusion of the Project, Contractor shall maintain ownership responsibilities of such facilities until the Project conclusion. Reimbursement for cost of such equipment will be made at the conclusion of the Project at the documented purchase price. At that time, Contractor shall provide Owner with a complete inventory for each unit of equipment. The inventory shall describe the equipment and identify the purchase price, serial number, model number and condition. Where said equipment has a title, said title shall be properly transferred to Owner or to its designee.
 4. Contractor is responsible for proper care and maintenance of all equipment while in Contractor's control. At the time of transfer to Owner, Owner may refuse acceptance of the equipment if Owner determines, in its sole discretion, that the equipment has not been properly cared for by Contractor or that such acquisition would not otherwise be in the best interest of Owner.
- B. DISCLAIMER OF WARRANTY: THE OWNER DISCLAIMS ANY WARRANTY THAT THE CONSTRUCTION DOCUMENTS FOR THE PROJECT ARE ACCURATE, PRACTICAL, CONSISTENT OR CONSTRUCTABLE.

SC-7.21 Project Management Services

SC-7.21 Add the following new paragraph immediately after Paragraph 7.20:

7.21 Project Management Services

- A. Contractor shall maintain sufficient off-site support staff, and competent full time staff at the Project site authorized to act on behalf of the Contractor to coordinate, inspect and provide general direction of the Work and progress of the subcontractors. Contractor shall provide no less than those personnel during the respective phases of construction that are set forth in **Exhibit C** to the Agreement. The Contractor shall not change any of those persons identified in **Exhibit C** unless mutually agreed to in writing by the Owner and Contractor. In such case, Owner shall have the right to approve the qualifications of the replacement personnel.

- B. Contractor shall establish and maintain lines of authority for its personnel, and shall provide this information to Owner and all other affected parties, such as the code inspectors of any permitting authority, the subcontractors, and Design Professional to provide general direction of the Work and progress of the various phases and subcontractors. Owner and Design Professional may attend meetings between Contractor and Subcontractors; however, such attendance is optional and shall not diminish either the authority or responsibility of the Contractor to administer the subcontracts.
- C. Contractor shall provide Owner, its representatives, and Design Professional with copies of the Project Management Plan developed and updated as required herein, employing the Construction Phase milestones, beginning and finishing dates, the various parties' respective responsibilities for performance and the relationships of their Work with respect to Subcontractors and suppliers. Contractor also shall continue to provide current scheduling information and provide direction and coordination regarding milestones, beginning and finishing dates, responsibilities for performance and the relationships of Contractor's Work to the Work of Subcontractors and suppliers to enable them to perform their respective tasks so that the construction progresses in a smooth and efficient manner in conformance with the overall Master Project Schedule. The schedule shall include all phases of the construction Work, material supplies, long lead procurement, approval of shop drawings, change orders in progress, schedules for change orders, and performance testing requirements. Contractor shall advise Owner, its representatives, and Design Professional of their required participation in any meeting or inspection giving each at least one week notice unless such notice is made impossible by conditions beyond Contractor's fault and control. Contractor shall hold jobsite meetings at least once each month with the construction team and at least once each week with the subcontractors, Design Professional's field representative, and Owner's representative, or more frequently as required by Work progress, to review progress, discuss problems and their solutions and coordinate future Work with all Subcontractors.
- D. Contractor shall develop and maintain a program, acceptable to Owner and Design Professional, to assure quality control of the Work. Contractor shall be responsible for and supervise the Work of all Subcontractors, providing instructions to each when their portion of the Work does not conform to the requirements of the Construction Documents, and Contractor shall continue to exert its influence and control over each Subcontractor to ensure that corrections are made in a timely manner so as to not affect the efficient progress of the Work. Should a disagreement occur between Contractor and Design Professional over the acceptability of the Work, Owner, in its sole discretion, shall have the right to determine the acceptability.
- E. Contractor shall secure all necessary permits from any permitting authorities. Contractor, with assistance from Design Professional, will obtain all necessary site, SWFWMD and utility permits. All costs incurred by Contractor with respect to performing its obligations under this paragraph shall be paid for by Owner. Owner shall fully cooperate with the Contractor where necessary.
- F. The Contractor shall provide or maintain the following at the job site:
 - 1. Maintain a log of daily activities, including manpower records, weather, delays, major decisions, etc.

2. Maintain a roster of companies on the Project with names and telephone numbers of key personnel.
 3. Establish and enforce job rules governing parking, clean-up, use of facilities and Worker discipline.
 4. Provide labor relations management for a harmonious, productive project.
 5. Provide and administer a safety program for the Project to meet OSHA and other governmental requirements. Monitor Subcontractor compliance with that safety program.
 6. Provide and administer a quality control program as developed pursuant to the Contract terms.
 7. Provide miscellaneous office supplies that support the construction efforts which are consumed by Contractor's own forces.
 8. Provide for travel to and from Contractor's home office to the Project site and City of Largo as the Project requires.
- G. Contractor shall provide personnel and equipment, or shall arrange for separate Subcontractors, to provide each of the following as a direct cost item:
1. Services of independent testing laboratories and provide the necessary testing of materials to ensure conformance with the Contract Documents.
 2. Printing and distributing of all required bidding documents and shop drawings, including the sets required by any permitting authority's inspectors.
- H. Contractor shall provide job site administration functions during construction to assure proper documentation, including but not limited to the following:
1. *Job Meetings*
 - a. Conduct a pre-construction conference with each Subcontractor after award of the subcontract and prior to the start of its portion of the Work.
 - b. Conduct weekly progress and coordination meetings to provide for a timely completed Project.
 - c. Conduct monthly Project status meetings with Design Professional and Owner.
 - d. Use the job site meetings as a tool for the pre-planning of Work and enforcing schedules, and for establishing procedures, responsibilities, and identification of authority for all parties to clearly understand.
 - e. Identify party or parties responsible for following up on any problems, delay items or questions raised at meetings. Note the action to be taken by such party or parties. Revisit each pending item at each subsequent meeting until resolution is achieved. Attempt to obtain from all present any problems or delaying event known to them for appropriate attention and resolution.
 2. Provide staff to review and approve shop drawings and to implement procedures for submittal and transmittal to Design Professional of such drawings for action, and closely monitor their submittal and approval process.

3. Provide staff to closely monitor material and equipment deliveries, perform critically important checking and follow-up procedures on supplier commitments for all Subcontractors and maintain a material and equipment expediting log.
 4. Develop and implement a procedure for the review, processing and payment of applications by Subcontractors for progress and final payments.
 5. Refer all questions for interpretation of the Contract Documents to Design Professional in writing.
 6. Record the progress of the Project. Submit written progress reports to Owner and Design Professional, including information on Subcontractors' Work, and the percentage of completion. Keep a daily log available to Owner, Design Professional, and any permitting authority inspectors.
 7. Prepare periodic punch lists for Subcontractors' work including unsatisfactory or incomplete items and schedules for their completion.
 8. Ascertain when the Work or designated portions thereof are ready for Design Professional's substantial completion inspections. From the punch lists of incomplete or unsatisfactory items prepared by Contractor and reviewed and supplemented by Design Professional, prepare a schedule for their completion indicating completion dates for Owner's review. Design Professional will issue a Certificate of Substantial Completion when the Work on the list has been accomplished and Substantial Completion has been achieved as otherwise required hereunder.
 9. Monitor Subcontractors' performance on the completion of the Project and provide notice to Owner and Design Professional that the Work is ready for final inspection. Secure and transmit to Owner, through Design Professional, all required guarantees, warranties, affidavits, releases, bonds and waivers, manuals, record drawings, and maintenance books.
 10. With Owner's personnel, direct the check-out of utilities, operations, systems and equipment for readiness and assist in their initial start-up and testing by the Subcontractors.
 11. Monitor the progress of Contractor's own forces and its Subcontractors on marked up field prints, which at Project completion Contractor shall develop into the final record drawings.
- I. Contractor shall maintain at the Project site, originals or copies of, on a current basis, files and administrative records such as, but not limited to the following, which shall be available at all times to Owner and Design Professional for reference or review:
1. Subcontracts and Purchase Orders
 2. Shop Drawing Submittal/Approval Logs
 3. Equipment Purchase/Delivery Logs
 4. Contract Drawings and Specifications with Addenda
 5. Warranties and Guarantees
 6. Cost Accounting Records
 7. Labor Costs
 8. Material Costs
 9. Equipment Costs
 10. Cost Proposal Request

11. Payment Request Records
 12. Meeting Minutes
 13. Cost-Estimates
 14. Bulletin Quotations
 15. Lab Test Reports
 16. Insurance Certificates and Bonds
 17. Contract Changes
 18. Permits
 19. Material Purchase Delivery Logs
 20. Technical Standards
 21. Design Handbooks
 22. "As-Built" Marked Prints
 23. Operating & Maintenance Instruction
 24. Daily Progress Reports
 25. Monthly Progress Reports
 26. Correspondence Files
 27. Transmittal Records
 28. Inspection Reports
 29. Punch Lists
 30. PMIS Schedule and Updates
 31. Suspense (Tickler) Files of Outstanding Requirements
 32. Project Management Plan
- J. Contractor shall keep all records and supporting documentation which concern or relate to the Work hereunder for a minimum of fifteen (15) years from the date of termination of this Agreement or the date the Project is completed, or such longer period of time as may be required by law, whichever is longer. Owner, or any duly authorized agents or representatives of Owner, shall have the right to audit, inspect and copy all such records and documentation as often as they deem necessary during the period of this Agreement and during the fifteen (15) year period noted above; provided, however, such activity shall be conducted only during normal business hours.

ARTICLE 9 – OWNER’S RESPONSIBILITIES

SC-9.13 Owner’s Site Representative

- SC-9.13 Add the following new paragraph immediately after Paragraph 9.12 of the General Conditions:

SC-9.13 Owner will furnish an Owner’s Site Representative (“OSR”) to represent Owner at the Site and assist Owner in observing the progress and quality of the Work. OSR is not Engineer’s consultant, agent, or employee. OSR will be assigned by Owner. The authority and responsibilities of OSR follow:

- A. General: OSR’s dealings in matters pertaining to the Work in general shall be with Engineer and Contractor. OSR’s dealings with Subcontractors shall only be through or with the full knowledge and approval of Contractor.
- B. Schedules: Review the progress schedule, schedule of Shop Drawing and Sample submittals, and Schedule of Values prepared by Contractor and consult with

Engineer concerning acceptability. OSR will participate in such review, but the exchange of information will be between Contractor and Engineer.

- C. Conferences and Meetings: Attend meetings with Contractor, such as preconstruction conferences, progress meetings, job conferences, and other Project-related meetings, and prepare and circulate copies of minutes thereof.
- D. Liaison:
 - 1. Working principally through Contractor's authorized representative or designee, assist in providing information regarding the provisions and intent of the Contract Documents.
 - 2. Serve as Owner's liaison with Contractor when Contractor's operations affect Owner's on-Site operations.
 - 3. Provide from Owner additional details or information, when required for proper execution of the Work.
- E. Interpretation of Contract Documents: Consult with Engineer when clarifications and interpretations of the Contract Documents are needed. OSR will participate in such consultations, and the exchange of information, including clarifications and interpretations as issued by Engineer, will be between Contractor and Engineer through OSR.
- F. Shop Drawings and Samples:
 - 1. Participate in review of Samples and Contractor-approved Shop Drawings. Exchange of Samples, Shop Drawings, and related information shall be between Contractor and Engineer.
 - 2. Advise Engineer and Contractor of the commencement of any portion of the Work requiring a Shop Drawing or Sample submittal for which OSR believes that the submittal has not been approved by Engineer.
- G. Modifications: Consider and evaluate Contractor's suggestions for modifications in Drawings or Specifications and report OSR's recommendations, if any, to Engineer. Exchange of Contractor's suggestions and Engineer's decisions shall be between Contractor and Engineer through OSR.
- H. Review of Work and Rejection of Defective Work:
 - 1. Conduct on-Site observations of Contractor's work in progress to assist Engineer in determining if the Work is in general proceeding in accordance with the Contract Documents.
 - 2. Report to Engineer whenever OSR believes that any part of Contractor's work in progress is defective, will not produce a completed Project that conforms generally to the Contract Documents, or will imperil the integrity of the design concept of the completed Project as a functioning whole as indicated in the Contract Documents, or has been damaged, or does not meet the requirements of any inspection, test or approval required to be made; and advise Engineer of that part of work in progress that OSR believes should be corrected or rejected or should be uncovered for observation, or requires special testing, inspection or approval.
- I. Inspections, Tests, and System Start-ups:

1. Verify that tests, equipment, and systems start-ups and operating and maintenance training are conducted in the presence of appropriate Owner's personnel, and that Contractor maintains adequate records thereof.
 2. Observe and record appropriate details relative to the test procedures and systems start-ups.
- J. Records:
1. Prepare a daily report or keep a diary or log book, recording Contractor's hours on the Site, Subcontractors present at the Site, weather conditions, data relative to questions of Change Orders, Field Orders, Work Change Directives, or changed conditions, Site visitors, deliveries of equipment or materials, daily activities, decisions, observations in general, and specific observations in more detail as in the case of observing test procedures; and send copies to Engineer.
 2. Record names, addresses, fax numbers, e-mail addresses, web site locations, and telephone numbers of all Contractors, Subcontractors, and major Suppliers of materials and equipment.
 3. Maintain records for use in preparing Project documentation.
- K. Reports:
1. Furnish to Owner periodic reports as required of progress of the Work and of Contractor's compliance with the Progress Schedule and schedule of Shop Drawing and Sample submittals.
 2. Immediately notify Owner and Engineer of the occurrence of any Site accidents, emergencies, acts of God endangering the Work, force majeure or delay events, damage to property by fire or other causes, or the discovery of any Constituent of Concern or Hazardous Environmental Condition.
- L. Payment Requests: Review applications for payment with Contractor for compliance with the established procedure for their submission and forward with recommendations for payment, noting particularly the relationship of the payment requested to the Schedule of Values, Work completed, and materials and equipment delivered at the Site but not incorporated in the Work.
- M. Certificates, Operation and Maintenance Manuals: During the course of the Work, verify that materials and equipment certificates, operation and maintenance manuals and other data required by the Contract Documents to be assembled and furnished by Contractor are applicable to the items actually installed and in accordance with the Contract Documents.
- N. Completion:
1. Participate in Engineer's visits to the Site to determine Substantial Completion, assist in the determination of Substantial Completion and the preparation of a punch list of items to be completed or corrected.
 2. Participate in Engineer's final visit to the Site to determine completion of the Work, in the company of Contractor, and prepare a final punch list of items to be completed and deficiencies to be remedied.
 3. Observe whether all items on the final list have been completed or corrected and make recommendations to Engineer concerning acceptance and issuance of the notice of acceptability of the work.

O. OSR shall not:

1. Authorize any deviation from the Contract Documents or substitution of materials or equipment (including “or-equal” items).
2. Exceed limitations of Owner’s authority as set forth in the Contract Documents.
3. Undertake any of the responsibilities of Engineer, Contractor, Subcontractors, or Suppliers.
4. Advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences or procedures of Contractor’s work.
5. Advise on, issue directions regarding, or assume control over security or safety practices, precautions, and programs in connection with the activities or operations of Contractor.
6. Nothing contained herein shall relieve the Contractor of the responsibility for the means, methods, techniques, sequences or procedures of Contractor’s work or the safety of the Work and the site.

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

SC-14.03 - Defective Work

Delete paragraph 14.03 B in its entirety and insert the following in its place:

OSR’s Authority: OSR has the authority to determine whether work is defective, and to reject defective work.

ARTICLE 15 – PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

SC-15.01 Progress Payments

SC-15.01.D Payment Becomes Due

Payment becomes due as provided in section 218.735, Florida Statutes (2021)

SC-15.01.B Applications for Payments

Add the following new subparagraphs following Paragraph 15.01.B.3:

4. Before submitting its first monthly Application for Payment, Contractor shall submit to Owner and Design Professional, for their review and approval, a revised Schedule of Values; all in FDOT format, listing the major elements of the Work and the dollar value for each element. After its approval by Owner, this revised Schedule of Values shall be used as the basis for Contractor’s monthly Applications for Payment thereafter. This revised schedule shall be updated and submitted each month to OSR along with a completed and notarized copy of the Application for Payment form.
 - a. The Contractor shall submit with each application for payment, payrolls, petty cash accounts, receipts, invoices, subcontractor invoices.
5. If payment is requested on the basis of materials and equipment not incorporated into the Project, but delivered and suitably stored at the site, the Application for Payment shall also be accompanied by a bill of sale, invoice or other documentation warranting that Owner has received the materials and

equipment free and clear of all liens, charges, security interests and encumbrances, together with evidence that the materials and equipment are covered by appropriate property insurance and other arrangements to protect Owner's interest therein, all of which shall be subject to Owner's satisfaction.

6. Contractor shall a notarized original copy of its monthly Application for Payment to Design Professional on or before the 25th day of each month for Work performed during the previous month. Invoices received after the 25th day of each month shall be considered for payment as part of the next month's application. Within ten (10) calendar days after receipt of each Application for Payment, OSR shall submit to Owner a Certificate for Payment in the amount recommended by Design Professional as being due and owing Contractor. Owner shall pay Contractor that portion of OSR's Certificate for Payment which Owner approves as being due and owing Contractor in accordance with the Florida Prompt Payment Act.
7. Owner shall retain five percent (5%) of the gross amount of each monthly payment request for the entirety of the Project. The sum remaining at the end of the Project shall not be fully released to Contractor until final payment is due and payable under Paragraph 15.06 of the General Conditions, as may be amended by the Supplementary Conditions. Any payment retainage shall be made in accordance with the Florida Prompt Payment Act.
8. Monthly payments to Contractor shall in no way imply approval or acceptance of Contractor's work.

SC-15.03 Substantial Completion

SC 15.03.B Add the following new subparagraph to Paragraph 15.03.B:

1. If some or all of the Work has been determined not to be at a point of Substantial Completion and will require re-inspection or re-testing by Engineer, the cost of such re-inspection or re-testing, including the cost of time, travel and living expenses, shall be paid by Contractor to Owner. If Contractor does not pay, or the parties are unable to agree as to the amount owed, then Owner may impose a reasonable set-off against payments due under Article 15.

SC-15.05 Final Inspection

SC 15.05.A Add the following new language to the end of Paragraph 15.05.A:

Owner reserves the right to inspect the Work and make an independent determination as to the Work's acceptability, even though Design Professional may have issued its recommendations. Unless and until Owner is completely satisfied, neither the final payment nor the retainage shall become due and payable. The final payment shall be the amounts withheld as retainage from the amount approved in each application for payment. Owner shall make final payment to Contractor within twenty-five (25) calendar days after the Work is fully and finally accepted by the Owner in accordance with the Florida Prompt Payment Act. Contractor's acceptance of final payment shall constitute a full waiver of any and all claims by Contractor against Owner arising out of or otherwise relating to the Work, except those identified in writing by Contractor as unsettled in the final application for payment. Upon the Owner's payment in full for all Work performed under the contract documents, contractor transfers to the city all ownership and

property interests, including but not limited to any intellectual property rights, copyrights, and/or patents, in the work.

SC-15.05 Final Payment

SC 15.05.D Add the following new language to the end of Paragraph 15.05.D:

Owner shall make final payment to Contractor within thirty (30) calendar days after the Work is finally accepted by Owner, provided that Contractor first, and as an absolute condition precedent to the accrual of Contractor's right to final payment, shall have furnished Owner with properly executed and notarized copies of the final Releases and Affidavits attached as Exhibit C and Exhibit D, as well as a duly executed copy of the Surety's consent to final payment form attached to the Agreement as Exhibit E.

Contractor's Application for Payment No. _____

Application Period:		Application Date:
To (Owner): City of Largo	From (Contractor):	Via (OSR):
Project: Trenchless Sanitary and Storm Sewer Rehabilitation Services	Contract:	
Owner's Contract No.: 24-B-806	Contractor's Project No.:	Engineer's Project No.: N/A

Application For Payment

Change Order Summary

Approved Change Orders			1. ORIGINAL CONTRACT PRICE.....	\$
Number	Additions	Deductions	2. Net change by Change Orders.....	\$ \$0.00
			3. Current Contract Price (Line 1 ± 2).....	\$ \$0.00
			4. TOTAL COMPLETED AND STORED TO DATE	
			(Column F total on Progress Estimates).....	\$ \$0.00
			5. RETAINAGE:	
			a. 5% X <u>\$0.00</u> Work Completed.....	\$ \$0.00
			b. 0% X <u>\$0.00</u> Stored Material.....	\$ \$0.00
			c. Total Retainage (Line 5.a + Line 5.b).....	\$ \$0.00
			6. AMOUNT ELIGIBLE TO DATE (Line 4 - Line 5.c).....	\$ \$0.00
			7. LESS PREVIOUS PAYMENTS (Line 6 from prior Application).....	\$
			8. AMOUNT DUE THIS APPLICATION.....	\$ \$0.00
			9. BALANCE TO FINISH, PLUS RETAINAGE	
			(Column G total on Progress Estimates + Line 5.c above).....	\$ \$0.00
TOTALS	\$0.00	\$0.00		
NET CHANGE BY CHANGE ORDERS	\$0.00			

Contractor's Certification

The undersigned Contractor certifies, to the best of its knowledge, the following:

(1) All previous progress payments received from Owner on account of Work done under the Contract have been applied on account to discharge Contractor's legitimate obligations incurred in connection with the Work covered by prior Applications for Payment;

(2) Title to all Work, materials and equipment incorporated in said Work, or otherwise listed in or covered by this Application for Payment, will pass to Owner at time of payment free and clear of all Liens, security interests, and encumbrances (except such as are covered by a bond acceptable to Owner indemnifying Owner against any such Liens, security interest, or encumbrances); and

(3) All the Work covered by this Application for Payment is in accordance with the Contract Documents and is not defective.

Contractor Signature

By: _____ Date: _____

Payment of: \$ _____
(Line 8 or other - attach explanation of the other amount)

is recommended by: _____
(OSR) (Date)

Payment of: \$ _____
(Line 8 or other - attach explanation of the other amount)

is approved by: _____
(Owner) (Date)

Approved by: _____
Funding or Financing Entity (if applicable) (Date)

NOTICE OF AWARD

Date of Issuance: _____, 2024

Owner: **City of Largo**

Owner's Contract No.: **24-B-806**

Engineer: **N/A**

Engineer's Project No.:

Project: **Trenchless Sanitary and Storm Sewer Rehabilitation Services** Contract Name:

Bidder:

Bidder's Address:

TO BIDDER:

You are notified that Owner has accepted your Bid dated _____ for the above Contract, and that you are the Successful Bidder and are awarded a **Contract for: Trenchless Sanitary and Storm Sewer Rehabilitation Services**. This project provides for the rehabilitation of pipelines and conduits (8 inch through 84 inch, and laterals) by various trenchless methods on an "as needed" basis. The trenchless pipe rehabilitation work includes wastewater and stormwater pipe cleaning, inspection, grouting, and lining services. These rehabilitation methods may be used in a variety of gravity and pressure applications such as sanitary sewers, storm sewers, and force mains.

The Contract Price of the awarded Contract is: \$ 1 (subject to unit prices)

Two unexecuted counterparts of the Agreement accompany this Notice of Award, and one copy of the Contract Documents accompanies this Notice of Award, or has been transmitted or made available to Bidder electronically.

You must comply with the following conditions precedent within 7 days of the date of receipt of this Notice of Award:

1. Deliver to Owner **two** counterparts of the Agreement, fully executed by Bidder.
2. Deliver with the executed Agreement(s) the Contract security and insurance documentation as specified in the Instructions to Bidders and General Conditions, Articles 2 and 6.
3. Other conditions precedent (if any):

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

Within ten days after you comply with the above conditions, Owner will return to you one fully executed counterpart of the Agreement, together with any additional copies of the Contract Documents as indicated in Paragraph 2.02 of the General Conditions.

Owner: **City of Largo**

Authorized Signature

By: **Norm Shaw**

Title: **Construction manager**

Copy: Engineer

NOTICE TO PROCEED

Owner:	City of Largo	Owner's Contract No.:	24-B-806
Contractor:		Contractor's Project No.:	
Engineer:	N/A	Engineer's Project No.:	
Project:	Trenchless Sanitary and Storm Sewer Rehabilitation Services	Contract Name:	

Effective Date of Contract:

TO CONTRACTOR:

Owner hereby notifies Contractor that the Contract Times under the above Contract will commence to run on [REDACTED], 20[REDACTED]. *[see Paragraph 4.01 of the General Conditions]*

On that date, Contractor shall start performing its obligations under the Contract Documents. No Work shall be done at the Site prior to such date. In accordance with the Agreement, the number of days to achieve Substantial Completion is _____, and the number of days to achieve readiness for final payment is _____.

Before starting any Work at the Site, Contractor must comply with the following:

[Note any access limitations, security procedures, or other restrictions]

Owner: **City of Largo**

By: **Authorized Signature**
Norm Shaw

Title: **Construction manager**

Date Issued:

Copy: Engineer

Work Change Directive No.

Date of Issuance:

Effective Date:

Owner: **City of Largo**

Owner's Contract No.: **24-B-806**

Contractor:

Contractor's Project No.:

Engineer: **N/A**

Engineer's Project No.:

Project: **Trenchless Sanitary and Storm Sewer
Rehabilitation Services** Contract Name:

Contractor is directed to proceed promptly with the following change(s):

Description:

Attachments: *[List documents supporting change]*

Purpose for Work Change Directive:

Directive to proceed promptly with the Work described herein, prior to agreeing to changes on Contract Price and Contract Time, is issued due to: *[check one or both of the following]*

☐ Non-agreement on pricing of proposed change.

☐ Necessity to proceed for schedule or other Project reasons.

Estimated Change in Contract Price and Contract Times (non-binding, preliminary):

Contract Price \$ [increase] [decrease].

Contract Time days [increase] [decrease].

Basis of estimated change in Contract Price:

☐ Lump Sum

☐ Unit Price

☐ Cost of the Work

☐ Other

RECOMMENDED:

AUTHORIZED BY:

RECEIVED:

By:
Engineer (Authorized Signature)

By:
Owner (Authorized Signature)

By:
Contractor (Authorized Signature)

Title:

Title:

Title:

Date:

Date:

Date:

Approved by Funding Agency (if applicable)

By:

Date:

Title:

Change Order No. _____

Date of Issuance:

Effective Date:

Owner: **City of Largo**

Owner's Contract No.: **24-B-806**

Contractor:

Contractor's Project No.:

Engineer: **N/A**

Engineer's Project No.:

Project: **Trenchless Sanitary and Storm Sewer Rehabilitation Services** Contract Name:

The Contract is modified as follows upon execution of this Change Order:

Description:

Attachments: *[List documents supporting change]*

CHANGE IN CONTRACT PRICE	CHANGE IN CONTRACT TIMES <i>[note changes in Milestones if applicable]</i>
Original Contract Price: \$ _____	Original Contract Times: Substantial Completion: _____ Ready for Final Payment: _____ days or dates
[Increase] [Decrease] from previously approved Change Orders No. ____ to No. ____: \$ _____	[Increase] [Decrease] from previously approved Change Orders No. ____ to No. ____: Substantial Completion: _____ Ready for Final Payment: _____ days
Contract Price prior to this Change Order: \$ _____	Contract Times prior to this Change Order: Substantial Completion: _____ Ready for Final Payment: _____ days or dates
[Increase] [Decrease] of this Change Order: \$ _____	[Increase] [Decrease] of this Change Order: Substantial Completion: _____ Ready for Final Payment: _____ days or dates
Contract Price incorporating this Change Order: \$ _____	Contract Times with all approved Change Orders: Substantial Completion: _____ Ready for Final Payment: _____ days or dates

RECOMMENDED:

ACCEPTED:

ACCEPTED:

By: _____

By: _____

By: _____

Engineer (if required)

Owner (Authorized Signature)

Contractor (Authorized Signature)

Title: _____

Title: _____

Title: _____

Date: _____

Date: _____

Date: _____

Approved by Funding Agency (if applicable)

By: _____
Title: _____

Date:

Date of Issuance:

Effective Date:

Owner: **City of Largo**

Owner's Contract No. **24-B-806**

Contractor:

Contractor's Project No.:

Engineer: **N/A**

Engineer's Project No.:

Project: **Project name**

Contract Name:

Contractor is hereby directed to promptly execute this Field Order, issued in accordance with General Conditions Paragraph 11.01, for minor changes in the Work without changes in Contract Price or Contract Times. If Contractor considers that a change in Contract Price or Contract Times is required, submit a Change Proposal before proceeding with this Work.

Reference:

Specification(s)

Drawing(s) / Detail(s)

Description:

Attachments:

ISSUED:

RECEIVED:

By: _____
Engineer (Authorized Signature)

By: _____
Contractor (Authorized Signature)

Norm Shaw

Title: **Construction Manager**

Title: _____

Date: _____

Date: _____

Copy to: Owner

CERTIFICATE OF SUBSTANTIAL COMPLETION

Owner: **City of Largo** Owner's Contract No.: **24-B-806**
Contractor: Contractor's Project No.:
Engineer: **N/A** Engineer's Project No.:
Project: **Trenchless Sanitary and Storm Sewer Rehabilitation Services** Contract Name:

This [preliminary] [final] Certificate of Substantial Completion applies to:

☐ All Work ☐ The following specified portions of the Work:

Date of Substantial Completion

The Work to which this Certificate applies has been inspected by authorized representatives of Owner, Contractor, and Engineer, and found to be substantially complete. The Date of Substantial Completion of the Work or portion thereof designated above is hereby established, subject to the provisions of the Contract pertaining to Substantial Completion. The date of Substantial Completion in the final Certificate of Substantial Completion marks the commencement of the contractual correction period and applicable warranties required by the Contract.

A punch list of items to be completed or corrected is attached to this Certificate. This list may not be all-inclusive, and the failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract.

The responsibilities between Owner and Contractor for security, operation, safety, maintenance, heat, utilities, insurance, and warranties upon Owner's use or occupancy of the Work shall be as provided in the Contract, except as amended as follows: *[Note: Amendments of contractual responsibilities recorded in this Certificate should be the product of mutual agreement of Owner and Contractor; see Paragraph 15.03.D of the General Conditions.]*

Amendments to Owner's
responsibilities: ☐ None
☐ As follows

Amendments to
Contractor's responsibilities: ☐ None
☐ As follows:

The following documents are attached to and made a part of this Certificate: *[punch list; others]*

This Certificate does not constitute an acceptance of Work not in accordance with the Contract Documents, nor is it a release of Contractor's obligation to complete the Work in accordance with the Contract.

EXECUTED BY OSR:		RECEIVED:		RECEIVED:	
By: _____	By: _____	By: _____	By: _____	By: _____	By: _____
(Authorized signature)		Owner (Authorized Signature)		Contractor (Authorized Signature)	
Title: Norm Shaw	Title: Jerald Woloszynski, PE	Title: _____	Title: _____	Title: _____	Title: _____
Construction Manager	City Engineer				

Date:

Date:

Date:

NOTICE OF ACCEPTABILITY OF WORK

PROJECT: Trenchless Sanitary and Storm Sewer Rehabilitation Services

OWNER: CITY OF LARGO

CONTRACTOR:

OWNER'S CONSTRUCTION CONTRACT IDENTIFICATION: 24-B-806

EFFECTIVE DATE OF THE CONSTRUCTION CONTRACT:

ENGINEER: N/A

NOTICE DATE:

To: _____
Owner

And To: _____
Contractor

From: _____
Engineer

The Engineer hereby gives notice to the above Owner and Contractor that Engineer has recommended final payment of Contractor, and that the Work furnished and performed by Contractor under the above Construction Contract is acceptable, expressly subject to the provisions of the related Contract Documents, the Agreement between Owner and Engineer for Professional Services dated _____, and the following terms and conditions of this Notice:

CONDITIONS OF NOTICE OF ACCEPTABILITY OF WORK

The Notice of Acceptability of Work ("Notice") is expressly made subject to the following terms and conditions to which all those who receive said Notice and rely thereon agree:

1. This Notice is given with the skill and care ordinarily used by members of the engineering profession practicing under similar conditions at the same time and in the same locality.
2. This Notice reflects and is an expression of the Engineer's professional opinion.
3. This Notice is given as to the best of Engineer's knowledge, information, and belief as of the Notice Date.

4. This Notice is based entirely on and expressly limited by the scope of services Engineer has been employed by Owner to perform or furnish during construction of the Project (including observation of the Contractor's work) under Engineer's Agreement with Owner, and applies only to facts that are within Engineer's knowledge or could reasonably have been ascertained by Engineer as a result of carrying out the responsibilities specifically assigned to Engineer under such Agreement.
5. This Notice is not a guarantee or warranty of Contractor's performance under the Construction Contract, an acceptance of Work that is not in accordance with the related Contract Documents, including but not limited to defective Work discovered after final inspection, nor an assumption of responsibility for any failure of Contractor to furnish and perform the Work thereunder in accordance with the Construction Contract Documents, or to otherwise comply with the Construction Contract Documents or the terms of any special guarantees specified therein.
6. This Notice does not relieve Contractor of any surviving obligations under the Construction Contract, and is subject to Owner's reservations of rights with respect to completion and final payment.

7.

By: _____

Title: _____

Dated: _____

SPECIFICATION PACKAGE

SECTION 01025

MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.01 EXPLANATION AND DEFINITIONS

The following explanation of the Measurement and Payment for the bid form items is made for information and guidance. The omission of reference to any item in this description shall not, however, alter the intent of the bid form or relieve the Contractor of the necessity of furnishing such as part of the Contract.

1.02 PAYMENT

- A. Payment shall be made for the items listed on the Bid Form on the basis of the work actually performed and completed. Such work shall include, but is not limited to, the furnishing of all necessary labor, materials, equipment, transportation, clean up, and all other appurtenances to complete the construction and installation of the work, to the configuration and extent as shown on the drawings, and/or described in the specifications.
- B. It is intended that all sediment and erosion control, testing, insurance, bond, license and other miscellaneous administrative costs, and all other costs to the Contractor not specifically identified in the following item description be distributed among and included in the unit prices stated. No additional payment shall be made for transportation, communications, office maintenance, project signs, maintenance of traffic, barriers, and other incidental work or services, and no further payment shall be made for re-mobilization unless all of the work is suspended by the Engineer for a period in excess of three months and through no fault to the Contractor.
- C. All required manufacturer testing and certification should be included in the unit prices shown in the Proposal and Contract. Density testing required for compacted back-filling, and concrete strength and materials testing required at the time of construction shall be performed and paid for by the contractor.

PART 2 - MATERIALS

Not Used

PART 3 - EXECUTION

3.01 CURED IN PLACE PIPE (CIPP) LINING - Bid Items No. 1, 3, 5, 7,9,11, 13, 15, 17, 19, 21, 23, 25, 27, & 29

- A. Payment for cured in place pipe (CIPP) lining, for the various pipe diameters, shall be made at the Contractor's corresponding unit price per linear foot of liner installed and accepted, as determined by the Engineer, in accordance with the specifications. Measurement shall be along the center line of the pipe, from wall of manhole inlet to wall of manhole inlet.
- B. The Contractor unit price shall include full compensation for all labor, materials, and equipment setup, initial line cleaning, initial and final CCTV inspection, grouting of liner annular space at manholes, plugging and bypass pumping required for the complete installation of cured in place pipe (CIPP) lining, in accordance with the specifications

**3.02 COST FOR EACH 1.5 MM INCREASE IN LINER THICKNESS - Bid Items No. 2, 4, 6, 8,
10, 12, 14, 16, 18, 20, 22, 24, 26, 28 & 30**

- A. Payment for this item will be made at the Contractors unit price per linear foot for each incremental 1.5 millimeter increase in liner thickness above the base liner thickness for each pipe diameter.
- B. Payment shall be made in addition to the base bid thickness unit price per linear foot for each pipe diameter.

**3.03 INITIAL SERVICE LATERAL CCTV INSPECTION, FROM MAIN, UP TO 30 LF - Bid Item
No. 31**

- A. Initial Service Lateral CCTV inspection is defined as the preliminary inspection of a service lateral for the purpose of allowing the City to evaluate the condition of the lateral and determine what rehabilitation method(s) are needed. This definition applies to sections 3.04, 3.05, 3.06 and 3.07.
- B. Payment for service lateral CCTV inspection (4" - 6" dia.), from main line, up to 30 linear feet shall be made at the Contractor's unit price per each CCTV inspection performed and accepted, as determined by the Engineer, in accordance with the specifications. Measurement shall be along the center line of the pipe, from the main line/service lateral connection to a point 30 feet up the lateral.
- C. The Contractor unit price shall include full compensation for all labor, materials, and equipment setup, plugging and bypass pumping required for service lateral CCTV inspection (4" - 6" dia.), up to 30 linear feet, in accordance with the specifications.

**3.04 INITIAL SERVICE LATERAL CCTV INSPECTION, FROM MAIN, BEYOND INITIAL 30 LF -
Bid Item No. 32**

- A. Payment for service lateral CCTV inspection (4" - 6" dia.), beyond initial 30 linear feet, shall be made at the Contractor's unit price per linear foot of service lateral inspected and accepted beyond the initial 30 LF, as determined by the Engineer, in accordance with the specifications. Measurement shall be along the center line of the pipe.
- B. The Contractor unit price shall include full compensation for all labor, materials, and equipment setup, plugging and bypass pumping required for service lateral CCTV inspection (4" - 6" dia.), beyond initial 30 linear feet, in accordance with the specifications.

**3.05 INITIAL SERVICE LATERAL CCTV INSPECTION, FROM CLEAN-OUT, UP TO 30 LF -
Bid Item No. 33**

- A. Payment for service lateral CCTV inspection (4" - 6" dia.), from clean-out, up to 30 linear feet shall be made at the Contractor's unit price per each CCTV inspection performed and accepted, as determined by the Engineer, in accordance with the specifications. Measurement shall be along the center line of the pipe, from the main line/service lateral connection to a point 30 feet up the lateral.
- B. The Contractor unit price shall include full compensation for all labor, materials, and equipment setup, plugging and bypass pumping required for service lateral CCTV inspection (4" - 6" dia.), from clean-out, up to 30 linear feet, in accordance with the specifications.

**3.06 INITIAL SERVICE LATERAL CCTV INSPECTION, FROM CLEAN-OUT, BEYOND INITIAL
30 LF - Bid Item No. 34**

- A. Payment for service lateral CCTV inspection (4" - 6" dia.), beyond initial 30 linear feet, shall be made at the Contractor's unit price per linear foot of service lateral inspected and accepted, as determined by the Engineer, in accordance with the specifications. Measurement shall be along the center line of the pipe.
- B. The Contractor unit price shall include full compensation for all labor, materials, and equipment setup, plugging and bypass pumping required for service lateral CCTV inspection (4" - 6" dia.), beyond initial 30 linear feet, in accordance with the specifications.

3.07 CURED IN PLACE PIPE (CIPP) SERVICE LATERAL LINING, INITIAL 30 FEET -

Bid Items No. 35

- A. Payment for cured in place pipe (CIPP) lining and main/lateral connection system (4" - 6" dia.) shall be made at the Contractor's unit price per each liner, up to 30 feet in length, installed and accepted, as determined by the Engineer, in accordance with the specifications. Measurement shall be along the center line of the pipe, from the main line/service lateral connection to the clean-out.
- B. The Contractor unit price shall include full compensation for all labor, materials, and equipment setup, initial lateral cleaning, any additional pre-installation CCTV inspection performed in addition to pay items 37 through 34, as deemed necessary by the Contractor, post CCTV inspection, plugging and bypass pumping required for the complete installation of cured in place pipe (CIPP) lining and main/lateral connection system (4" - 6" dia.), in accordance with the specifications.

3.08 CURED IN PLACE PIPE (CIPP) SERVICE LATERAL LINING, BEYOND INITIAL 30 FEET -

Bid Item No. 36

- A. Payment for cured in place pipe (CIPP) lining beyond the initial 30 linear feet (4" - 6" dia.) be made at the Contractor's corresponding unit price per liner foot of additional liner length, installed and accepted, as determined by the Engineer, in accordance with the specifications.
- B. The Contractor unit price shall include full compensation for all labor, materials, and equipment setup, initial lateral cleaning, any additional pre-installation CCTV inspection performed in addition to pay items 37 through 34, as deemed necessary by the Contractor, post CCTV inspection, plugging and bypass pumping required for the complete installation of additional cured in place pipe (CIPP) lining (4" - 6" dia.), in accordance with the specifications.

3.09 CLEAN-OUT INSTALLATION, UP TO 5 FT. IN DEPTH - Bid Items No. 37, 38 & 39

- A. Payment for service lateral clean-out installation, up to 5 feet in depth shall be made at the Contractor's unit price for the various surface conditions, per each clean-out installed and accepted, as determined by the Engineer, in accordance with the specifications. Depth measurement shall be from the existing grade to the invert elevation of the service lateral at the point of the clean-out installation.
- B. The Contractor unit price shall include full compensation for all labor, materials, and equipment required for service lateral clean-out installation, including backfill, compaction and all necessary surface restoration, in accordance with the specifications.

3.10 CLEAN-OUT INSTALLATION, BEYOND 5 FT. IN DEPTH - Bid Item No. 40

- A. Payment for service lateral clean-out installation, beyond 5 feet in depth shall be made at the Contractor's unit

price per vertical foot in depth beyond the initial 5 foot clean-out installation cost. Depth measurement shall be from the existing grade to the invert elevation of the service lateral at the point of the clean-out installation.

- B. The Contractor unit price shall include full compensation for all labor, materials, and equipment required for service lateral clean-out installation beyond 5 feet in depth, in accordance with the specifications.

3.11 PRESSURE TEST, MAIN LINE JOINT - Bid Items No. 41, 42 & 43

- A. Payment for pressure testing of main line pipe joints, for the various pipe diameters, shall be made at the Contractor's unit price per each joint tested, in accordance with the specifications.
- B. The Contractor unit price shall include full compensation for all labor, materials, and equipment setup, initial line cleaning, plugging and bypass pumping required perform main line pipe joint pressure testing, in accordance with the specifications.

3.12 GROUT SEAL MAIN LINE JOINT - Bid Items No. 44, 45 & 46

- A. Payment for sealing main line pipe joints with chemical grout, for the various pipe diameters, shall be made at the Contractor's unit price per each joint sealed, in accordance with the specifications.
- B. The Contractor unit price shall include full compensation for all labor, materials, and equipment setup, initial line cleaning, plugging bypass pumping and all other work required to grout seal main line pipe joints, in accordance with the specifications. The Contractors unit price for main line joint grouting shall also include the cost of Warranty CCTV inspection.

3.13 GROUT SEAL SERVICE LATERAL CONNECTION - Bid Item No. 47

- A. Payment for grout sealing service laterals connections, from the main line, with chemical grout, for a minimum distance of 24 inches, shall be made at the Contractor's unit price per each lateral sealed, in accordance with the specifications.
- B. The Contractor unit price shall include full compensation for all labor, materials, and equipment setup, plugging and bypass pumping required to grout seal service lateral connections, in accordance with the specifications.

3.14 MOBILIZATION - Bid Items No. 48 & 49

- A. Payment for mobilization shall be made at the Contractor's unit price for mobilization for each task order issued, at the appropriate linear foot/lateral liner category price.
- B. The Contractor unit price shall include full compensation for mobilizing all necessary staff and equipment to perform the work specified in the task order.

3.15 MAINTENANCE OF TRAFFIC - Bid Items No. 50, 51 & 52

- A. Payment for maintenance of traffic shall be made at the Contractor's unit price per each day traffic maintenance is required, to perform the assigned work. Maintenance of traffic provisions must

conform to the requirements of the governmental agency having jurisdiction over the right-of-way.

- B. The Contractor unit price shall include full compensation for all labor, materials, and equipment required to setup, maintain and remove all necessary maintenance of traffic provisions, in accordance with the specifications.

3.16 WORK IN REAR EASEMENTS AND/OR AWAY FROM TRAVELWAYS - Bid Item No. 53

- A. Payment for work performed in rear easement areas and/or away from travel ways shall be made at the Contractor's unit price per each instance where work is necessary in these areas
- B. The Contractor unit price shall include full compensation for the additional cost, including all labor, materials, and equipment required to perform work assignments in rear easements and/or way from travelways.

3.17 SPECIALTY CLEANING - Bid Items No. 54, 55, 56, 57, & 58

Payment for initial, routine, line cleaning shall be included in the unit costs for the various rehabilitation methods. Specialty cleaning is defined as the removal of material and/or debris where the level of debris is greater than 20% of the pipe diameter, or when there is the presence of grease, roots, pre-existing liner system, tuberculation or other such materials that require special cleaning equipment. The unit price for specialty cleaning shall be inclusive of any additional equipment or resources necessary for the removal and disposal of such material, and shall be paid for the actual lineal feet cleaned.

- A. Payment for specialty cleaning, for the various pipe diameter ranges and categories, shall be made at the Contractor's corresponding unit price per linear foot of lines cleaned and accepted, as determined by the Engineer, in accordance with the specifications. Measurement shall be along the center line of the pipe for the actual length of pipe cleaned.
- B. The Contractor unit price shall include full compensation for all labor, materials, and equipment, setup, plugging and bypass pumping required for specialty cleaning, including removal and disposal of debris materials.

3.18 HAMMER TAP REMOVAL - Bid Item No. 59

- A. Payment for hammer tap removal shall be made at the Contractor's unit price per each hammer tap removed and accepted, as determined by the Engineer, in accordance with the specifications.
- B. The Contractor unit price shall include full compensation for all labor, materials, and equipment, setup, plugging and bypass pumping required to cut protruding hammer taps flush with the inside surface of the pipe and removal of all resulting debris.

3.19 LATERAL REINSTATEMENT AND GROUTING - Bid Item No. 60

- A. Payment for lateral reinstatement and grouting shall be made at the Contractor's unit price per each service lateral reinstated, grouted and accepted, as determined by the Engineer, in accordance with the specifications.
- B. The Contractor unit price shall include full compensation for all labor, materials, and equipment, setup, plugging and bypass pumping required to reinstate the the service lateral and seal the annular space between the liner and host pipe with chemical grout.

3.20 WARRANTY CLEANING AND CCTV INSPECTION - Bid Item No. 61

- A. Payment for warranty cleaning and CCTV inspection shall be made at the Contractor's corresponding unit price per linear foot of line cleaned and inspected, as determined by the Engineer, in accordance with the specifications. Measurement shall be along the center line of the pipe, from wall of manhole inlet to wall of manhole inlet.
- B. The Contractor unit price shall include full compensation for all labor, materials, and equipment, setup, plugging and bypass pumping required for warranty cleaning and CCTV inspection, including removal and disposal of debris materials.

END OF SECTION

SECTION 01045
EXECUTION OF WORK

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Contractor shall provide labor, materials, tools, equipment, and incidentals shown, specified, and required for execution of the Work as specified in this Section, including the following:
 - a. Construction Electronic Documentation
 - b. Demolition
 - c. Cutting and Coring
 - d. Patching
 - e. Installation
2. Requirements for demolition, removal and disposal of existing buildings, structures, pavement, curbs, and sidewalks and electrical, plumbing, heating and ventilation equipment and materials as indicated in the Contract Documents for demolition.
3. General requirements for installation of equipment and material. Additional installation requirements are included in the individual Specification Sections.
4. General requirements for connections to existing facilities.
 - a. To extent possible, materials, equipment, systems, piping, and appurtenances that will be placed into service upon completion of connection to existing facilities shall be checked, successfully tested, and in a condition for operation prior to making connections to existing facilities, if valves, gates, or similar watertight and gastight isolation devices are not provided at the connection point.
5. Requirements for cutting and coring, and rough and finish patching of holes and openings in existing construction. Provide cutting, coring, fitting, and patching, including attendant excavation and fill, required to complete the Work, and to:
 - a. Remove and replace defective Work;
 - b. Remove samples of installed Work as specified or required for testing;

- c. Remove construction required to perform required alterations or additions to existing work;
- d. Connect to completed Work not performed in proper sequence;
- e. Remove or relocate existing utilities and pipes that obstruct the Work in locations where connections must be made;
- f. Make connections or alterations to existing or new facilities.

1.02 REFERENCES

A. Definitions:

- 1. "Manufacturer's installation instructions" includes manufacturer's written instructions; drawings; illustrative, wiring and schematic diagrams; diagrams identifying external connections; and other such information pertaining to installation of equipment and materials. Installation instructions are printed instructions, including those attached to the equipment and materials, all inclusive.
- 2. "Salvage" items are equipment and materials scheduled for selective removal by the Contractor to furnish to the Owner. Contractor shall be responsible for removal, handling, and depositing of equipment and material to location designated by Owner.

B. Reference Standards:

- 1. 29 CFR 1910, OSHA.
- 2. ANSI A10.2, Safety Code for Building Construction

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

- 1. Review installation procedures under other Sections and coordinate Work that must be performed with or before the Work specified in this Section.
- 2. Notify other contractors in advance of Work for connections to existing facilities to prevent delay of the Work.
- 3. Contractor shall remove and dispose of equipment and materials indicated for demolition on the Contract Documents, unless indicated as salvage items for the Owner. Contractor shall obtain ownership of removed equipment and materials following Engineer and Owner approval. Disposal of equipment and materials shall be in accordance with the Contract Documents.

B. Sequencing:

1. Contractor shall remove and demolish equipment and materials in sequence specified in the Contract Documents and following approval by Engineer and Owner.
2. Contractor shall replace equipment and materials removed without proper authorization from Engineer, which are necessary for the operation of the existing facilities. Re-installation of equipment and materials shall be to the satisfaction of the Engineer at no cost to the Owner.

C. Title to Equipment and Materials:

1. Equipment and materials indicated for demolition and removal in the Contract Documents, and not designated as Owner's salvaged items, shall become the Contractor's property following removal from the Site. Contractor shall be responsible for legally disposing of the equipment and material.
2. Contractor shall have no right or title to any of the equipment, materials or other items to be removed until the elements have been removed from the Site.
3. Contractor shall not sell or assign, or attempt to sell or assign any interest in the equipment, materials or other items until removal from Site.
4. Contractor shall have no claim against the Owner because of the absence of equipment, fixtures and materials.

D. Salvage Equipment and Materials:

1. Contract Documents indicate equipment and materials that shall be retained by Owner. Owner has the right to request any demolished equipment and materials be retained at their discretion.
2. Contractor shall move salvaged equipment and materials to storage areas located at the Site as instructed by Owner.
3. Architectural equipment and materials may be salvaged for incorporation into the Work when approved by Engineer.

E. Use of Explosives: Contractor shall not use explosives or blasting equipment and material in the Work in accordance with the Contract Documents.

1.04 SUBMITTALS

A. Action/Informational Submittals:

1. Construction electronic documentation as specified in this Section.
2. Demolition Plan: Submit detailed description of methods, equipment, and sequence for demolition Work.

3. Cutting and Patching Request:

- a. Submit written request to Engineer, well in advance of executing cutting or alteration that affects one or more of the following:
 - 1) Design function or intent of Project.
 - 2) Work of Owner or other contractors.
 - 3) Structural value or integrity of an element of the Project.
 - 4) Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.
 - 5) Efficiency, operational life, maintenance, or safety of operational elements.
 - 6) Visual qualities of sight-exposed elements.
- b. Request shall include:
 - 1) Identification of Project and contract name and number.
 - 2) Description of affected Work of Contractor and work of others (if any).
 - 3) Necessity for cutting.
 - 4) Effect on work of Owner, other contractors (if any), and on structural or weatherproof integrity of Project.
 - 5) Description of proposed Work, describing: scope of cutting and patching; trades who will be executing the Work; products proposed to be used; extent of refinishing; schedule of operations; alternatives to cutting and patching, if any.
 - 6) Designation of entity responsible for cost of cutting and patching, when applicable.
 - 7) Written permission of other contractors (if any) whose work will be impacted.

4. Recommendation Regarding Cutting and Patching:

- a. Should conditions of work, or schedule, indicate a change of materials or methods, submit written recommendation to Engineer including:
 - 1) Conditions indicating change.
 - 2) Recommendations for alternative materials or methods.

- 3) Items required with substitution request, in accordance with the substitution request requirements of the Contract Documents.
5. Product Data: Submit manufacturer's product data for the protective compound to be applied to core-drilled surfaces and cut concrete surfaces.
6. Informational Submittal: Submit written indication designating the day and time that the construction associated with cutting and patching will be uncovered, to provide for observation. Do not begin cutting or patching operations until submittal is accepted by Engineer.
7. Comply with submittal requirements of individual Specification Sections for patching materials.

1.05 SITE CONDITIONS

- A. Owner does not assume responsibility for the actual condition of structures and equipment to be demolished and removed.
- B. Existing Site conditions shall be maintained to the greatest extent possible by the Owner to the time of Notice to Proceed.
- C. Contractor shall perform investigations, explorations, and probes as necessary at the Site prior to initiating demolition Work to ascertain any required protective measures before proceeding with demolition and removal. Contractor shall give particular attention to shoring and bracing requirements to prevent damage to the Work and existing structures.
- D. Contractor shall verify measurements, dimensions and other conditions of each existing structure, system, equipment and material indicated in the Contract Documents for new Work prior to ordering equipment and materials.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. General:
 1. Provide materials and products in accordance with the individual Specification Sections and the Contract Documents.
 2. Provide materials and products that visually match existing adjacent surfaces to fullest extent possible for exposed surfaces.
 3. If not indicated in the Contract Documents, provide materials and products that are identical to existing materials and products affected by the Work.

4. If identical materials and products are unavailable, provide materials and products that shall equal or exceed performance requirements of existing materials and products.
- B. Compound Applied to Core-Drilled Surfaces and Cut Concrete Surfaces:
1. Product and Manufacturer: Provide one of the following:
 - a. Sikagard 62, by Sika Corporation.
 - b. Or equal.

PART 3 – EXECUTION

3.01 CONSTRUCTION ELECTRONIC DOCUMENTATION

- A. Pre-Construction Documentation
1. Contractor shall provide photographic and video documentation of the Site where Work is being performed. Engineer and Owner reserve the right to be present during documentation.
 2. Contractor shall provide both photographic and video documentation at grade-level and aerial of the Site prior to commence Work.
 3. Contractor shall submit pre-construction documentation to Engineer and Owner for review. Contractor, Engineer, and Owner shall visit Site to field verify electronic documentation prior to commencing the Work. Site visit verification shall establish existing conditions prior to commencing Work.
- B. Construction Progress Documentation
1. Contractor shall document Work progress at locations and construction as directed by Engineer, at a minimum.
 2. Contractor shall provide electronic documentation prior to and following any shutdown, switchover, demolition, de-commissioning, cutting, patching, repair, etc. Engineer and Owner reserve the right to be present during documentation.
 3. Contractor shall document following exposure of buried utilities, piping, valve, appurtenance and other underground elements.
 4. Engineer reserves the right to provide construction progress documentation to confirm Contractor electronic documentation.
 5. Contractor shall provide photos with each Application for Payment.

6. Photographs shall be taken at locations that adequately illustrate the condition of construction and the state of progress.

C. Post-Construction Documentation

1. Contractor shall take photographic and video documentation of the Site where Work has been completed and prior to Substantial Completion or partial utilization by Owner. Engineer and Owner reserve the right to be present during documentation.
2. Contractor shall provide both photographic and video documentation at grade-level and aerial of the Site following completion of the Work.

D. Submittal Requirements:

1. Documentation shall be time stamped for verification, including date and time.
2. Documentation shall be organized in a logic manner, such as by structure, building, physical site location, etc. for easy of comparison.
3. Photographic documentation shall be high resolution electronic versions.
4. Documentation shall be submitted to Engineer for review and approval prior to commence Work and at completion of the Work.

3.02 DEMOLITION

A. General:

1. Demolition Work shall comply with the applicable provisions and recommendation of ANSI A10.2, Safety Code for Building Construction, all governing codes, and as specified in this Section.
2. Contractor shall furnish competent and experienced personnel for the various type of demolition and removal Work. Demolition and removal Work shall be performed with regard to the safety of Owner employees, individuals at the Site, and the public.
3. Contractor shall remove temporary work, such as enclosures, signs, guards, etc. when such temporary Work is no longer required or when directed at the completion of the Work.
4. Contractor shall perform patching, restoration and Work in accordance with individual Specification Sections and details shown on Contract drawings.
5. Contractor shall be responsible for damage caused by demolition Work to existing structures, equipment and materials indicated for reuse or to remain at no additional cost to Owner.

6. Contractor shall maintain a clean working environment during the demolition Work in accordance with Section 01740 – Cleaning and Waste Management.

B. Protection during Demolition:

1. Contractor shall provide, erect, and maintain catch platforms, lights, barriers, weather protection, warning signs and other items as required for proper protection of the public, occupants of the building, personnel engaged in demolition Work, and adjacent construction.
2. Contractor shall provide and maintain weather protection at exterior openings so as to fully protect the interior premises against damage from the elements until such openings are closed by the Work.
3. Contractor shall provide and maintain temporary protection of the existing structure designated to remain where demolition, removal and Work is being done, connections made, materials handled or equipment moved. Temporary protection shall be provided in accordance with Section 01530 – Protection of Work and Property.
4. Contractor shall take necessary precautions to prevent dust from rising by wetting demolished masonry, concrete, plaster and similar debris. Unaltered portions of the existing buildings affected by the operations in the Contract Documents shall be protected by dust proof partitions and other adequate means. Dust control shall be provided in accordance with Section 01560 – Temporary Controls.
5. Contractor shall provide adequate fire protection in accordance with Section 01510 – Temporary Utilities and authorities having jurisdiction.
6. Contractor shall perform the demolition Work with minimum traffic interference. Contractor shall not close or obstruct walkways, passageways, or stairways. Contractor shall not store or place materials in passageways, stairs or other means of egress.
7. Contractor shall minimize disturbances to exterior walls and roofs to small sections that are readily repaired and patched to maintain watertight conditions in existing structures and buildings.

C. Performance of Demolition:

1. Equipment, piping, valves and appurtenances:
 - a. Contractor shall drain equipment, piping, valves, and appurtenances prior to demolition Work. Contractor shall be responsible for collection, transport, and disposal of drained contents at no additional cost to the Owner.
 - b. Contractor shall provide line stops, plugs, blind flanges, etc. for equipment, piping, valves and appurtenance required to remain in service during the

Project. Contractor shall provide temporary or permanent supports in accordance with the Contract Documents.

- c. Supports, pedestals and anchors shall be removed with the equipment and piping unless otherwise noted in the Contract Documents.
- d. Concrete bases, anchor bolts and other supports shall be removed to approximately 1 inch below the surrounding finished area and the recesses shall be patched to match the adjacent areas.
- e. Wall and roof openings shall be closed, and damaged surfaces shall be patched to match the adjacent areas, in accordance with the Contract Documents and as directed by the Engineer.
- f. Wall sleeves, wall pipes, and wall castings shall be plugged or blanked off in accordance with the Contract Documents and as directed by the Engineer.
- g. Openings in concrete shall be closed in accordance with the Contract Documents and as directed by the Engineer.

2. Electrical components and equipment:

- a. Contractor shall de-energize panelboards, lighting fixtures, switches, circuit breakers, electrical conduits, motors, limit switches, pressure switches, instrumentation such as flow, level and/or other meters, wiring, and similar electrical equipment prior to removal.
- b. Contractor shall relocate or isolate electrical equipment and materials that serve equipment, piping, valves and appurtenance that are to remain in service during the Project.

3. Reused and relocated equipment:

- a. Contractor shall receive approval from Engineer prior to removal and relocation of equipment and material. Equipment and materials removed by Contractor prior to Engineer's approval that is required for Owner's operation of the facility shall be reinstalled at no cost to the Owner.
- b. Prior to removal and relocation Work, equipment and materials indicated for reuse and relocation shall be operated by Owner with Contractor and Engineer present to witness existing functionality and operation.
- c. Contractor shall provide personnel responsible for reinstallation of equipment and material for the removal Work.
- d. Contractor shall be responsible and provide storage and protection of equipment and materials in accordance with Section 01660 – Product

Storage and Protection Requirements until relocation and reinstallation Work is performed.

- e. Contractor shall provide replacement equipment and material that is damaged during the removal Work at no cost to the Owner. Contractor shall be responsible to provide same type, model, electrical components, etc. equipment and material as approved by Engineer and Owner.

4. Structural removal:

- a. Contractor shall provide and install temporary shoring, struts, and bracing required for the demolition Work for structural materials.
- b. Contractor shall cut and remove structural material at the interface of demolition Work and the existing structural element. Cutting and removal shall occur in small sections, including masonry units, to prevent instability of structural elements.
- c. Contractor shall patch, repair, and refinish adjacent surfaces that remain following demolition Work.
 - 1) Adjacent surfaces shall be repaired and refinished to the condition prior to the demolition Work and in accordance with the Contract Documents.
 - 2) Adjacent surfaces shall be cleaned of dirt, grease, loose paint, etc., prior to refinishing.
- d. Contractor shall limit cutting of existing roof areas designated to remain to the limits required for the proper installation of the Work.
 - 1) Cut and remove insulation, joists, flashing, membranes, shingles, and metals, etc. in accordance with the Contract Documents and as directed by the Engineer for installation of the Work.
 - 2) Provide temporary weather tight protection as required until new roofing and flashings are installed.

5. Architectural repairs and removal Work, not specifically shown on the Drawings, may include, but not limited to, the following:

- a. Brickwork: Re-pointing; removing and replacing broken, cracked, disintegrating and missing materials.
- b. Windows: Removing cracked or disintegrating sealant material; replacing missing or broken glass; re-caulking and sealing frames; glazing sealants.

- c. Re-finishing: Removing rust, sealing or peeling paint from surfaces by scraping, sanding or wire brushing; priming and repainting surfaces.
- d. Roofing: Patching and repairing membrane or built-up roofing; metal flashing repair; correcting roof pitch to eliminate ponding; cleaning and/or replacing roof drains.
- e. Masonry: Cutting and installing new expansion and control joints.
- f. Parapets: Removing and construction of new walls and copings; clean and patching of copings; replacing copings where broken.
- g. Concrete surfaces: Patching, cleaning, sealing and resurfacing floors, walls, lintels, sills and trim. Replace lintels where broken. Patching or replacing broken, spalled, cracked and disintegrating concrete encased steel columns and piers.
- h. Openings: Cutting and modifying as required for new Work. Provide new lintels, doors and frames.
- i. Doors: Patching and refinishing doors and frames.
- j. Ceilings: Patching, refinishing and replacing.
- k. Guards, handrails and appurtenances: Cleaning and repainting steel materials. Replacing steel material with new aluminum material.
- l. Demolished Exterior Openings: Remove window sash, frame, sill, stool and trim at exterior doors indicated for enclosure and sealing. Provide brick and/or masonry block for closure and sealing.

D. Maintenance during Demolition:

- 1. Contractor shall maintain the buildings, structures and public properties free from accumulations of waste, debris and rubbish, generated by the demolition Work.
- 2. Contractor shall provide cleaning and waste management of demolition equipment and materials in accordance with Section 01740 – Cleaning and Waste Management.

3.03 CUTTING AND CORING

A. General:

- 1. Contractor shall notify Engineer in writing and receiving Engineer's approval prior to cutting load bearing walls (concrete or masonry) and structural concrete floors.
- 2. Perform cutting and coring to limit extent of patching required.

3. Structural Elements: Do not cut or core structural elements in manner that would change structural element's load-carrying capacity as load deflection ratio.
4. Operating Elements: Do not cut or core operating elements in manner that would reduce capacity to perform as intended. Do not cut or core operating elements or related components in manner that would increase maintenance requirements or decrease operational life or safety.
5. Replace, patch, and repair materials and surfaces cut or damaged during cutting and coring Work, Contractor shall use methods that do not void required or existing warranties.
6. Provide temporary or permanent bypass provisions prior to cutting existing pipe, conduit, ductwork, or other utilities serving facilities scheduled to be removed or relocated in accordance with the Contract Documents.
7. Inspection: Examine and prepare surfaces prior to commencing Work. Contractor shall report unsatisfactory or questionable conditions to Engineer in writing. Contractor shall not proceed with the Work until unsatisfactory conditions are corrected.
8. Preparation:
 - a. Provide temporary support required to maintain structural integrity, to protect adjacent Work from damage, and to support the element(s) to be cut or cored.
 - b. Protection of Existing Construction During Cutting and Coring:
 - 1) Protect existing structures, equipment, and materials during cutting and coring to prevent damage.
 - 2) Provide protection from adverse weather conditions that will be exposed during cutting and coring Work.
 - 3) Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
9. Restoration:
 - a. Clean equipment, materials, piping systems, valves, conduit and appurtenances that were damaged due to the Work prior to applying paint or other finishing materials.
 - b. Restore damaged pipe coverings, including insulation, to original condition.

B. Cutting:

1. General:

- a. Cut existing structures and appurtenances that provide surfaces for installation or repair of the Work. Cut existing construction using methods to minimize damage and disturbance to retained and adjoining construction elements.
 - b. Cutting equipment used shall be hand or small power tools suitable for sawing or grinding. Avoid using hammering or chopping equipment for cutting Work.
 - c. Cut holes and slots as small as possible and to size required for incorporation of the Work and in accordance with the Contract Documents.
 - d. Cut or drill from exposed or finished side to concealed side to avoid marring finished surfaces.
 - e. Provide adequate bracing of area to be cut prior to cutting.
 - f. Provide equipment and material to remove cut spoils.
 - g. Provide temporary protection for cut openings where and when Work is not being performed.
2. Concrete and Masonry:
- a. Cut through concrete and masonry using concrete wall saw with diamond saw blades.
 - b. Provide control for slurry generated during sawing on both sides of element being cut.
 - c. After cutting concrete and before installing new Work on or through the opening, coat exposed concrete and steel with protective coating material specified in this Section. Apply protective coating in accordance with manufacturer's instructions.

C. Coring:

- 1. Core-drill holes through concrete and masonry walls, slabs, or arches, in accordance with the Contract Documents, unless written authorization is furnished by Engineer.
- 2. Protection: Protect existing structures, equipment, materials, utilities, and adjacent areas from water and other damage by core-drilling Work.
- 3. Coring:
 - a. Perform coring with non-impact rotary tool using diamond core-drills.

- b. Size holes for pipe, conduit, sleeves, equipment or mechanical seals, as required, to be installed through the penetration and in accordance with the Contract Documents.
 - c. After core-drilling and before installing equipment and material through the penetration, coat exposed concrete and steel with protective coating material specified in this Section. Apply protective coating in accordance with manufacturer's instructions.
- 4. Cleaning: Vacuum or otherwise remove slurry and tailings from the work area following core-drilling.

3.04 PATCHING

A. General:

- 1. Construction shall be patched by filling, repairing, refinishing, closing-up, and similar methods at completion of the Work.
- 2. Provide equipment and materials in accordance with the Contract Documents for patching Work. Comply with manufacturer's installation instructions.
- 3. Provide airtight connections to pipes, sleeves, ducts, conduit, and other penetrations through surfaces when patching the Work. Provide durable patching seams that minimize visual appearance.
- 4. Patched areas shall be tested to demonstrate integrity of installation as directed by the Engineer. Contractor shall provide testing equipment, material and services for patch testing.

B. Restoration:

- 1. Restore exposed finishes of patched areas to minimize evidence of patching and refinishing.
- 2. Contractor shall extend refinishing and restoration into adjoining areas to blend patched areas with existing adjacent areas.
 - a. Refinish to nearest intersection for continuous surfaces.
 - b. Refinish the entire assembly and system for equipment and materials.
 - c. Repair and rehang existing ceilings to provide an even-plane surface of uniform appearance.
 - d. Apply plaster and finishes to match adjacent interior walls and partition areas for openings sealed with brick and/or masonry block.

3.05 INSTALLATION

- A. Install equipment and materials in accordance with the Contract Documents, approved Shop Drawings, and manufacturer's installation instructions. When manufacturer's installation instructions conflict with the Contract Documents, obtain interpretation or clarification from Engineer before proceeding.
- B. Preparation of surfaces shall be performed prior to installation of equipment and material.
 - 1. New floor finishes: Repair and patch with concrete, asphalt latex type emulsion and underlayment as required for existing surfaces or new flooring surface.
 - 2. Ceramic tile flooring or bases installed over concrete floors: Grind away cove, if present, for installation of new Work.
- C. Concrete surfaces shall achieve compression strength in accordance with the Contract Documents prior to installation of equipment and materials.
 - 1. Anchor bolts and templates shall be provided by Contractor and as specified in the individual Specification Sections.
 - 2. Concrete foundations shall be treated with sealer to prevent oil from seeping into concrete as specified in the individual Specification Sections.
- D. Maintain the work area in a broom-clean condition while installing materials and equipment.
- E. Contractor shall be responsible for equipment for hoisting, lifting, moving, rigging, etc. for installation of equipment and materials.
 - 1. Contractor shall be responsible for design of temporary installation system used for the installation Work, unless otherwise indicated in the Contract Documents.
 - 2. Contractor shall be responsible for damage to existing structure, equipment, and material caused prior, during, and following installation of the Work with the Contractor furnished temporary installation system at no cost to Owner. Repairs shall be in accordance with the Contract Documents, shall return to condition prior to installation Work, and as directed by the Engineer.
 - 3. Owner's hoists, monorails, bridge cranes, rigging, etc. shall not be used by the Contractor unless written authorization is provided by Owner.
- F. Alteration or repair of new equipment and materials shall not be permitted without written authorization from Engineer.
- G. Field welding or burning of new equipment and materials shall not be permitted unless indicated in the Contract Documents or without written authorization from Engineer.

- H. Contractors shall install temporary shoring and bracing where necessary during installation of the Work where required:
1. System shall be provided in accordance with the Contract Documents and code requirements.
 2. Temporary system shall consist of adjustable sound timbers or rolled shapes easily removable following installation of the Work.
 3. Contractor shall be responsible for damage to existing structures and new Work during installation, utilization, and removal of the temporary system at new additional cost to the Owner.
- I. Manufacturer's Installation Services: Provide competent, qualified manufacturer's representatives of equipment and material for services specified in the individual Specification Sections, including, but not limited to:
1. Supervising installation
 2. Checking the completed installation
 3. Adjusting and testing of equipment and materials
 4. Instructing Owner's operations and maintenance

[END OF SECTION]

SECTION 01050
FIELD ENGINEERING

PART 1 – GENERAL

1.01 SUMMARY

- A. Contractor shall provide field engineering and professional services of the types indicated for the Project, including:
1. Furnishing civil, structural, and other professional engineering services specified or required to execute Contractor's construction methods.
 2. Developing and making all detail surveys and measurements required for construction.
 3. Keeping a transit, theodolite, or total station (theodolite with electronic distance measurement device); leveling instrument; and related implements such as survey rods and other measurement devices, at the Site at all times, and having a skilled instrument person available when necessary for laying out the Work.
 4. Being solely responsible for all locations, dimensions and levels. No data other than Change Order or Field Order shall justify departure from dimensions and levels required by the Contract Documents.
 5. Rectifying all Work improperly installed because of not maintaining, not protecting, or removing without authorization established reference points, stakes, marks, and monuments.
 6. Providing such facilities and assistance necessary for Engineer to check lines and grade points placed by Contractor.
- B. Related Sections:
1. Section 01782 – Project Record Documents.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Departures from Contract Drawings:
1. Contract Drawings show the extent and arrangement of the Work.
 2. Contractor shall notify Engineer of departures from the Drawings that the Contractor deems required for incorporation of the Work at the Site.
 3. Contractor shall provide field engineering services for equipment and materials that require modifications to existing structures, auxiliary equipment, piping,

electrical controls that are not indicated for modifications in the Contract Documents.

1.03 SERVICES AND RESPONSIBILITIES

A. Contractor's Field Engineer:

1. Contractor shall employ and retain field engineer at the Site capable of performing field engineering tasks required, including:
 - a. Provide reports to Engineer on the Work.
 - b. Check formwork, reinforcing, inserts, structural steel, bolts, sleeves, piping and other equipment and materials for conformance with Contract Documents.
 - c. Maintain field office files and drawings, record documents, and coordination with Subcontractors.
 - d. Prepare layout and coordination drawings for construction operations.
 - e. Check and coordinate Work for conflicts, interferences, and discrepancies with notification to Engineer.
 - f. Cooperate with Engineer and Owner in observing the Work and field inspections.
 - g. Review and coordinate the Work with Shop Drawings and other submittals.

B. Contractor's Surveyor:

1. Contractor shall employ or retain the services of a licensed surveyor registered in the State of Florida with experience and capability of performing surveying and layout tasks required in the Contract Documents and as required for the Work. Surveyor's tasks include, but are not necessarily limited to, the following:
 - a. Providing required surveying equipment, including transit or theodolite, level, stakes, and surveying accessories.
 - b. Establishing required lines for constructing all facilities, structures, pipelines, and site improvements.
 - c. Preparing and maintaining professional-quality, accurate, well organized, legible notes of all measurements and calculations made while surveying and laying out the Work.
 - d. Complying with requirements of the Contract Documents relative to surveying and related work.

1.04 SUBMITTALS

A. Action/Informational Submittals:

1. Surveying:
 - a. Plan for conducting survey Work, submitted ten days prior to beginning of survey Work.
 - b. Field books after completing survey Work.
 - c. Certified survey in accordance with this Section.
2. Certificates: Signed Contractor or Contractor's surveyor certifying elevations and locations of Work are in conformance with Contract Documents, with explanations of deviations.
3. Qualification Statements: Contractor's surveyor.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 SURVEYING

- A. Contractor shall establish baselines for location of equipment, materials and structures of the Work with bench marks and batter boards adjacent to Work.
- B. Contractor shall provide detailed surveys necessary for the Work including, but not limited to, slope stakes, batter boards, working points, lines and elevations.
- C. Specific surveying:
 1. Contractor shall have weirs surveyed by professional, licensed surveyor.
 2. Contractor shall adjust weirs within a tolerance of +/- 0.05-inches of elevations shown on the Contract Documents.
 3. Surveyed points for weirs shall be no greater than 10-feet spacing, and no less than two points per section of weir plate.

3.02 CLOSEOUT ACTIVITIES

- A. Contractor shall provide Project record documents for field engineering and surveying in accordance with Section 01782 – Project Record Documents.

- B. Contractor shall provide certified weir elevation survey report in accordance with the requirements specified in this Section.

3.03 PROTECTION

- A. Contractor shall preserve and protect benchmarks, reference points and stakes. Contractor shall re-establish damaged, destroyed, or lost bench marks, reference points and stakes. Contractor shall remove and re-install equipment and material installed based on Contractor established bench marks, reference points and stakes that have been damaged, destroyed, or lost at no additional cost to Owner.
- B. Contractor shall preserve and protect existing and new control points, property markers and monuments during construction of the Work. Contractor shall establish and replace damaged or lost control points, property markers and monuments due to Contractor's construction activities at no cost to the Owner. Contractor shall provide computations and calculations to establish location of replacement Work.

[END OF SECTION]

SECTION 01090
REFERENCES

PART 1 – GENERAL

1.01 SUMMARY

- A. Definitions and terminology applicable to all the Contract Documents are included in the General Conditions.

1.02 REFERENCES

- A. Abbreviations and Acronyms: Common abbreviations that may be found in the Contract Documents are listed below:

alternating current	a-c
ampere	A
Architectural Barriers Act	ABA
Americans with Disabilities Act	ADA
Americans with Disabilities Act Accessibility Guidelines	ADAAG
ante meridian	a.m.
average	avg
biochemical oxygen demand	BOD
brake horsepower	bhp
British thermal unit	Btu
Centigrade (or Celsius)	C
chlorinated polyvinyl chloride	CPVC
Code of Federal Regulations	CFR
cubic inch	cu in
cubic foot	cu ft
cubic yard	cdu yd, or CY
cubic feet per minute	cfm
cubic feet per second	cfs
degree Centigrade (or Celsius)	degrees C or °C

degrees Fahrenheit	degrees F or °F
dry film thickness	dft
diameter	dia
direct current	d-c
dollars	\$
each	ea
efficiency	eff
Fahrenheit	F
feet	ft
feet per hour	fph
feet per minute	fpm
feet per second	fps
figure	Fig
flange	flg
foot-pound	ft-lb
gallon	gal
gallons per hour	gph
gallons per minute	gpm
gallons per second	gps
gram	g
grams per liter	g/L
Hertz	Hz
horsepower	hp or HP
hour	hr
human-machine interface	HMI
inch	in.
inches water gage	in. w.g.
inch-pound	in.-lb
inside diameter	ID

iron pipe size	IPS
thousand pounds	kips
thousand pounds per square inch	ksi
kilovolt-ampere	kva
kilowatt	kw
linear foot	lin ft or LF
liter	L
maximum	max
mercury	Hg
milligram	mg
milligrams per liter	mg/l or mg/L
milliliter	ml
millimeter	mm
million gallons per day	mgd or MGD
million gallons	MG
minimum	min
national pipe threads	NPT
net positive suction head	NPSH
net positive suction head available	NPSHA
net positive suction head required	NPSHR
nominal pipe size	NPS
number	no.
operator interface terminal	OIT
ounce	oz
ounce-force	ozf
outside diameter	OD
parts per hundred	pph
parts per million	ppm
parts per billion	ppb

polyvinyl chloride	PVC
post meridian	p.m.
pound	lb
pounds per square inch	psi
pounds per square inch absolute	psia
pounds per square inch gauge	psig
pounds per square foot	psf
process control system	PCS
programmable logic controller	PLC
revolutions per minute	rpm
second	sec
specific gravity	sp gr or SG
square	sq
square foot	sq ft or sf
square inch	sq in.
square yard	sq yd or SY
standard	std
standard cubic feet per minute	scfm
total dynamic head	TDH

B. Definitions: Terminology used in the Specifications includes:

1. "Indicated" refers to graphic representations, notes, or schedules on the Drawings, or to other paragraphs or schedules in the Specifications and similar locations in the Contract Documents.
2. "Shown", "noted", "scheduled", and "specified" are used to help the user locate the reference without limitation on the location.
3. "Installer", "applicator", or "erector" is Contractor or another entity engaged by Contractor, either as an employee or subcontractor, to perform a particular construction activity, including installation, erection, application or similar Work. Installers shall be experienced in the Work that installer is engaged to perform.
4. "Experienced", when used with the term "installer" means having successfully completed a minimum of five previous projects similar in size and scope to this

Project; being familiar with the special requirements indicated; being familiar with Laws and Regulations; and having complied with requirements of authorities having jurisdiction, and complying with requirements of the Supplier of the material or equipment being installed.

5. Trades: Use of a term such as “carpentry” does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as “carpenter”, unless otherwise indicated in the Contract Documents or required by Laws or Regulations. Such terminology also does not imply that specified requirements apply exclusively to trade personnel of the corresponding generic name.
6. “Assigned specialists” and similar terms: Certain Sections of the Specifications require that specific construction activities be performed by specialists recognized as experts in those operations. Engage said specialists for those activities, and their engagement is a requirement over which Contractor has no option. These requirements do not conflict with enforcement of building codes and other Laws and Regulations. Also, such requirements are not intended to interfere with local trade union jurisdictional settlements and similar conventions. Such assignments shall not relieve Contractor of responsibility for complying with the requirements of the Contract Documents.

C. Reference Standards:

1. Refer to General Conditions relative to reference standards and resolving discrepancies between reference standards and the Contract Documents. Provisions of reference standards are in effect in accordance with the Specifications.
2. Copies of Standards: Each entity engaged in the Work shall be familiar with reference standards applicable to its construction activity. Copies of applicable reference standards are not bound with the Contract Documents. Where reference standards are needed for a construction activity, obtain copies of standards from the publication source.
3. Abbreviations and Names: Where reference standards, specifications, codes, manuals, Laws or Regulations, or other published data of international, national, regional or local organizations are referred to in the Contract Documents, the organization issuing the standard may be referred to by their acronym or abbreviation only.
4. Following acronyms or abbreviations that may appear in the Contract Documents shall have the meanings indicated below. Listing is alphabetical by acronym.

AA	Aluminum Association
AABC	Associated Air Balance Council

AAMA	American Architectural Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ACIFS	American Cast Iron Flange Standards
ACS	American Chemical Society
ADC	Air Diffusion Council
ADSC	International Association of Foundation Drilling.
AEIC	Association of Edison Illuminating Companies
AF&PA	American Forest and Paper Association
ABMA	American Bearing Manufacturers Association (formerly Anti- Friction Bearing Manufacturers Association (AFBMA))
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AHDGA	American Hot Dip Galvanizers Association
AI	Asphalt Institute
AIA	American Institute of Architects
AIChE	American Institute of Chemical Engineers
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
ALSC	American Lumber Standards Committee
AMA	Acoustical Materials Association
AMCA	Air Movement and Control Association
AMP	National Association of Architectural Metal Manufacturers, Architectural Metal Products Division
ANSI	American National Standards Institute
APA	The Engineered Wood Association
API	American Petroleum Institute
APHA	American Public Health Association
AREA	American Railway Engineering Association
ARI	Air Conditioning and Refrigeration Institute

ASA	American Standards Association
ASAE	American Society of Agricultural Engineers
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASNT	American Society for Non-Destructive Testing
ASPA	American Sod Producers Association
ASQ	American Society for Quality
ASSE	American Society of Safety Engineers
ASTM	American Society for Testing and Materials
AWCI	Association of the Wall and Ceiling Industry
AWI	Architectural Woodwork Institute
AWPA	American Wood Protection Association
AWPI	American Wood Preservers Institute
AWS	American Welding Society
AWWA	American Water Works Association
BAAQMD	Bay Area Air Quality Management District
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Industry Association
BOCA	Building Officials and Code Administrators
CBMA	Certified Ballast Manufacturers Association
CDA	Copper Development Association
CEMA	Conveyor Equipment Manufacturers Association
CGA	Compressed Gas Association
CISCA	Ceilings and Interior Systems Construction Association
CISPI	Cast Iron Soil Pipe Institute
CLFMI	Chain Link Fence Manufacturers Institute
CMAA	Crane Manufacturers Association of America
CPSC	Consumer Product Safety Commission

CRSI	Concrete Reinforcing Steel Institute
CSI	Construction Specifications Institute
DIN	Deutsches Institut für Normung eV (German Institute for Standardization)
DIPRA	Ductile Iron Pipe Research Association
EJCDC	Engineers Joint Contract Documents Committee
EJMA	Expansion Joint Manufacturers Association, Inc.
ETL	Intertek Testing Services, Inc. (formerly ETL Testing Laboratories, Inc.)
FBC	Florida Building Code
FCC	Federal Communications Commission
FDEP	Florida Department of Environmental Protection
FDOT	Florida Department of Transportation
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FM	Factory Mutual (FM Global)
FRPI	Fiberglass Reinforced Plastics Institute
FS	Federal Specification
GA	Gypsum Association
GANA	Glass Association of North America
HEW	United States Department of Health, Education and Welfare
HI	Hydraulic Institute
HMI	Hoist Manufacturers Institute
HUD	United States Department of Housing and Urban Development
IBC	International Building Code
ICC	International Code Council
ICEA	Insulated Cable Engineers Association
IEEE	Institute of Electrical and Electronics Engineers
IESNA	Illuminating Engineering Society of North America
IFI	Industrial Fasteners Institute

IFCEA	Insulated Power Cable Engineers Association
IRI	Industrial Risk Insurers
ISA	Instrumentation, Systems, and Automation Society (formerly Instrument Society of America)
ISO	Insurance Services Office
IOS	International Organization for Standardization
LPI	Lightning Protection Institute
MIA	Marble Institute of America
ML/SFA	Metal Lath/Steel Framing Association
MS/MIL	Military Specifications
MSS	Manufacturers' Standardization Society
MMA	Monorail Manufacturers Association
NAAMM	National Association of Architectural Metal Manufacturers
NACE	National Association of Corrosion Engineers
NAPF	National Association of Pipe Fabricators, Inc.
NARUC	National Association of Regulatory Utilities Commissioners
NBHA	National Builders Hardware Association
NBS	United States Department of Commerce, National Bureau of Standards
NCMA	National Concrete Masonry Association
NEC	National Electric Code
NELMA	Northeastern Lumber Manufacturers' Association
NEMA	National Electrical Manufacturers Association
NESC	National Electrical Safety Code
NETA	International Electrical Testing Association
NFPA	National Fire Protection Association
NFRC	National Fenestration Rating Council
NGA	National Glass Association
NHLA	National Hardwood Lumber Association
NHPMA	Northern Hardwood and Pine Manufacturers Association
NIST	United States Department of Commerce, National Institute of Standards and Technology

NLGA	National Lumber Grades Authority
NRCA	National Roofing Contractors Association
NRMCA	National Ready Mixed Concrete Association
NSF	National Sanitation Foundation
NSSGA	National Stone, Sand, and Gravel Association
NTMA	National Terrazzo and Mosaic Association
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PCI	Precast/Prestressed Concrete Institute
PEI	Porcelain Enamel Institute
PFI	Pipe Fabrication Institute
PPI	Plastics Pipe Institute
PGMC	Primary Glass Manufacturers Council
PS	Product Standards Section, United States Department of Commerce
RCSC	Research Council on Structural Connections (part of AISC)
RMA	Rubber Manufacturers Association
SAE	Society of Automotive Engineers
SBCCI	Southern Building Code Congress International, Inc.
SCAQMD	Southern California Air Quality Management District
SCPRF	Structural Clay Products Research Foundation
SCTE	Society of Cable Telecommunications Engineers
SDI	Steel Deck Institute
SDI	Steel Door Institute
SIGMA	Sealed Insulating Glass Manufacturing Association
SJI	Steel Joist Institute
SMACNA	Sheet Metal and Air Conditioning Contractor's National Association
SPI	Society of the Plastics Industry
SPIB	Southern Pine Inspection Bureau
SSPC	Society for Protective Coatings

SWFWMD	Southwest Florida Water Management District
SWI	Steel Window Institute
TCNA	Tile Council of North America
TEMA	Tubular Exchanger Manufacturers Association
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance
UBC	Uniform Building Code
UL	Underwriters Laboratories, Inc.
USAB	United States Access Board
USDOE	United States Department of Energy
USEPA	United States Environmental Protection Agency
USGBC	United States Green Building Council
USGS	United States Geological Survey
USPHS	United States Public Health Service
WCLIB	West Coast Lumber Inspection Bureau
WCMA	Window Covering Manufacturers Association
WCMA	Wood Component Manufacturers Association
MDMA	Window and Door Manufacturers Association
WWEMA	Water and Wastewater Equipment Manufacturers Association
WWPA	Western Wood Products Association

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

[END OF SECTION]

SECTION 01200
PROJECT MEETINGS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Pre-Construction Meeting:
 - a. Purpose of conference is to designate responsible personnel, establish working relationships, discuss preliminary schedules submitted by Contractor, and review administrative and procedural requirements for the Project. Matters requiring coordination will be discussed and procedures for handling such matters will be established.
 - b. Date, Time and Location: Conference will be held after execution of the Contract and before Work starts at the Site. Owner will establish the date, time, and location of conference and notify the interested and involved parties. Pre-construction meeting shall be held within the 20-day period after the effective date of the agreement and no later than 10 days prior to on-site activities.
2. Progress Meetings:
 - a. Progress meetings will be held throughout the Project. Contractor shall attend each progress meeting prepared to discuss in detail all items on the agenda.
 - b. Engineer will preside at progress meetings and will prepare and distribute minutes of progress meetings to all meeting participants and others as requested.
 - c. Date, Time, and Location:
 - 1) Regular periodic meetings on a day and time agreeable to Owner, Engineer, and Contractor.
 - 2) Contractor's Field Office at the Site or other location mutually agreed upon by Owner, Contractor, and Engineer.
 - d. Additional meetings may be conducted as progress of Work requires at a mutually agreed date, time and location.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Pre-Construction Meeting:

1. Contractor shall provide pre-construction meeting submittals with sufficient number of copies for each attendee:
2. Required Attendees:
 - a. Contractor
 - 1) Project manager.
 - 2) Site superintendent.
 - 3) Safety representative.
 - 4) Major Subcontractors.
 - b. Owner.
 - c. Engineer.
 - d. Resident Project Representative (RPR).
 - e. Representatives of governmental or other regulatory agencies.
3. Contractor shall prepare and submit a health and safety plan, as specified in this Section prior to the pre-construction meeting.
4. Agenda, minimum:
 - a. Procedural requirements:
 - 1) Designation of responsible personnel
 - 2) Use of Site and Owner's requirements, including general regards for community relations
 - 3) Delivery of materials and equipment to the Site
 - 4) Safety and first aid procedures
 - 5) Confined space entry plan
 - 6) Security procedures
 - 7) Housekeeping procedures
 - b. Administrative requirements:

- 1) Distribution of Contract Documents.
 - 2) Shop Drawing submittal procedures.
 - 3) Maintaining record documents at the Site.
 - 4) Contract modification procedures
 - 5) Processing of Payment Application
- c. Site mobilization requirements:
- 1) Working hours, overtime, and holidays.
 - 2) Field offices, trailers, and staging areas.
 - 3) Temporary facilities and utilities, including usage and coordination.
 - 4) Temporary controls, such as sediment and erosion control, noise, dust, storm water, and other measures.
 - 5) Access to Site, access roads, and parking for construction vehicles.
 - 6) Protection of traffic and existing property, including site barriers and temporary fencing.
 - 7) Security
 - 8) Storage of materials and equipment.
 - 9) Reference points and benchmarks, surveys and layouts.
 - 10) Site maintenance during the project, including cleaning and removal of trash and debris.
 - 11) Site restoration.
- d. Schedules
- 1) Preliminary construction schedule
 - 2) Critical work sequencing
 - 3) Preliminary Shop Drawing submittal schedule
 - 4) Preliminary Schedule of Values

B. Progress Meetings:

1. Progress meetings frequency shall be conducted as specified in this Section, unless modified and agreed upon by Owner, Contractor, and Engineer. Additional meetings may be conducted as progress of Work requires.
2. Contractor shall provide submittals specified in this Section prior to each progress meeting.
3. Attendance:
 - a. Contractor, including project manager, site superintendent, safety representative, and representatives of Subcontractors and Suppliers as required.
 - b. Engineer, including project manager (or designated representative), Resident Project Representative (if any), others as required by Engineer.
 - c. Owner.
 - d. Subcontractors, only with Engineer's approval or request, as required in the agenda.
4. Agenda, minimum:
 - a. Review, comment, and amendment (if required) of minutes of previous progress meeting.
 - b. Review of progress since the previous progress meeting.
 - c. Planned progress through next 30 – 60 days.
 - d. Review of Progress Schedule
 - 1) Contract Times, including Milestones (if any)
 - 2) Critical path.
 - 3) Schedules for fabrication and delivery of materials and equipment.
 - 4) Corrective measures, if required.
 - e. Submittals:
 - 1) Review of status of critical submittals.
 - 2) Review revisions to schedule of submittals.
 - f. Contract Modifications:
 - 1) Requests for interpretation

- 2) Clarification notices
- 3) Field Orders
- 4) Proposal requests
- 5) Change Proposals
- 6) Change Orders.
- 7) Claims.
- g. Applications for progress payments.
- h. Problems, conflicts, and observations.
- i. Quality standards, testing, and inspections.
- j. Coordination between parties.
- k. Site management issues, including access, security, maintenance and protection of traffic, maintenance, cleaning, and other Site issues.
- l. Safety.
- m. Permits.
- n. Record documents status.
- o. Punch list status, as applicable.
- p. Other business.

1.03 SUBMITTALS

A. Pre-Construction Meeting Submittals:

- 1. Prior to the conference, submit the following preliminary schedules in accordance with the General Conditions:
 - 1) Progress schedule
 - 2) Schedule of submittals
 - 3) Schedule of values
- 2. Contractor's safety and first aid procedures.
- 3. Confined space entry plan (where applicable).

4. List of emergency contact information
- B. Progress Meeting Submittals:
1. List of Work accomplished since the previous progress meeting.
 2. Up-to-date Progress Schedule.
 3. Up-to-date Schedule of Submittals.
 4. Detailed “look-ahead” schedule of Work planned through the next progress meeting, with specific starting and ending dates for each activity, including shutdowns, deliveries of important materials and equipment, Milestones (if any), and important activities affecting the Owner, Project, and Site.
 5. When applicable, list of upcoming, planned time off (with dates) for personnel with significant roles on the Project, and the designated contact person in their absence.

1.04 EMERGENCY CONTACT INFORMATION

- A. Contractor shall provide list of emergency contact information for 24-hour use throughout the Project. Emergency contact information shall be updated and kept current throughout the Project. If personnel or contact information change, provide updated emergency contact information list at the next progress meeting.
- B. Contractor’s list of emergency contact information shall include:
1. Contractor’s project manager’s office, field office, cellular, and home telephone numbers.
 2. Contractor’s Site superintendent’s office, field office, cellular, and home telephone numbers.
 3. Contractor’s foreman’s field office, cellular (if available), and home telephone numbers.
 4. Major Subcontractors’ and Suppliers’ office, cellular, and home telephone numbers of project manager and foreman (when applicable).
- C. Additional Emergency Contact Information:
1. Owner’s Project Manager: office, cellular, and home telephone numbers.
 2. Owner’s central 24-hour emergency telephone number.
 3. Engineer’s office, cellular, and home telephone numbers.

4. Resident Project Representative's office, field office, cellular, and home telephone numbers.
5. Emergency telephone numbers, including: "Emergency: Dial 911", and seven-digit telephone numbers for the hospital, ambulance, police, and fire department nearest to the Site. Provide names of each of these institutions.
6. Other involved entities as applicable.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

[END OF SECTION]

SECTION 01310
CONSTRUCTION PROGRESS SCHEDULE

PART 1 – GENERAL

1.01 SUMMARY

- A. Contractor shall prepare and submit Progress Schedules and related documents in accordance with the General Conditions, as may be modified by the Supplementary Conditions, and this Section, unless otherwise accepted by Engineer.
 - 1. Maintain and update Progress Schedules and related documents.
 - 2. Progress Schedule shall be a Critical Path Method (CPM) Progress Schedule.
- B. Engineer's acceptance of the Progress Schedule or related documents, and comments or opinions concerning activities in the Progress Schedule and related documents shall not control independent judgment of Contractor concerning means, methods, techniques, sequences and procedures of construction, unless the associated means, method, technique, sequence, or procedure is directed by the Contract Documents. Contractor is solely responsible for complying with the Contract Times.

1.02 REFERENCES

- A. Definitions:
 - 1. Activity: An element of the construction work that has the following specific characteristics: consumes time, consumes resources, has a definable start and finish, is assignable, and is measurable.
 - 2. Constraint: An imposed date on the Progress Schedule or an imposed tie between Activities. The Contract Times are Constraints.
 - 3. CPM Progress Schedule: Computerized Progress Schedule in Critical Path Method (CPM) format which accounts for the entire Work, defines the interrelationships between elements of the Work, reflects the uncompleted Work, and indicates the sequence with which the Work has been completed, indicates the sequence in which uncompleted Work will be completed, and indicates the duration of each Activity.
 - 4. Critical Path: The continuous chain of Activities with the longest duration for completion within the Contract Times.
 - 5. Early Start: The earliest possible date an Activity can start according to the assigned relationships among Activities.

6. Early Finish: The earliest date an Activity can finish according to the assigned relationships among the Activities.
7. Late Finish: The latest date an Activity can finish without extending the Contract Times.
8. Late Start: The latest date an Activity can start without extending the Contract Times.
9. Float: The time difference between the calculated duration of the Activity chain and the Critical Path.
10. Total Float: The total number of days that an Activity (or chain of Activities) can be delayed without affecting the Contract Times.
11. Network Diagram: A time-scaled logic diagram depicting the durations and relationships of the Activities.
12. Work Areas, Area, or System: A logical breakdown of the Project elements or a group of Activities which, when collectively assembled, are readily identifiable on the Project (for example, yard piping, a structure or building, a treatment process, or other logical grouping).

1.03 ADMINISTRATIVE REQUIREMENTS

A. Initial Progress Schedule:

1. Type and Organization of Progress Schedules:
 - a. Prepare one Progress Schedule covering the entire Project using scheduling software that is acceptable to Engineer.
 - b. Sheet Size: 11" by 17", unless otherwise accepted by Engineer.
 - c. Time Scale: Indicate first date of each work week.
 - d. Activity Designations: Indicate title and related Specification Section number.
 - e. Organization:
 - 1) Indicate on the separate Schedule of Submittals dates for submitting and reviewing Shop Drawings, Samples, and other submittals.
 - 2) Group deliveries of materials and equipment into a separate sub-schedule that is part of the Progress Schedule.
 - 3) Group construction into Work Area sub-schedules (that are part of the Progress Schedule) by Activity.

- 4) Clearly indicate the Critical Path on the Progress Schedule.
- 5) Organize each Work Area sub-schedule by Specification Section number.

2. Preliminary Progress Schedule:

- a. Contractor shall submit to Engineer the preliminary Progress Schedule with associated Network Diagrams within 10 days after the Contract Times commence running on the effective date of the Agreement, or as otherwise required by the Contract Documents.
- b. Engineer will review schedules and return review copy within 10 days after receipt.
- c. If required, resubmit within seven days after return of review copy.
- d. Submit three copies of preliminary Progress Schedule and associated reports and schedule-related documents to accompany the preliminary Progress Schedule, in accordance with the Submittals Article of this Section.

3. Initial Acceptance of Progress Schedule:

- a. At least 10 days before submission of the first Application for Payment, Contractor shall schedule a conference at the Site for review of the preliminary Progress Schedule.
 - 1) Attendees shall include Contractor, Engineer, Owner, and others as required.
 - 2) Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the Progress Schedule and associated Network Diagram.
 - 3) Owner reserves the right to not make progress payment to Contractor until acceptable Progress Schedule, Network Diagram, and other reports and schedule-related documents required are submitted to Engineer.
- b. Submit three copies each of acceptable Progress Schedule with Network Diagram, reports, and other schedule-related documents required to accompany the initial acceptable Progress Schedule, in accordance with the Submittals Article of this Section.
- c. Initially-accepted Progress Schedule shall be identified as the baseline Progress Schedule.

B. Progress Schedule Updates:

1. Update the Progress Schedule each month. If during progress of the Work events develop that necessitate changes in the initially accepted Progress Schedule (i.e., baseline Progress Schedule), identify updated Progress Schedules sequentially as Progress Schedule Revision 1, 2, 3, and continuing in sequence as required.
2. The update to the Progress Schedule shall be based on retained logic. Progress override logic is not allowed.
3. Required scheduling software, and schedule organization, format, and content for updated Progress Schedules are identical to that required in this Section for initial Progress Schedules.
4. Submit to Engineer three hard copies of the updated Progress Schedule, Network Diagram, narrative report, and other schedule-related reports and documents required.
5. Submit updated Network Diagrams when revisions are proposed to the logic. Indicate in the narrative report delays that have occurred since the previous updated Progress Schedule. Engineer will not recommend payment by Owner of progress payments until updated Progress Schedule is received, reviewed, and accepted by Engineer. Payment for out-of-sequence Work is not allowed.

C. Distribution:

1. Distribute copies of the reviewed schedules to:
 - a. Job site file.
 - b. Subcontractors.
 - c. Other concerned parties.

1.04 NETWORK DIAGRAMS (PERT CHARTS)

A. General:

1. Contractor shall prepare and submit Network Diagrams, as generated using the scheduling software on paper of the size indicated for Progress Schedules in this Section.
2. Group Network Diagrams by Area and show the order and interdependence of Activities and sequence and quantities in which the Work will be accomplished.
3. Do not use match lines on Network Diagrams. Depict interrelationships to or from Activities outside the Area shown using an Activity symbol with Activity number and description.
4. In preparing Network Diagrams, comply with the basic concept of precedence diagramming method (PDM) network scheduling to show how start of a given

Activity depends on completion of preceding Activities, and how the Activity's completion may affect the start of subsequent Activities.

5. Level of schedule detail shall define the day-to-day Activities of the Work.

B. Content:

1. Clearly indicate the Critical Path and distinguish the Critical Path from other paths on the network.
2. Organize Network Diagrams by grouping into major Work Areas, including one for procurement of materials and equipment, and by specific Activity within each Area.
3. Logic diagrams shall include the following:
 - a. Activity number.
 - b. Activity description.
 - c. Activity duration (in work days).
 - d. Critical Path denoted.
 - e. Float for each Activity.
 - f. Activity or System designation.
 - g. Coded Area designation.
 - h. Responsibility code (e.g., each prime contractor and their respective Subcontractors, trade, operation, Suppliers, or other entity responsible for accomplishing an Activity).
 - i. Shift number (if more than one shift per day is to be employed).

C. Revisions:

1. When conditions develop that require revisions to logic or durations of the Network Diagram associated with the initially accepted Progress Schedule (i.e., baseline Progress Schedule), identify updates to the Network Diagram in the same manner required in this Section for Progress Schedule updates.
2. Revision of the logic or durations from the baseline Progress Schedule initially accepted by Engineer shall be submitted to Engineer for acceptance.
3. Incorporate into the Progress Schedule revisions to logic or duration accepted by Engineer and include in monthly narrative report both a description of revisions and listing of Activities affected by revisions.

4. Changes resulting from Change Orders and other additions or deletions, shall be fully incorporated into the Progress Schedule and Network Diagram on the first update after the associated Change Order is approved by Owner, including adjustments to the Contract Price.

1.05 TIME IMPACT ANALYSIS

A. General:

1. Prepare and submit a time impact analysis when one or more of the following occurs:
 - a. Change Order proposal is prepared
 - b. When delays are experienced.
2. Time impact analysis shall illustrate the influence of each Change Order or delay.
3. Each time impact analysis shall include a sketch (fragnet) demonstrating how Contractor proposes to incorporate the changes in the Project or, as applicable, delays into the Progress Schedule. Fragnet shall include all logic, and additions required as result of said Change Order or delay.
4. Fragnet shall show all CPM logic revisions for the Work associated with the Change Order or delay and its relationship to other Activities in the Network Diagram.
5. Timing of Time Impact Analysis:
 - a. Submit each time impact analysis within 7 days after the following, as applicable:
 - 1) Start of the delay.
 - 2) After the submittal of Change Order proposal to Engineer

B. Evaluation by Engineer and Acceptance:

1. Engineer's evaluation of each time impact analysis comprised of complete information will be completed in timely manner after Engineer's receipt. Changes in the Contract Times will be made only by Change Order.
2. When mutual agreement is reached between the parties, on effect of the change or delay in the Project, incorporate into the next Progress Schedule update the associated fragnets illustrating the influence of changes and delays.

1.06 RECOVERY SCHEDULES

A. General:

1. When updated Progress Schedule indicates that the ability to comply with the Contract Times falls 30 or more days behind schedule, and there is no excusable delay, Change Order, or Work Change Directive to support an extension of the Contract Times, Contractor shall prepare and submit a recovery Progress Schedule demonstrating Contractor's plan to accelerate the Project to achieve compliance with the Contract Times (i.e., "recovery" schedule) for Engineer's acceptance.
2. Submit recovery schedule within 14 days after submittal of updated Progress Schedule where need for recovery schedule is indicated.

B. Implementation of Recovery Schedule:

1. At no additional cost to Owner, Contractor shall do one or more of the following:
 - a. Furnish additional labor and construction equipment
 - b. Employ additional work shifts
 - c. Expedite procurement of materials and equipment to be incorporated into the Work
 - d. Other measures necessary to complete the Work within the Contract Times.
2. Upon acceptance of recovery schedule by Engineer, incorporate recovery schedule into the next Progress Schedule update.

- C. Lack of Action:** Contractor's refusal, failure or neglect to submit a recovery schedule, shall constitute reasonable evidence that Contractor is not prosecuting the Work or separable part thereof with the diligence that will ensure completion within the Contract Times. Such lack of action shall constitute sufficient basis for Owner to exercise remedies available to Owner under the Contract Documents

1.07 USE OF FLOAT

- A. Total Float and Contract Float belong to the Project and may be used by Owner, Engineer, or Contractor to accommodate modifications, regardless of origination, in the Work or to mitigate the effect of events that may delay performance or completion of the Work.
- B. Changes or delays that influence scheduled Work Activities with Float and that do not extend the critical path will not be justification for an extension in Contract Times.

1.08 SUBMITTALS

A. Action/Informational Submittals:

1. Initial Progress Schedules:

- a. Preliminary Progress Schedule with associated Network Diagrams.
 - b. Acceptable Progress Schedule with associated Network Diagrams.
2. Progress Schedule Updates:
- a. Progress Schedule updates shall comply with requirements of this Section, and shall include updated Progress Schedule, updated Network Diagram when relationships among Activities are changed.
 - b. Submit updated Progress Schedule at each progress meeting. If a Progress Schedule remains unchanged from one progress meeting to the next, submit a written statement to that effect.
3. Time Impact Analyses: Submit in accordance with this Section.
4. Recovery Schedule: Submit in accordance with this Section.
5. Qualifications: Progress Schedule preparer, and other personnel that will assist Progress Schedule preparer in preparing and maintaining the Progress Schedule.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

[END OF SECTION]

SECTION 01370
SCHEDULE OF VALUES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. General requirements for preliminary and final Schedule of Values.
2. Schedule of Values and the Progress Schedule updates specified in Section 01310 – Construction Progress Schedules, shall be basis for preparing each Application for Payment. Schedule of Values may be used as a basis for negotiating price of changes, if any, in the Work.

1.02 ADMINISTRATIVE REQUIREMENTS

A. General Requirements:

1. Schedule of Values shall include breakdown of costs for materials and equipment, installation, and other costs used in preparing the Bid by Contractor and each Subcontractor. List purchase and delivery costs for materials and equipment for which Contractor may apply for payment as stored materials.
2. Include separate amounts for each Specification Section in the Contract Documents by structure, building, and work area.
3. Identify each line item with number corresponding to the associated Specification Section number. List sub-items of major products or systems, as appropriate or when requested by Engineer.
4. Include in Schedule of Values unit price payment items with their associated quantity. Provide in the Schedule of Values detailed breakdown of unit prices when required by Engineer.
5. Include in Schedule of Values itemized list of Work for each major part of the Contract, for each payment item.
6. Sum of individual values shown on the Schedule of Values shall equal the total of associated payment item. Sum of payment item totals in the Schedule of Values shall equal the Contract Price.

B. Specific Requirements:

1. Include in each line item a directly proportional amount of Contractor's overhead and profit. Do not include overhead and profit as separate item(s).

2. Include separate line item for each allowance, and for each unit price item
3. Include line item for bonds and insurance in amount not exceeding two percent of the Contract Price. This may be applied for in the first Application for Payment.
4. Include items for the General Conditions, permits (when applicable), construction Progress Schedule, and other items required by Engineer. Include such items in Applications for Payment on schedule accepted by Engineer
5. Line items for Site maintenance such as dust control, snow removal, compliance with storm water pollution prevention plans and permits, spill prevention control and countermeasures plans, and for construction photographic documentation; temporary utilities and temporary facilities, field offices, temporary controls, field engineering, and similar Work shall be included in the Schedule of Values and proportioned in Applications for Payment throughout duration of the Work.
6. Include separate line items under each appropriate payment item for mobilization and demobilization. Document for Engineer the activities included in mobilization and demobilization line items.
 - a. Mobilization will be limited to two percent of the Contract Price, and will be paid in two payments, each of 50 percent of total amount for mobilization.
 - b. Demobilization shall be at least one percent of the Contract Price and shall be included with the Application for Payment following Substantial Completion, or other schedule accepted by Engineer.
7. Costs for submittals, operations and maintenance manuals, field testing, and training of operations and maintenance personnel shall be as follows, unless otherwise accepted by Engineer:
 - a. Up to three percent of total cost of each item (including overhead and profit), including materials and equipment, and installation, may be apportioned to testing and included in the Application for Payment following Engineer's acceptance of the associated written Site testing report(s).
8. Sub-schedule of Unit Material Values:
 - a. Submit a sub-schedule of unit costs and quantities for products specified under a unit cost allowance and for products on which progress payments will be requested for stored products.
 - b. The form of submittal shall parallel that of the Schedule of Values, with each item identified using the same corresponding line item in the Schedule of Values.
 - c. The unit quantity for bulk materials shall include an allowance for normal waste.

- d. The unit values for the materials shall be broken down into:
 - 1) Cost of the material, delivered and unloaded at the site, with taxes paid.
 - 2) Installation costs, including Contractor's overhead and profit.
 - e. The installed unit value multiplied by the quantity listed shall equal the cost of that item in the Schedule of Values.
- C. Preliminary Schedule of Values: Submit preliminary Schedule of Values to Engineer for initial review. Contractor shall incorporate Engineer's comments into the Schedule of Values and resubmit to Engineer. Engineer may require corrections and re-submittals until Schedule of Values is acceptable.
- D. Time Frame for Submittals:
- 1. Submit preliminary Schedule of Values within ten days of date that the Contract Times commence running in accordance with the Notice to Proceed, or as otherwise required by the Contract Documents.
 - 2. Submittal of the Schedule of Values shall be in accordance with the General Conditions. Engineer will not accept Applications for Payment without an acceptable Schedule of Values.
 - 3. When required by Engineer, promptly submit updated Schedule of Values to include cost breakdowns for changes in the Contract Price.

1.03 SUBMITTALS

- A. Submit the following:
- 1. Electronic pdf copy of preliminary Schedule of Values.
 - 2. Electronic pdf copy of final Schedule of Values.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

[END OF SECTION]

SECTION 01410
TESTING LABORATORY SERVICES

PART 1 – GENERAL

1.01 SUMMARY

- A. This specification addresses requirements for testing services specifically required to be provided by the Contractor. This section does not apply to any testing required to be provided by the Owner or Owner's representative.
- B. This section does not apply to any Special Inspections. Special Inspections cannot be provided by the Contractor in accordance with the governing Building Code.
- C. Contractor shall employ and pay for independent testing entity to perform specified services covered by this specification. Entity selected shall be subject to approval by Engineer.
- D. Inspection, sampling, and testing shall be as specified in the individual Specification Sections.
- E. Related Sections, but not limited to, the following:
 - 1. Section 02200 – Earthwork.
 - 2. Section 02640 – Utility Structures.
 - 3. Division 03 specifications.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Owner's Responsibilities:
 - 1. The Owner will authorize from the testing allowance the cost of one (1) series of initial tests only, on the area or item being evaluated. The Contractor shall pay for costs of additional testing as required due to improper performance of Work.
- B. Contractor's Responsibilities:
 - 1. Provide to laboratory representative samples of materials to be tested, in required quantities.
 - 2. Provide labor and facilities:
 - a. To provide access to the Work to be tested, and where required, to Suppliers' operations.

- b. To obtain and handle samples at the Site, in accordance with testing facility's procedures.
 - c. To facilitate inspections and tests.
 - d. For testing entity's exclusive use for storage and curing of test samples.
 - e. Forms for preparing concrete test beams and cylinders.
- 3. Notify testing entity and Engineer sufficiently in advance of operations to allow for assignment of personnel and scheduling of tests.
 - 4. When tests cannot be performed after such notice, reimburse Owner for laboratory personnel and travel expenses incurred due to Contractor's negligence.
 - 5. Arrange with testing entity and pay for additional services, sampling, and testing required for Contractor's convenience.
 - 6. Provide to testing entity the preliminary design mix proposed for concrete, and other material mixes that require testing by the testing laboratory.

C. Testing Entity's Responsibilities:

- 1. Cooperate with Contractor and Engineer and provide qualified personnel promptly when notified.
- 2. Perform specified inspections, sampling, and testing of materials and methods of construction; comply with applicable standards; ascertain compliance with requirements of the Contract Documents.
- 3. Promptly notify Engineer and Contractor of irregularities or deficiencies in the Work observed during performance of services.
- 4. Submit specified quantity of report copies of inspections and tests to Contractor and Engineer.
- 5. Perform additional tests and services as required to ensure compliance with the Contract Documents.

D. Limitations of Authority of Testing Laboratory

- 1. Laboratory is not authorized to release, revoke, alter, or enlarge on requirements of Contract Documents, approve or accept any portion of the Work, or perform any duties of the Contractor.

E. Report Requirements:

- 1. Electronic Submittal of testing reports.

2. Include the following information:
 - a. Date issued.
 - b. Project title, number, and name of the Site.
 - c. Testing laboratory name and address.
 - d. Name and signature of inspector or person obtaining samples.
 - e. Date of inspection or sampling.
 - f. Record of temperature and weather.
 - g. Date of test.
 - h. Identification of material or product tested and associated Specification Section.
 - i. Location in the Project.
 - j. Type of inspection or test.
 - k. Results of tests and observations regarding compliance with the Contract Documents.

1.03 SUBMITTALS

- A. Submit copies of material and product test reports where required by the Contract Documents and as requested by Engineer.
- B. Quality Assurance Submittals:
 1. Qualifications statement indicating experience and facilities for tests required under the Contract Documents.
 2. Copy of report of inspection of facilities during most recent NIST inspection tour. Include memorandum of remedies of deficiencies reported during inspection.
 3. Copy of certificate of calibration for each instrument or measuring device proposed for use, by accredited calibration agency.

1.04 QUALIFICATIONS

- A. Comply with applicable requirements of ASTM E329, Specification for Agencies Engaged in Construction Inspection and/or Testing.

- B. Laboratory shall be authorized to operate in the same State or Commonwealth as the Site. Where applicable, laboratory shall be certified by the authority having jurisdiction for the types of testing required.
- C. Testing equipment used by laboratory will be calibrated at maximum twelve month intervals by devices of accuracy traceable to either NIST's Standard Reference Materials (SRM), ISO 17025, General Requirements for the Competence of Testing and Calibration Laboratories, or certified by State, Commonwealth, or local bureau of weights and measures, or values of natural physical constants generally accepted in the engineering and scientific community.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

[END OF SECTION]

SECTION 01510
TEMPORARY UTILITIES

PART 1 – GENERAL

1.01 SUMMARY

A. Contractor shall provide temporary utilities required for the Project and to complete the Work.

1. Make arrangements with utility service companies for temporary services and obtain required permits and approvals for temporary utilities.
2. Pay utility service costs, including connection fees, required for the Work as needed.
3. Continuously maintain adequate utilities for all purposes during the Project, until removal of temporary utilities and temporary facilities. At minimum, provide and maintain temporary utilities through Substantial Completion and removal of temporary field offices and sheds.
4. Maintain, including cleaning, temporary utilities and continuously provide consumables as required.
5. Temporary utilities and temporary facilities shall be adequate for personnel using the Site and requirements of Project.
6. Provide temporary utilities and temporary facilities in compliance with Laws and Regulations and, when applicable, requirements of utility owners.

B. Provide the following temporary utilities:

1. Electricity and lighting.
2. Telephone and communications.
3. Heating.
4. Sanitary facilities.
5. Water service.
6. First-aid facilities.
7. Fire protection.

1.02 ADMINSTRATIVE REQUIREMENTS

A. Use of Owner's System:

1. Existing Utility Systems: Do not use systems in existing buildings or structures for temporary utilities without Owner's written permission and mutually acceptable basis agreed upon by the parties for proportionate sharing of costs between Owner and Contractor.
2. Use of Permanent Utility Systems Provided Under the Project:
 - a. Permanent lighting, water, heating, ventilating, and fire protection systems and first-aid facilities may be used to provide temporary utilities and temporary facilities if the following are met:
 - 1) Obtain Owner's written permission to use permanent systems.
 - 2) Permanent systems provided under this project that are to be used for temporary utilities or as temporary facilities shall have achieved Substantial Completion, including complete functionality of all controls, prior to their use by Contractor as temporary utilities/facilities.
 - 3) Contractor shall pay all costs while using permanent system, including operation, maintenance, replacement of consumables, and provide replacement parts.
 - b. Do not use the following permanent facilities:
 - 1) Telephone and communication facilities.
 - 2) Sanitary facilities.

1.03 SYSTEM DESCRIPTION

A. Electricity and lighting:

1. Contractor shall provide electrical and lighting service for construction field offices, sheds, storage containers, etc. and as required for the Work.
2. General 120/240 V service requirements:
 - a. Contractor shall provide 120/240 V, single phase, 3-wire temporary system for small power requirements and general lighting.
 - b. Contractor shall provide main disconnect, overcurrent protection, meter outlet, branch circuit breakers, and wiring for temporary service to the Contractor's field office service connections. Contractor shall provide equipment and appurtenances in accordance with electricity service provider and applicable standards and codes

- c. Contractor shall register the 120/240 V electrical service meter in the Contractor's name and shall be responsible for electrical charges at no additional cost to the Owner.
 - d. Contractor shall provide electrical service other than 120/240 V, single phase, 3-wire service as required for the Work at the Contractor's own expense.
- 3. General lighting requirements:
 - a. Contractor shall provide a minimum of 10 foot candles for enclosed and partially enclosed structures for performing the Work.
 - b. Contractor shall provide a night lighting circuit for security. Light intensity shall be a minimum of 2 foot candles.
 - c. In Engineer's field office, Contractor shall provide a minimum of 50 foot-candles at desk top height.
- 4. Contractor shall energize the electrical system 15-minutes prior to and following regular work day hours at the Site. Required from Monday through Friday, all inclusive.
- 5. Contractor shall energize the night lighting system at end of typical working day and de-energize at start of typical working day. System shall be continuously energized on Saturdays, Sundays, and holidays.
- 6. Contractor shall provide an independent grounding cable connected directly to the structure, building, and equipment for erection and fabrication by electrical welders. Grounding by adjacent conduit, piping, etc. shall be prohibited at the Site.
- 7. Contractor shall coordinate usage of temporary electrical system with Subcontractors, Suppliers, and Owner including the following:
 - a. Usage is suitable for 120V, single phase, 60 Hz operation with a maximum operating input of 1,500 volt-amperes.
 - b. One unit connected to a single outlet.
 - c. Restrict usage in case of overloading circuits to correct loading.
- B. Cellular mobile phones: Contractor shall provide cell phone for its operations at the Site and for summoning emergency medical assistance.
- C. Heating:
 - 1. Contractor shall provide temporary heating, ventilation coverings and enclosures necessary to protect the Work and materials against wetness and temperature damage, to dry out the Work, and to facilitate the Work in structures.

2. Equipment, fuel, materials, personnel and methods used shall be adequate to maintain critical installation temperatures and ventilation of Work at all times in areas where necessary to perform the Work.
3. Enclosed structures shall have a minimum temperature of 50°F, unless otherwise specified, where Work is performed.
4. Contractor shall provide sufficient heat to maintain a minimum temperature of 65°F before and during application of interior finishing, painting, coating, etc.
5. Contractor shall replace any Work damaged by dampness or insufficient/abnormal heating at no cost to the Owner.

D. Sanitary facilities:

1. Contractor shall provide suitably-enclosed chemical or self-contained toilets for Contractor's employees and visitors to the Site. Location of temporary toilets shall be acceptable to Owner and screened from public observation.
2. Facilities shall be maintained and provided in accordance with State or Commonwealth Labor Regulations and local ordinances. Contents shall be removed and disposed in accordance with local and state or commonwealth regulations as required.
3. Contractor shall be prohibited from committing nuisances within, on, or in the vicinity of the Site.

E. Water service:

1. Contractor shall provide temporary water service for the Work including for construction purposes, sanitary facilities, fire protection, field office, and cleaning purposes.
2. Where new water services are being installed as part of the project, the water service will be made available to after installation and acceptance, and with City's written approval. All City water shall be metered using a Pinellas-County approved flow meter and connected to a backflow preventor, where one does not exist.

F. First-aid facilities:

1. Contractor shall provide temporary first-aid stations at or immediately adjacent to the Site's major work areas. Contractor shall provide temporary first-aid stations inside its temporary field office. Locations of first-aid stations shall be determined by Contractor's safety representative.
2. Contractor shall provide list of emergency telephone numbers at each hardwired telephone at the Site. List shall be in accordance with the list of emergency contact information required in Section 01200 – Project Meetings.

G. Fire protection:

1. Contractor shall comply with NFPA 241, Safeguarding Building Construction, Alteration, and Demolition Operations, and requirements of fire marshals and authorities having jurisdiction at the Site.
2. Contractor shall provide temporary fire exits, fire extinguishers, hoses and safety devices as required by authorities having jurisdiction.
3. Contractor shall notify Engineer, Owner, and fire marshals in the event of fire at the Site including, but not limited to, fuel tanks and similar hazardous utilities and devices. Contractor shall cooperate with Owner of fuel tank and utilities to prevent occurrence of fire or explosion.
4. Contractor shall perform safety precautions and comply with fire marshal's instructions in the event of fire.

PART 2 – PRODUCTS

2.01 EQUIPMENT

- A. Materials and equipment for temporary systems may be new or used but shall be adequate for purposes intended and shall not create unsafe conditions and shall comply with Laws and Regulations.
- B. Provide required materials, equipment, and facilities, including piping, wiring, and controls.
- C. Electrical system requirements: System shall consist of wiring, switches, insulated supports, poles, fixtures, sockets, receptacles, lamps, guards, cutouts and fuses as required for completion of the Work.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Install temporary facilities in neat, orderly, manner, and make structurally, mechanically, and electrically sound throughout.
- B. Location of Temporary Utilities and Temporary Facilities:
 1. Locate temporary systems for proper function and service.
 2. Temporary systems shall not interfere with or provide hazards or nuisances to: the Work under this and other contracts, movement of personnel, traffic areas, materials handling, hoisting systems, storage areas, finishes, and work of utility companies.

3. Do not install temporary utilities on the ground, with the exception of temporary extension cords, hoses, and similar systems in place for short durations.
- C. Modify and extend temporary systems as required by progress of the Work.

3.02 MAINTENANCE

- A. Maintain temporary systems to provide safe, continuous service as required.
- B. Properly supervise operation of temporary systems:
1. Enforce compliance with Laws and Regulations.
 2. Enforce safe practices.
 3. Prevent abuse of services.
 4. Prevent nuisances and hazards caused by temporary systems and their use.
 5. Prevent damage to finishes.
 6. Ensure that temporary systems and equipment do not interrupt continuous progress of construction.
- C. At end of each work day, check temporary systems and verify that sufficient consumables are available to maintain operation until work is resumed at the Site. Provide additional consumables if the supply on hand is insufficient.
- D. Contractor shall replace broken and burned out lamps, blown fuses, and damaged wiring and appurtenances as required to maintain adequate and safe operating conditions.
- E. Contractor shall permit subcontractors and others at a mutually agreed arrangement to use temporary electrical system that meet the following requirements:
1. Equipment are suitable for 120 V, single phase, 60 Hz operation.
 2. Operating input does not exceed 1,500 volt-amperes.
 3. Single piece of equipment connected to one outlet.
 4. Contractor shall restrict use of equipment as required to prevent overloading circuits.

3.03 CLOSEOUT ACTIVITES

- A. Completely remove temporary utilities, facilities, equipment, and materials when no longer required. Repair damage caused by temporary systems and their removal and restore the Site to condition required by the Contract Documents; if restoration of damaged areas is not specified, restore to preconstruction condition.

- B. Contractor is responsible for and shall return to original condition those portions of permanent electric system used in completing the Work.
- C. Where temporary utilities are disconnected from existing utility, provide suitable, watertight or gastight (as applicable) cap or blind flange, as applicable, on service line, in accordance with requirements of utility owner.
- D. When permanent utilities and systems that were used for temporary utilities, upon Substantial Completion replace all consumables such as filters and light bulbs and parts used during the Work.

END OF SECTION

SECTION 01530
PROTECTION OF WORK AND PROPERTY

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Contractor shall be responsible for the preservation and protection of property adjacent to the work site against damage or injury as a result of his operations under this Contract. Any damage or injury occurring on account of any act, omission or neglect on the part of the Contractor shall be restored in a proper and satisfactory manner or replaced by and at the expense of the Contractor to an equal or superior condition than previously existed.
- B. Contractor shall comply promptly with such safety regulations as may be prescribed by the Owner or the local authorities having jurisdiction and shall, when so directed, properly correct any unsafe conditions created by, or unsafe practices on the part of, his employees. In the event of the Contractor's failure to comply, the Owner may take the necessary measures to correct the conditions or practices complained of, and all costs thereof will be deducted from any monies due the Contractor. Failure of the Engineer to direct the correction of unsafe conditions or practices shall not relieve the Contractor of his responsibility hereunder.
- C. In the event of any claims for damage or alleged damage to property as a result of work under this Contract, the Contractor shall be responsible for all costs in connection with the settlement of or defense against such claims. Prior to commencement of work in the vicinity of property adjacent to the work site, the Contractor, at his own expense, shall take such surveys as may be necessary to establish the existing condition of the property. Before final payment can be made, the Contractor shall furnish satisfactory evidence that all claims for damage have been legally settled or sufficient funds to cover such claims have been placed in escrow, or that an adequate bond to cover such claims has been obtained.

1.02 PROTECTION OF WORK AND MATERIAL

- A. During the progress of the work and up to the date of final payment, the Contractor shall be solely responsible for the care and protection of all work and materials covered by the Contract.
- B. All work and materials shall be protected against damage, injury, or loss from any cause whatsoever, and the Contractor shall make good any such damage or loss at his own expense. Protection measures shall be subject to the approval of the Engineer.

1.03 BARRICADES, WARNING SIGNS AND LIGHTS

- A. The Contractor shall provide, erect and maintain as necessary, strong and suitable barricades, danger signs and warning lights along all roads accessible to the public, as required by the authority having jurisdiction, to provide safety to the public. All barricades and obstructions along public roads shall be illuminated at night and all lights for this purpose shall be kept burning from sunset to sunrise.
- B. Each Contractor shall provide and maintain such other warning signs and barricades in areas of and around their respective work as may be required for the safety of all those employed in the work, the Owner's operating personnel, or those visiting the site.
- C. The wording of all project signage shall be subject to Owner approval. No other signage other than Owner-approved project signage shall be permitted.

1.04 EXISTING UTILITIES AND STRUCTURES

- A. The term existing utilities shall be deemed to refer to both publicly owned and privately owned utilities such as electric power and lighting, telephone, water, gas, storm drains, process lines, sanitary sewers and all appurtenant structures.
- B. Where existing utilities and structures are indicated on the Drawings, it shall be understood that all of the existing utilities and structures affecting the work may not be shown and that the locations of those shown are approximate only. It shall be the responsibility of the Contractor to ascertain the actual extent and exact location of existing utilities and structures. In every instance, the Contractor shall notify the proper authority having jurisdiction and obtain all necessary directions and approvals before performing any work in the vicinity of existing utilities.
- C. Prior to beginning any excavation work, the Contractor shall, through field investigations, determine any conflicts or interferences between existing utilities and new utilities to be constructed under this project. This determination shall be based on the actual locations, elevations, slopes, etc., of existing utilities as determined in the field investigations, and locations, elevation, slope, etc. of new utilities as shown on the Drawings. If an interference exists, the Contractor shall bring it to the attention of the Engineer as soon as possible. If the Engineer agrees that an interference exists, he shall modify the design as required. Additional costs to the Contractor for this change shall be processed through a Change Order as detailed elsewhere in these Contract Documents. In the event the Contractor fails to bring a potential conflict or interference to the attention of the Engineer prior to beginning excavation work, any actual conflict or interference which does arise during the Project shall be corrected by the Contractor, as directed by the Engineer, at no additional expense to the Owner.
- D. The work shall be carried out in a manner to prevent disruption of existing services and to avoid damage to the existing utilities. Temporary connections shall be provided, as required, to avoid interruption of existing services. Any damage resulting from the work of this Contract shall be promptly repaired by the Contractor at his own expense in a manner approved by the Engineer and further subject to the requirements of any

authority having jurisdiction. Where it is required by the authority having jurisdiction that they perform their own repairs or have them done by others, the Contractor shall be responsible for all costs thereof.

- E. Where excavations by the Contractor require any utility lines or appurtenant structures to be temporarily supported and otherwise protected during the construction work, such support and protection shall be provided by the Contractor. All such work shall be performed in a manner satisfactory to the Engineer and the respective authority having jurisdiction over such work. In the event the Contractor fails to provide proper support or protection to any existing utility, the Engineer may, at his discretion, have the respective authority to provide such support or protection as may be necessary to protect the safety of such utility, and the costs of such measures shall be paid by the Contractor.

PART 2 – PRODUCTS

2.01 MATERIALS, GENERAL

- A. Materials may be new or used, suitable for the intended purpose, but must not violate requirements of applicable codes and standards.

2.02 FENCING

- A. Minimum fence height shall be six feet.
- B. Open Mesh Fence:
 - 1. No. 11 gauge, two inch mesh, 72 inches high galvanized chain link fabric, with extension arms and three strands of galvanized barbed wire.
 - 2. Galvanized steel posts; 1 ½-inch line posts and two-inch corner posts.

2.03 BARRIERS

- A. Materials are Contractor's option, as appropriate to serve required purpose.

PART 3 – EXECUTION

3.01 GENERAL

- A. Install facilities of a neat and reasonably uniform appearance, structurally adequate for the required purposes.
- B. Maintain barriers during entire construction period.
- C. Relocate barriers as required by the progress of construction.

3.02 FENCES

- A. Provide and maintain fences necessary to assure security of the Site during construction to keep unauthorized people and animals from accessing the Site when construction is not in progress.
- B. Gates shall have locks; and keys shall be furnished to the Owner.
- C. Provide additional security measures as deemed necessary and approved by the Engineer.

3.03 TREE AND PLANT PROTECTION

- A. Preserve and protect existing trees and plants at site which are designated to remain, and those adjacent to site.
- B. Consult with the Owner and remove roots and branches which will interfere with construction.
- C. Employ qualified and certified tree trimmer to remove branches and treat cuts.
- D. Provide temporary barriers to a height of six feet, around each, or around each group, of trees and plants.
- E. Protect root zones of trees and plants:
 - 1. Do not allow vehicular traffic or parking.
 - 2. Do not store materials or products.
 - 3. Prevent puddling or continuous running water.
- F. Carefully supervise excavating, grading and filling, and other construction operations in the vicinity of the trees and plant to prevent damage.
- G. Replace, or suitably repair, trees and plants designated to remain which are damaged or destroyed due to construction operations.

3.04 REMOVAL

- A. Completely remove barricades and temporary measures after construction has progressed to the point that they are no longer needed and with Engineer approval.
- B. Repair damage caused by construction. Fill and grade areas of the site to the required elevations and clean up the area.

[END OF SECTION]

SECTION 01550
CONTRACTOR ACCESS AND PARKING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Contractor shall provide and maintain temporary laydown and employee parking areas and appurtenances required during the Project for use by Contractor, other contractors employed on the Project, Owner's, and emergency vehicles.
2. Laydown areas shall be as shown on the Drawings or as mutually agreed between Owner and Contractor during the pre-construction meeting.
3. Laydown and employee parking areas shall be designed and maintained by Contractor and shall be fully passable to vehicles in all weather conditions.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Access roads:

1. Contractor shall construct and maintain such temporary access roads as required to perform the Work.
2. Contractor shall construct access roads, where possible, in locations over the areas of future road systems.
3. Access roads shall be located within the property lines of the Owner unless the Contractor independently secures easements for use and convenience.
 - a. Contractor shall submit written documentation to the Engineer for Contractor secured easements across privately held property.
 - b. Easement agreements shall specify terms and conditions of use and provisions for Site restoration.
 - c. Written release from property owner certifying that terms of the easement agreement have been complied with by the Contractor shall be furnished to the Engineer prior to final payment.
4. Provide access for emergency vehicles.
5. Maintain driveways a minimum of 15 feet wide, between and around combustible materials in storage and mobilization areas.

6. Maintain traffic areas free as possible of excavated materials, construction equipment, products, and debris.
7. Keep fire hydrants and water control valves free from obstruction and accessible for use.
8. Provide traffic control devices as required by governing authorities along established public thoroughfares which will be used as haul routes to site access.

B. Use of existing access roads:

1. Contractor will be allowed to use Owner's existing roads as shown on the Drawings.
2. Prevent interference with traffic on existing roads and parking areas. At all times, keep access roads and entrances serving the Site clear and available to Owner, Owner's employees, emergency vehicles, and other contractors. Do not use access roads or Site entrances for parking or storage of materials or equipment.
3. Contractor shall indemnify and hold harmless Owner and Engineer from expenses caused by Contractor's operations over existing roads and parking areas.
4. Schedule deliveries to minimize use of driveways and Site entrances.
5. Contractor shall suitably maintain existing access road at Contractor's expense for the duration of the Contract time.

C. Contractor parking areas:

1. Contractor employee vehicles shall park in area(s) designated by Owner or as shown on the Drawings.
2. Contractor shall construct and maintain parking area at the Site.

D. State and local regulations:

1. Contractor shall obtain and pay all cost associated with bonds required by authorized entity (i.e., Florida Department of Transportation) for the use of State maintained roads.
2. Contractors shall obey traffic laws and comply with requirements, rules, and regulations of the authorized entity (i.e., Florida Department of Transportation), including local authorities having jurisdiction, to maintain warning signs, lights, barriers, etc. for the protection of traffic on public roadways.

E. Site security:

1. Refer to Section 01530 – Protection of Work and Property.

F. Dust control:

1. Contractor shall take measures to control dust from Contractor's operations and prevent spillage of excavated materials onto access roads.
2. Provide dust control measures in accordance with Section 01560 – Temporary Controls.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

[END OF SECTION]

SECTION 01560
TEMPORARY CONTROLS

PART 1 – GENERAL

1.01 SUMMARY

- A. Contractor shall provide and maintain methods, equipment, and temporary construction as required to control environmental conditions at the Site and adjacent areas.
- B. Maintain controls until no longer required.
- C. Temporary controls include, but are not limited to, the following:
 - 1. Dust control.
 - 2. Noise controls.
 - 3. Pest and rodent control.
 - 4. Pollution control.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 DUST CONTROL

- A. Contractor shall take measures to control dust from Contractor's operations and prevent spillage of excavated materials on public roads.
- B. Contractor shall remove spillage of excavated materials, debris and dust from public roads by methods approved by Engineer.
- C. Contractor shall provide temporary dust-proof partitions where required to protect unaltered portions of existing structures and facilities and as directed by Engineer or Owner. Temporary partitions shall be provided where demolition Work is required, to protect equipment and material, and shall consist of the following:
 - 1. Wood studs with plywood on both sides and extend from floor to ceiling.
 - 2. Closure plate at floor and ceiling.
 - 3. One door (minimum) with hardware.

D. Contractor shall refer to applicable sections of local and state/commonwealth regulations on dust control for additional guidance.

1. Contractor shall apply water at locations, quantities, and frequencies required by Engineer to control dust for nuisance prevention to Owner, Engineer, and properties in the vicinity of the Site.
2. Dust control and cleaning measures shall be provided at no additional cost to the Owner.

3.02 NOISE CONTROL

- A. Contractor's vehicles and equipment shall minimize noise emissions to greatest degree practicable. Provide mufflers, silencers, and sound barriers when necessary.
- B. Noise levels shall comply with Laws and Regulations, including OSHA requirements and local ordinances.
- C. Noise emissions shall not interfere with the work of Owner or others.

3.03 PEST AND RODENT CONTROL

- A. Provide rodent and pest control as required to prevent infestation of the Site and storage areas.
- B. Employ methods and use materials that do not adversely affect conditions at the Site or on adjoining properties.
- C. In accordance with laws and regulations, promptly and properly dispose of pests and rodents trapped or otherwise controlled.

3.04 POLLUTION CONTROL

- A. General:
 1. Provide means, methods, and facilities required to prevent contamination of soil, water, and atmosphere caused by discharge of noxious substances from construction operations.
 2. Equipment used during construction shall comply with Laws and Regulations.
- B. Spills and Contamination:
 1. Provide equipment and personnel to perform emergency measures required to contain spills and to remove contaminated soils and liquids.
 2. Excavate contaminated material and properly dispose of off-site, and replace with suitable compacted fill and topsoil.

- C. Protection of Surface Waters: Implement special measures to prevent harmful substances from entering surface waters. Prevent disposal of wastes, effluents, chemicals, and other such substances in or adjacent to surface waters and open drainage routes, in sanitary sewers, or in storm sewers.
- D. Atmospheric Pollutants:
 - 1. Provide systems for controlling atmospheric pollutants related to the Work.
 - 2. Prevent toxic concentrations of chemicals and vapors.
 - 3. Prevent harmful dispersal of pollutants into atmosphere.
- E. Solid Waste:
 - 1. Provide systems for controlling and managing solid waste related to the Work.
 - 2. Prevent solid waste from becoming airborne, and from discharging to surface waters and drainage routes.
 - 3. Properly handle and dispose of solid waste.

[END OF SECTION]

SECTION 01570
TRAFFIC CONTROL

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Provide, operate and maintain equipment, services and personnel, with traffic control and protective devices, as required to expedite vehicular traffic flow around the construction area.
- B. Remove temporary equipment and facilities when no longer required, restore grounds to original, or to specified conditions.

1.02 REFERENCES

- A. Traffic regulation shall be in accordance with FDOT Roadway and Traffic Design Standards, Manual on Uniform Traffic Control Devices (MUTCD), and FDOT Standard Specifications, latest Editions.

1.03 TRAFFIC CONTROL PLAN

- A. The Contractor shall prepare and submit a Maintenance of Traffic (MOT) plan, where required by the Contract Documents.

1.04 TRAFFIC SIGNALS AND SIGNS

- A. Provide and operate traffic control and directional signals required to direct and maintain an orderly flow of traffic in all areas under Contractor's control, or affected by Contractor's operations.
- B. Construction requiring traffic signal modification shall be reported to the Owner at least 72 hours prior to the commencement of such activities. All excavation work within 30 feet of any traffic signal shall be reported to the Owner at least 72 hours prior to its commencement.
- C. All existing traffic signs shall remain visible throughout construction activities unless superseded by required construction signage.

1.05 FLAGMEN

- A. Provide qualified and suitably equipped flagmen when construction operations encroach on traffic lanes, as required for regulation of traffic.

1.06 FLARES AND LIGHTS

- A. Provide lights as required by FDOT MUTCD to clearly delineate traffic lanes and guide traffic, for use by flagmen in directing traffic, and to provide illumination of critical traffic and parking areas.

1.07 CONSTRUCTION PARKING CONTROL

- A. Control vehicular parking to preclude interference with public traffic or parking, access by emergency vehicles, Owner's operations, or construction operations.
- B. Monitor parking of construction personnel's private vehicles.
- C. Maintain free vehicular access to and through parking areas and driveways.
- D. Prohibit parking on or adjacent to access roads, or in non-designated areas.

1.08 CONSTRUCTION VEHICLES

- A. All slow moving construction vehicles shall have a slow moving sign visible from the rear of the vehicle.
- B. All vehicles used for construction activities shall have audible back up warning devices.

1.09 ROAD CLOSURES

- A. No road shall be closed prior to receiving approval from the Owner.
- B. At least seven days prior to a proposed road closure, the Contractor shall submit to the Owner a complete MOT plan. This plan shall include the following minimum information:
 - 1. Sketch of Site and all area roads, streets, and driveways.
 - 2. Proposed detour route.
 - 3. All necessary traffic control devices to be used.
 - 4. Contractor's emergency contact person name and phone number to be available 24 hours a day.
 - 5. Estimated times/dates of road closure.
- C. Only the Owner shall have the authority to approve an emergency City road closure.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. All traffic control devices shall meet or exceed FDOT standards.

- B. All traffic signs shall have high intensity face material.

PART 3 – EXECUTION

3.01 MAINTENANCE AND INSPECTION

- A. Upon notification by the Owner either verbally or in writing, the Contractor shall correct any noted deficiencies within one hour.
- B. Inspection of all traffic control items shall be performed by Contractor at least twice per day. One of these inspections shall be at the end of the workday or at night.

[END OF SECTION]

SECTION 01610
PRODUCT REQUIREMENTS AND OPTIONS

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes:

1. Common requirements for products.
2. Contractor's options for selecting products.
3. Requirements for consideration of "or equal" products.
4. Warranty requirements of products.

1.02 REFERENCES

A. Definitions:

1. "Products" includes materials, equipment, machinery, components, fixtures, systems, and other goods incorporated in the Work. Products do not include machinery and equipment used for preparing, fabricating, conveying, erecting, or installing the Work. Products include Owner-furnished goods incorporated in the Work where use of such goods is specifically required in the Contract Documents.
2. "Special Warranties" includes additions or modifications to standard warranty requirements specified in the Contract Documents.

1.03 SUBMITTALS

A. Warranty Log Book:

1. Submit warranty log book prepared specifically for this Project. Submittal shall include a summary listing of all equipment and material warranties furnished in the Contract, date received, and start/end date of warranty period. Individual warranty documentation shall be provided in the submittal.
2. Submit prior to submittal of final Application for Payment.

B. Patent Documentation: Submit licensing arrangement and agreement documentation.

1.04 REQUIREMENT

A. Common Products:

1. Provide products that have not been previously incorporated into another project or facility unless otherwise indicated in the Contract Documents.
2. Provide products of the same generic kind from a single source.
3. Provide products complete with accessories, trim, finish, fasteners, and other items shown, indicated, or required for a complete installation for the indicated use and performance.
4. Standard Products: When available, and unless custom or nonstandard options are specified or indicated, provide standard products of types that have been produced and used successfully in similar situations on other projects.
5. Visual Matching: Where required in the Contract Documents, provide products that match referenced existing construction, approved mock-ups, or approved Sample, as determined by Engineer.
6. Where the Contract Documents include the phrase “as selected” for product color, finish pattern, option, or similar phrase, provide products selected by Engineer as follows:
 - a. Standard Range: Where the Contract Documents include the phrase “standard range of colors, patterns, textures” or similar phrase, provide color, pattern, density, or texture selected by Engineer from manufacturer’s product line that does not include premium items.
 - b. Full Range: Where the Contract Documents include the phrase “full range of colors, patterns, textures” or similar phrase, Engineer will select color, pattern, density, or texture from manufacturer’s entire product line, including standard and premium items.

B. Product Compatibility:

1. Similar products by the same Supplier shall be compatible with each other, unless otherwise indicated in the Contract Documents.
2. Provide products compatible with products previously selected or installed on the Project.

C. Product Options:

1. For products specified only by reference standard or description, without reference to Supplier, provide products meeting that standard, by a Supplier or from a source that complies with the Contract Documents.
2. For products specified by naming one or more products or Suppliers, provide the named products that comply with the Contract Documents, unless an “or equal” or substitute product is approved by Engineer.

3. For products specified by naming one or more products or Suppliers and the term, "or equal", when Contractor proposes a product or Supplier as an "or equal", submit to Engineer a request for approval of an "or equal" product or Supplier.
4. For products specified by naming only one product or manufacturer and followed by words indicating that no substitution is allowed, there is no option and no substitution will be allowed.

D. Concerning Patents:

1. Owner shall be provided a guarantee by Contractor and equipment Supplier that equipment and material furnished in accordance with the Contract Documents is not the subject of patent litigation.
2. Patent litigation or controversy shall include, but not limited to, the following:
 - a. Actual furnished equipment and material that is subject or could be subject to patent litigation or is known to infringe on a patent.
 - b. Furnished equipment and material that may result in a process that use of equipment and material in a manner that infringes upon or violates a patent.
3. When patent infringement may occur, Contractor and Supplier shall submit license arrangements among parties, including Contractor, Supplier, and patent owner (controller of patent) at a minimum, which shall permit use of equipment and material as specified in the Contract Documents.
4. Supplier shall indemnify and hold harmless Owner and Engineer against all claims, costs, losses, and damages arising out of or relating to any infringement or patent rights or copyrights incident to the use of equipment and material specified in the Contract Documents and as required in General Conditions and as modified in the Supplemental Conditions.

E. "Or Equal" Products:

1. For proposed products not named in the Contract Documents and considered as an "or equal" as defined in the General Conditions, Contractor shall request in writing Engineer's approval of the "or equal". Request for approval of an "or equal" product shall accompany the Shop Drawing or product data submittal for the proposed product and shall include:
 - a. Contractor's request that the proposed product be considered as an "or equal" in accordance with the General Conditions, accompanied by Contractor's certifications required in the General Conditions.
 - b. Documentation adequate to demonstrate that proposed product does not require revisions to the Contract Documents, that proposed product is consistent with the Contract Documents, and that proposed product will

produce results and performance required in the Contract Documents, and that proposed product is compatible with other portions of the Work.

- c. Detailed comparison of significant qualities of proposed product with the products and manufacturers named in the Contract Documents. Significant qualities include attributes such as performance, weight, size, durability, visual effect, performance and specific features and requirements shown or indicated.
- d. Evidence that proposed product manufacturer will furnish warranty equal to or better than specified, if any.
- e. List of similar installations for completed projects with project names and physical addresses of installation along with the names, telephone numbers, email addresses and physical address of design professionals and owners associated with the referenced installation, if requested.
- f. Samples, if requested.
- g. Other information requested by Engineer.

1.05 WARRANTY

- A. Warranties specified for products shall be in addition to, and run concurrent with, Contractor's general warranty and guarantee and requirements for the required correction period. Disclaimers and limitations in specific product warranties do not limit Contractor's general warranty and guarantee.
 - 1. Product manufacturer's warranty is preprinted written warranty published by product manufacturer and specifically endorsed by product manufacturer to Owner.
 - 2. Equipment and material shall be guaranteed to be free from defects in workmanship, design, and/or materials for a period of one (1) year unless otherwise specified in the individual Specification Section for a Special Warranty.
 - 3. Warranty period shall start on the date of the particular equipment and material is substantially complete, which includes requirements specified in Section 01670 – Checkout and Startup Procedures for start-up certification and specified elsewhere in the Contract Documents.
 - 4. Warranty requirements may be added to or modified in the individual Specification Sections. Special warranty is written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by product manufacturer's warranty or to provide increased rights to Owner.
 - 5. Special Warranty information, if any, will be located in the Specification Section for that product.

- B. Requirements for Special Warranties: Provide written Special Warranty document that contains appropriate terms and identification, ready for execution by product manufacturer and Owner. Submit draft warranty with submittals required for product.
1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed by product manufacturer and other parties as appropriate.
 2. Specified Form: When specified forms are included in the Contract Documents, prepare written document, properly executed by product manufacturer and Owner, using appropriate form.
 3. Refer to Specifications for content and requirements for submitting Special Warranties.
- C. Submit product manufacturer's warranties and special warranties as submittals in accordance with Schedule of Submittals accepted by Engineer.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

[END OF SECTION]

SECTION 01650
PRODUCT DELIVERY REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. General requirements for preparing for shipping, delivering, and handling materials and equipment.
 - 2. Contractor shall make all arrangements for transporting, delivering, and handling of materials and equipment required for prosecution and completion of the Work.

1.02 SUBMITTALS

- A. Refer to individual Specification Sections for submittal requirements relative to delivery and handling materials and equipment.

1.03 SHIPMENT REQUIREMENTS

- A. When practical, factory-assemble materials and equipment. Match mark or tag separate parts and assemblies to facilitate field assembly. Cover machined and unpainted parts that may be damaged by the elements with strippable, protective coating.
- B. Package materials and equipment to facilitate handling, and protect materials and equipment from damage during shipping, handling, and storage. Mark or tag outside of each package or crate to indicate the associated purchase order number, bill of lading number, contents by name, Owner's contract name and number, Contractor name, equipment number, and approximate weight. Include complete packing lists and bills of materials with each shipment.
- C. Protect materials and equipment from exposure to the elements and keep thoroughly dry and dust-free at all times. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Lubricate bearings and other items requiring lubrication in accordance with manufacturer's instructions.
- D. Advance Notice of Shipments:
 - 1. Keep Engineer informed of delivery of all materials and equipment to be incorporated in the Work.
- E. Do not ship materials and equipment until:

1. Related Shop Drawings, Samples, and other submittals have been approved or accepted (as applicable) by Engineer, including, but not necessarily limited to, Submittals associated with the materials and equipment being delivered.
2. Manufacturer's instructions for handling, storing, and installing the associated materials and equipment have been submitted to and accepted by Engineer in accordance with the Specifications.
3. Results of source quality control testing (factory testing), when required by the Contract Documents for the associated materials or equipment, have been reviewed and accepted by Engineer.
4. Facilities required for handling materials and equipment in accordance with manufacturer's instructions are in place and available.
5. Required storage facilities have been provided.

1.04 DELIVERY REQUIREMENTS

A. Scheduling and Timing of Deliveries:

1. Arrange deliveries of materials and equipment in accordance with the accepted Progress Schedule and in ample time to facilitate inspection prior to installation.
 - a. Equipment and material shall not be delivered to the Site prior to 90 days in advance of scheduled installation.
 - b. Partial payment requests will not be processed for materials delivered prior to 90 days before installation or for materials that are improperly stored.
2. Schedule deliveries to minimize space required for and duration of storage of materials and equipment at the Site or delivery location, as applicable.
3. Coordinate deliveries to avoid conflicting with the Work and conditions at Site, and to accommodate the following:
 - a. Work of other contractors and Owner.
 - b. Owner's operations and maintenance.
 - c. Storage space limitations.
 - d. Availability of equipment and personnel for handling materials and equipment.
 - e. Owner's use of premises.
4. Deliver materials and equipment to the Site during regular working hours.

5. Deliver materials and equipment to avoid delaying the Work and the Project, including work of other contractors, as applicable. Deliver anchor system materials, including anchor bolts to be embedded in concrete or masonry, in ample time to avoid delaying the Work.

B. Deliveries:

1. Shipments shall be delivered with Contractor's name, Subcontractor's name (if applicable), Site name, Project name, and contract designation clearly marked.
2. Site may be listed as the "ship to" or "delivery" address; but Owner shall not be listed as recipient of shipment unless otherwise directed in writing by Engineer.
3. Provide Contractor's telephone number to shipper; do not provide Owner's telephone number.
4. Arrange for deliveries while Contractor's personnel are at the Site. Contractor shall receive and coordinate shipments upon delivery. Shipments delivered to the Site when Contractor is not present will be refused by Owner, and Contractor shall be responsible for the associated delays and additional costs, if incurred.

C. Containers and Marking:

1. Have materials and equipment delivered in manufacturer's original, unopened, labeled containers.
2. Clearly mark partial deliveries of component parts of materials and equipment to identify materials and equipment, to allow easy accumulation of parts, and to facilitate assembly.

D. Inspection of Deliveries:

1. Immediately upon delivery, Contractor shall inspect shipment to verify that:
 - a. Materials and equipment comply with the Contract Documents and approved or accepted (as applicable) submittals.
 - b. Quantities are correct.
 - c. Materials and equipment are undamaged.
 - d. Containers and packages are intact and labels are legible.
 - e. Materials and equipment are properly protected.
2. Promptly remove damaged materials and equipment from the Site and expedite delivery of new, undamaged materials and equipment, and remedy incomplete or lost materials and equipment to furnish materials and equipment in accordance with the Contract Documents, to avoid delaying progress of the Work.

3. Advise Engineer in writing when damaged, incomplete, or defective materials and equipment are delivered, and advise Engineer of the associated impact on the Progress Schedule.

1.05 HANDLING REQUIREMENTS

- A. Provide equipment and personnel necessary to handle materials and equipment, including those furnished by Owner, by methods that prevent soiling or damaging materials and equipment and packaging.
- B. Provide additional protection during handling as necessary to prevent scraping, marring, and otherwise damaging materials and equipment and surrounding surfaces.
- C. Handle materials and equipment by methods that prevent bending and overstressing.
- D. Lift heavy components only at designated lifting points.
- E. Handle materials and equipment in safe manner and as recommended by the manufacturer to prevent damage. Do not drop, roll, or skid materials and equipment off delivery vehicles or at other times during handling. Hand-carry or use suitable handling equipment.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

[END OF SECTION]

SECTION 01660
PRODUCT STORAGE AND PROTECTION REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

- A. General requirements of storing and protecting equipment and materials.

1.02 STORAGE

- A. Store and protect materials and equipment in accordance with manufacturer's recommendations and the Contract Documents.
- B. Contractor shall make all arrangements and provisions necessary for, and pay all costs for, storing materials and equipment. Construction equipment, and materials and equipment to be incorporated into the Work shall be placed to avoid injuring the Work and existing facilities and property, and so that free access is maintained at all times to all parts of the Work and to public utility installations in vicinity of the Work. Store materials and equipment neatly and compactly in locations that cause minimum inconvenience to Owner, other contractors, public travel, and owners, tenants, and occupants of adjoining property. Arrange storage in manner to allow easy access for inspection.
- C. Areas available at the Site for storing materials and equipment are shown or indicated in the Contract Documents, or as approved by Engineer.
- D. Store materials and equipment to become Owner's property to facilitate their inspection and ensure preservation of quality and fitness of the Work, including proper protection against damage by freezing, moisture, and high ambient temperatures. Store in indoor, climate-controlled storage areas all materials and equipment subject to damage by moisture, humidity, heat, cold, and other elements, unless otherwise acceptable to Owner.
- E. Contractor shall be fully responsible for loss or damage (including theft) to stored materials and equipment.
- F. Do not open manufacturer's containers until time of installation, unless recommended by the manufacturer, directed by Engineer, or otherwise specified in the Contract Documents.
- G. Do not store materials or equipment in structures being constructed unless approved by Engineer in writing.
- H. Do not use lawns or other private property for storage without written permission of the owner or other person in possession or control of such premises.

- I. Contractor shall not store unnecessary equipment and materials at the Site.
- J. Contractor shall prevent structures from being loaded with a weight that endanger its security and/or safety of persons.
- K. Stored equipment and materials shall not be placed within 10 feet of fire hydrants.
- L. Gutters, drainage channels and inlets shall be kept unobstructed at all times.

1.03 PROTECTION

- A. Contractor shall provide temporary storage containers/facilities, if required, to protect equipment and materials at the Site.
- B. Equipment to be incorporated into the Work shall be boxed, crated, or otherwise completely enclosed and protected during shipping, handling, and storage, in accordance with Section 01650 – Product Delivery Requirements.
- C. Store all materials and equipment off the ground (or floor) on raised supports such as skids or pallets.
- D. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Painted equipment surfaces that are damaged or marred shall be repainted in their entirety in accordance with equipment manufacturer and paint manufacturer requirements, to the satisfaction of Engineer.

1.04 SPECIFIC STORAGE REQUIREMENTS

- A. Uncovered:
 - 1. The following types of materials may be stored outdoors without cover on supports so there is no contact with the ground:
 - a. Piping, except polyvinyl chloride (PVC) or chlorinated PVC (CPVC) pipe.
- B. Covered:
 - 1. The following materials and equipment may be stored outdoors on supports and completely covered with covering impervious to water:
 - a. Grout and mortar materials.
 - b. Rough lumber.
 - c. PVC and CPVC pipe.
 - 2. Tie down covers with rope, and slope covering to prevent accumulation of water.
- C. Fully Protected:

1. All materials and equipment not named as uncovered or covered in this Section, shall be stored on supports in buildings or trailers that have concrete or wooden flooring, roof, and fully closed walls on all sides. Covering with plastic sheeting or similar material in space without floor, roof, and walls is not acceptable. Comply with the following:
 - a. Provide heated storage for materials and equipment that could be damaged by low temperatures or freezing.
 - b. Provide air-conditioned storage for materials and equipment that could be damaged by high temperatures.
 - c. Protect mechanical and electrical equipment from being contaminated by dust, dirt, and moisture.
 - d. Maintain humidity at levels recommended by manufacturers of electrical and electronic equipment.
 - e. Energize space heaters for electrical equipment and material.
- D. Maintenance of Storage: On scheduled basis, periodically inspect stored materials and equipment to ensure that:
 1. Condition and status of storage facilities is adequate to provide required storage conditions.
 2. Required environmental conditions are maintained on continuing basis.
 3. Materials and equipment exposed to elements are not adversely affected.

1.05 RECORDS

- A. Keep up-to-date account of materials and equipment in storage to facilitate preparation of Applications for Payment, if the Contract Documents provide for payment for materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

[END OF SECTION]

SECTION 01670
CHECKOUT AND STARTUP PROCEDURES

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Checkout of products and equipment.
 - 2. Startup procedures of products and equipment.
- B. Contractor shall initially start up and place equipment installed under the Contract into successful operation, in accordance with the equipment manufacturer's written instructions and as instructed by Supplier at the Site.
- C. Provide all material, labor, tools, and equipment required to complete equipment checkout and start-up.
- D. Provide chemicals, lubricants, and other required operating fluids.
- E. General activities include:
 - 1. Cleaning, as required under other provisions of the Contract Documents.
 - 2. Removing temporary protective coatings.
 - 3. Checking and correcting (if necessary) leveling plates, grout, bearing plates, anchorage devices, fasteners, and alignment of piping, conduits, and ducts that may place stress on the connected equipment.
 - 4. All adjustments required.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Definitions:
 - 1. Displacement, as used herein, shall mean total peak-to-peak movement of vibrating equipment, in mils; velocity or speed of the vibration cycle, measured in distance per time, velocity and acceleration of the vibration cycle. Displacement, velocity and acceleration shall be measured by instruments/equipment equal to IRD Mechanalysis, Bentley, Nevada.
- B. Coordination:

1. Coordinate checkout and start-up with other contractors performing Work at the Site.
2. Do not start up system or subsystem for continuous operation until all components of that system or subsystem, including instrumentation and controls, have been tested to the extent practicable and proven to be operable as intended by the Contract Documents.
3. Responsibility for proper operation is by Contractor.
4. Supplier shall be present during checkout, start-up, and initial operation, except as otherwise specified.
5. Do not start up system, unit process, or equipment without submitting acceptable preliminary operations and maintenance manuals by Contractor, in accordance with Section 01730 – Operations and Maintenance Data.

C. Contractor's Requirements Prior to Owner's Responsibility:

1. Owner will assume responsibility for the equipment upon Substantial Completion.
2. Prior to turning over to Owner responsibility for operating and maintaining system or equipment shall be in accordance with this Section and the following requirements:
 - a. Submit acceptable final operations and maintenance manuals in accordance with Section 01730 – Operations and Maintenance Data.
 - b. Provide training of operations and maintenance personnel in accordance with Section 01821 – Instruction of Owner's Personnel.
 - c. Complete system field quality control testing in accordance with the Contract Documents including, but not limited to, the following:
 - 1) Start-up certification shall be performed and completed by the equipment Supplier for the equipment and material prior to be placed into intended use by Owner as specified in the Contract Documents.
 - 2) Equipment and material shall be operated for a minimum 14-day operational period to verify performance, unless otherwise required by the Contract Documents or approved by the Owner in writing. In addition to specific requirements specified in the individual specification sections, process data that is recorded in the PLC shall be submitted to the Engineer in tabular format showing hourly process performance data. A log of all alarms shall also be submitted, along with notes describing corrective measures applied in response to alarm condition.

- 3) If equipment and material does not perform satisfactorily during the operational period, then the warranty period start shall be delayed until satisfactorily performance is verified.
 - a) Contractor shall repair or replace equipment and material that does not perform satisfactorily at no cost to Owner.
 - b) Contractor shall furnish all equipment and material, labor, and incidentals necessary to provide equipment and material to the performance level required by the Contract Documents.
- d. Obtain from Engineer final certificate of Substantial Completion for either entire Work or the portion being turned over to Owner.

1.03 SUBMITTALS

- A. Startup Schedule: Detailed summary of schedule, duration, manpower requirement, and Contractor's means and methods for startup.
- B. Vibration testing results.
- C. Closeout Submittals: Manufacturer's certification of installation in accordance with this Section.
- D. Startup testing and operational demonstration performance data.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 PRELIMINARY REQUIREMENTS

- A. Prior to the start-up of the facilities, Contractor shall have prepared and tested all equipment, subsystems and systems in accordance with the requirements of the individual Specification Section to check its ability for sustained operation, including inspections and adjustments by Manufacturer's representative.
- B. Contractor shall develop and submit schedule in accordance with this Section.
- C. After the facilities are sufficiently complete to permit start-up, Contractor shall furnish competent personnel to start-up the facilities. Contractor will be responsible for startup of all facilities constructed under this Contract. During the initial start-up period the Contractor shall check and provide for mechanical operation in accordance with the Contract Documents.

3.02 FIELD QUALITY CONTROL

A. Manufacturers' Field Services:

1. When specified, furnish services of factory trained representatives of material and equipment manufacturers as specified, including supervising installation, adjusting, checkout, start-up, and testing of materials and equipment.
2. Certification:
 - a. When services by manufacturer are required at the Site, within 14 days after first test operation of equipment, submit to Engineer a letter from manufacturer, on manufacturer's letterhead, stating that materials and equipment are installed in accordance with manufacturer's requirements and installation instructions, and in accordance with the Contract Documents.
 - b. Include in the final operations and maintenance manual for the associated equipment a copy of the letter or completed form, as applicable.
3. Manufacturer shall bring any discrepancies to the immediate attention of the Contractor for correction. Contractor shall promptly correct any discrepancies noted by the Manufacturer. Manufacturer shall coordinate correction of discrepancies with the Contractor. Discrepancies and their correction shall be noted in inspection records and in all required reports. Any corrections that result in changes to the work as shown on the Contract Documents shall be approved by the Engineer prior to their execution.

3.03 VIBRATION TESTING

- A. Stationary rotating equipment, products and materials shall have vibration testing performed at the Site with a rated horsepower exceeding 1 horsepower.
- B. Vibration testing shall be performed by an experienced factory-trained and authorized third-party analysis expert shall be provided for and paid for by the Contractor. Each unit or pump system shall be tested separately without duplicate equipment running. All field testing shall be done in the presence of the Engineer. The Engineer shall be furnished with seven (7) certified copies of vibration test data for each test performed.
- C. General testing requirements:
 1. Variable speed drives – Tests shall be conducted at the full range of speeds between maximum and minimum.
 2. Two-speed drives – Tests shall be conducted at both speeds.
 3. Constant-speed drives – Tests shall be conducted under various loading conditions as determined by the Engineer.

4. Frequency of vibration, in frequency (i.e. Hz, cycles per second) and cycles per minute (cpm), shall be determined when vibration exceeds specified levels or as otherwise necessary. Vibration shall be measured on the bearing housing and the motor, unless other additional locations are deemed necessary by the Engineer and/or specified, the vibration analyst and/or published industry standards.
5. Vibration shall be checked in the radial and axial directions. Vibration shall be limited to the latest version of the relevant Hydraulic Institute (HI) Standards.
 - a. Unless otherwise specified elsewhere, axial vibration shall not exceed 0.1 in/sec; and radial vibration shall not exceed 0.2 in/sec. For pumps radial vibration shall not exceed that permitted by the Hydraulic Institute Standards except that, at vibration frequencies in excess of 8,000 cpm, the velocity shall not exceed 0.2 in/sec.
6. Noise or vibration in any rotating equipment which the Engineer judges to be excessive or damaging, shall be cause for rejection.

D. Test results:

1. Contractor shall correct deficiencies within thirty days when vibration field test results exceed source quality control tests results, Manufacturer's recommendations, or the limits specified in the Contract Documents.
2. After corrections have been completed, the vibration testing shall be re-run at the Contractor's expense and the results re-submitted to the Engineer for review.

3.04 SYSTEM START-UP

- A. Equipment and materials shall be provided in conformance with the manufacturer's installation instructions and in accordance with the Contract Documents.
- B. Provide start-up services as specified in the individual Specification Sections.
- C. Contractor shall furnish consumables required for startup including, but not limited to, electricity, water, chemicals, and lubrication. Contractor shall provide a plan for disposal of water used for testing unless otherwise specified in the Contract Documents.
- D. General system requirements:
 1. Start-up of the plant by Contractor shall include all mechanical systems, including but not limited to, pumps, compressors, and like equipment, and the ventilating, air conditioning (or heating), plumbing, and electrical systems. Start-up of either the heating or air conditioning systems is dependent upon the time of year that the plant start up is initiated. Contractor will be required to return at the beginning of the next heating or air conditioning season (whichever is applicable) to start the appropriate system.

2. Cleaning as required under provisions of the Contract Documents.
3. Remove temporary protective coatings.
4. Flushing and replacing greases and lubricants as required by Manufacturer
5. Lubrication.
6. Verify the following:
 - a. Shaft and coupling alignments and reset where needed.
 - b. Set motor, pump and other equipment rotation, safety interlocks, and belt tensions.
 - c. Leveling plates, grout, bearing plates, anchor bolts, fasteners, and alignment of piping, conduits and ducts that may apply stress on equipment.
7. Valves:
 - a. Tighten packing glands to ensure no leakage but allow valve stems to operate without galling.
 - b. Replace packing in valves to retain maximum adjustment after system is determined to be complete.
 - c. Replace packing on valves that continue to leak.
 - d. Remove and repair bonnets that leak.
 - e. After cleaning, coat packing gland threads and valve stems with surface preparation of "Molycote" or "Fel-Pro".
8. Verify that control valve seats are free of foreign matter and are properly positioned for intended service.
9. Tighten flanges and other pipe joints after system has been placed in operation.
10. Replace gaskets that show signs of leakage after tightening.
11. Inspect all joints for leakage:
 - a. Promptly remake each joint that appears to be faulty; do not wait for rust or other corrosion to form.
 - b. Clean threads on both parts and apply compound and remake joints.

12. After system has been placed in operation, clean valve seats and headers in fluid system to ensure freedom from foreign matter.
13. Remove rust, scale, and foreign matter from equipment and renew defaced surfaces.
14. Repair damaged insulation.

[END OF SECTION]

SECTION 01730
OPERATION AND MAINTENANCE DATA

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes: Requirements for operation and maintenance data, manuals, and documentation.
 - 1. Submit operation and maintenance data, in accordance with this Section and in accordance with requirements elsewhere in the Contract Documents, as instructional and reference manuals by operations and maintenance personnel at the Site.
 - 2. Required operation and maintenance data groupings are listed in this Section. At minimum, submit operation and maintenance data for:
 - a. All equipment and systems.
 - b. Valves, gates, actuators, and related accessories.
 - c. Instrumentation and control devices.
 - d. Electrical gear.
 - 3. For each operation and maintenance manual, submit the following:
 - a. Preliminary Submittal: Electronic copy of entire operation and maintenance manual, except for test data and service reports by Supplier.
 - b. Final Submittal: Printed and bound copy of complete operations and maintenance manual and electronic copy, including test data and service reports by Supplier.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Quantity Required and Timing of Submittals:
 - 1. Preliminary Submittal:
 - a. Printed Copies: None, except as may be required by Contractor.
 - b. Electronic Copies: One copy.
 - c. Submit to Engineer, whichever occurs first:

- 1) 60 days prior to starting training of operations and maintenance personnel.
 - 2) 30 days prior to field quality control testing at the Site.
- d. Furnish preliminary operation and maintenance data submittal in acceptable form and content, as determined by Engineer, before associated materials and equipment will be eligible for payment.
2. Preliminary Submittal shall be reviewed by Engineer. One electronic copy shall be returned to Contractor with required revisions noted.
3. Final Submittal: Provide 14 days prior to checkout and startup procedures specified in Section 01670 – Checkout and Startup Procedures, unless Submittal is specified as required prior to an interim Milestone.
 - a. Printed Copies: Two copies.
 - b. Electronic Copies: One copy.

B. Format of Printed Copies:

1. Binding and Cover:
 - a. Bind each operation and maintenance manual in durable, permanent, stiff-cover binder(s), comprising one or more volumes per copy as required. Binders shall be minimum one-inch wide and maximum of three-inch wide. Binders for each copy of each volume shall be identical.
 - b. Provide the following information on cover of each volume:
 - 1) Title: "OPERATING AND MAINTENANCE INSTRUCTIONS".
 - 2) Name or type of material or equipment covered in the manual.
 - 3) Volume number, if more than one volume is required, listed as "Volume ___ of ___", with appropriate volume-designating numbers filled in.
 - 4) Name of Project and, if applicable, Contract name and number.
 - 5) Name of building or structure, as applicable.
 - c. Provide the following information on spine of each volume:
 - 1) Title: "OPERATING AND MAINTENANCE INSTRUCTIONS".
 - 2) Name or type of material or equipment covered in the manual.

- 3) Volume number, if more than one volume is required, listed as "Volume ___ of ___", with appropriate volume-designating numbers filled in.
- 4) Project name and building or structure name.

2. Drawings:

- a. Bind into the manual drawings, diagrams, and illustrations up to and including 11 inches by 17 inches in size, with reinforcing.
- b. Documents larger than 11 inches by 17 inches shall be folded and inserted into clear plastic pockets bound into the manual. Mark pockets with printed text indicating content and drawing numbers. Include no more than three drawing sheets per pocket.

3. Copy Quality and Document Clarity:

- a. Contents shall be original-quality copies. Documents in the manual shall be either original manufacturer-printed documents or first-generation photocopies indistinguishable from originals. If original is in color, copies shall be in color.
- b. Clearly mark in ink to indicate all components of materials and equipment on catalog pages for ease of identification. In standard or pre-printed documents, indicate options furnished or cross out inapplicable content.

4. Organization:

- a. Provide table of contents in each volume for each chapter or section.
- b. Use dividers and indexed tabs between major categories of information, such as operating instructions, preventive maintenance instructions, and other major subdivisions of data in each manual.

C. Format of Electronic Copies:

1. Each electronic copy shall include all information included in the corresponding printed copy.
2. Submit electronic copy via transferable method and format acceptable to Engineer.
3. File Format:
 - a. Acceptable formats include Adobe PDF, Microsoft Word, Autodesk DWF, AutoCAD DWG, and Microstation DGN.

- b. Files shall be electronically searchable.
 - c. Submit separate file for each separate document in the printed copy.
 - d. Within each file, provide bookmarks for the following:
 - 1) Each chapter and subsection listed in the corresponding printed copy document's table of contents.
 - 2) Each figure.
 - 3) Each table.
 - 4) Each appendix.
4. Submit drawings and figures in one of the following formats: ".bmp", ".tif", ".jpg", ".gif", ".dwf", ".dwg", ".dgn".

D. General Content Requirements:

- 1. Prepare each operations and maintenance manual specifically for the Project. Include in each manual all pertinent instructions, as-built drawings as applicable, bills of materials, technical bulletins, installation and handling requirements, maintenance and repair instructions, and other information required for complete, accurate, and comprehensive data for safe and proper operation, maintenance, and repair of materials and equipment furnished for the Project. Include in manuals specific information required in the Specification Section for the material or equipment, data required by Laws and Regulations, and data required by authorities having jurisdiction.
- 2. Submit complete, detailed written operating instructions for each material or equipment item including: function; operating characteristics; limiting conditions; operating instructions for start-up, normal and emergency conditions; regulation and control; operational troubleshooting; and shutdown. Also include, as applicable, written descriptions of alarms generated by equipment and proper responses to such alarm conditions.
- 3. Submit written explanations of all safety considerations relating to operation and maintenance procedures.
- 4. Submit complete, detailed, written preventive maintenance instructions including all information and instructions to keep materials, equipment, and systems properly lubricated, adjusted, and maintained so that materials, equipment, and systems function economically throughout their expected service life. Instructions shall include:
 - a. Written explanations with illustrations for each preventive maintenance task such as inspection, adjustment, lubrication,

calibration, and cleaning. Include pre-startup checklists for each equipment item and maintenance requirements for long-term shutdowns.

- b. Recommended schedule for each preventive maintenance task.
 - c. Lubrication charts indicating recommended types of lubricants, frequency of application or change, and where each lubricant is to be used or applied.
 - d. Table of alternative lubricants.
 - e. Troubleshooting instructions.
 - f. List of required maintenance tools and equipment.
5. Submit complete bills of material or parts lists for materials and equipment furnished. Lists or bills of material may be furnished on a per-drawing or per-equipment assembly basis. Bills of material shall indicate:
- a. Manufacturer's name, address, telephone number, fax number, and Internet website address.
 - b. Manufacturer's local service representative's or local parts supplier's name, address, telephone number, fax number, Internet website address, and e-mail addresses, when applicable.
 - c. Manufacturer's shop order and serial number(s) for materials, equipment or assembly furnished.
 - d. For each part or piece include the following information:
 - 1) Parts cross-reference number. Cross-reference number shall be used to identify the part on assembly drawings, Shop Drawings, or other type of graphic illustration where the part is clearly shown or indicated.
 - 2) Part name or description.
 - 3) Manufacturer's part number.
 - 4) Quantity of each part used in each assembly.
 - 5) Current unit price of the part at the time the operations and maintenance manual is submitted. Price list shall be dated.
6. Submit complete instructions for ordering replaceable parts, including reference numbers (such as shop order number or serial number).

7. Submit manufacturer's recommended inventory levels for spare parts, extra stock materials, and consumable supplies for the initial two years of operation. Consumable supplies are items consumed or worn by operation of materials or equipment, and items used in maintaining the operation of material or equipment, including items such as lubricants, seals, reagents, and testing chemicals used for calibrating or operating the equipment. Include estimated delivery times, shelf life limitations, and special storage requirements.
8. Submit manufacturer's installation and operation bulletins, diagrams, schematics, and equipment cutaways. Where materials pertain to multiple models or types, mark the literature to indicate specific material or equipment supplied. Marking may be in the form of checking, arrows, or underlining to indicate pertinent information, or by crossing out or other means of obliterating information that does not apply to the materials and equipment furnished.
9. Submit original-quality copies of each approved and accepted Shop Drawing, product data, and other submittal, updated to indicate as-installed condition. Reduced drawings are acceptable only if reduction is to not less than one-half original size and all lines, dimensions, lettering, and text are completely legible on the reduction.
10. Submit complete electrical schematics and wiring diagrams, including complete point-to-point wiring and wiring numbers or colors between all terminal points.
11. Submit copy of warranty bond and service contract as applicable.
12. When copyrighted material is used in operations and maintenance manuals, obtain copyright holder's written permission to use such material in the operation and maintenance manual.

1.03 SUBMITTALS

- A. Action/Informational Submittals: Submit preliminary schedule (listing) of operations and maintenance data for Engineer's review. Preliminary operations and maintenance data shall be grouped as major equipment and material systems and divided into sub-systems as required for clarity, subject to Engineer's approval.
- B. Closeout Submittals:
 1. Operation and maintenance data: Submit the operations and maintenance data indicated in the Contract Documents, grouped into submittals as approved by Engineer.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

[END OF SECTION]

SECTION 01740
CLEANING AND WASTE MANAGEMENT

PART 1 – GENERAL

1.01 SUMMARY

- A. Administrative and procedural requirements for progress and closeout cleaning at the Site.
 - 1. Contractor shall execute cleaning during the Project, at completion of the Work, and as required by the General Conditions and this Section.
 - 2. Maintain in a clean manner the Site, the Work, and areas adjacent to or affected by the Work.
- B. Administrative and procedural requirements for disposing of non-hazardous excavation and construction waste.
 - 1. Contractor shall comply with the requirements and procedures for construction waste management and disposal.
 - 2. Extent of required construction waste management and disposal includes within the Project limits, as shown or indicated.

1.02 RELATED SECTIONS

- A. Section 01045 – Execution of the Work.

1.03 REFERENCES

- A. Definitions:
 - 1. “Construction waste” is building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
 - 2. “Demolition waste” is building and site improvement materials resulting from demolition or selective demolition operations.
 - 3. “Disposal” is removal to an off-Site location of demolition and construction waste and subsequent sale, recycling, reuse, or disposal in a landfill or incinerator conforming to Laws and Regulations and acceptable to authorities having jurisdiction.
- B. Reference Standards: NFPA 241, Safeguarding Construction, Alteration, and Demolition Operations

1.04 ADMINISTRATIVE REQUIREMENTS

A. Failure of Contractor to Maintain Clean Site:

1. Owner will provide written notification to Contractor for failure to maintain a clean Site.
2. Written notification shall provide five (5) days for Contractor to remedy Site cleaning and waste management to the Engineer's and Owner's satisfaction.
3. Following the five (5) day remedy period, Owner shall without prejudice to any other rights provide services to clean Site to the satisfaction of Owner and Engineer. Contractor shall be responsible for reimbursement of Owner's costs and expenses for the cleaning work.

1.05 SUBMITTALS

A. Closeout Submittals:

1. Landfill and Incinerator Disposal Records: Provide copy of receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Submit manifests, weight tickets, receipts, and invoices.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Replace loaded containers with empty containers as demand requires.
- B. Deposit recyclable materials in containers free from debris.
- C. Transport and deposit waste in containers to minimize dust. Close container covers immediately after materials are deposited.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 PROGRESS CLEANING

- A. General: Clean the Site, work areas, and other areas occupied by Contractor at least weekly. Dispose of materials in accordance with the General Conditions and the following:
 1. Comply with NFPA 241 for removing combustible waste materials and debris.
 2. Do not hold non-combustible materials at the Site more than three days if the temperature is expected to rise above 80 degrees F. When temperature is less

than 80 degrees F, dispose of non-combustible materials within seven days of their generation.

3. Provide suitable containers for storage of waste materials and debris.
4. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately.

B. Work Areas:

1. Clean areas where the Work is in progress to level of cleanliness necessary for proper execution of the Work.
2. Remove liquid spills promptly and immediately report spills to Owner, Engineer, and authorities having jurisdiction.
3. Where dust would impair proper execution of the Work, broom-clean or vacuum entire work area, as appropriate.
4. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

C. Installed Work: Keep installed Work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of material or equipment installed, using only cleaning agents and methods specifically recommended by material or equipment manufacturer. If manufacturer does not recommend specific cleaning agents or methods, use cleaning agents and methods that are not hazardous to health and property and that will not damage exposed surfaces.

D. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration until Substantial Completion.

E. Cutting and Patching:

1. Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.
2. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.

F. During handling and installation of materials and equipment, clean and protect construction in progress and adjoining materials and equipment already in place. Apply protective covering where required for protection from damage or deterioration, until Substantial Completion.

G. Clean completed construction as frequently as necessary throughout the construction period.

3.02 EXCAVATION WORK NEAR PUBLIC OR PRIVATE PROPERTY

- A. Contractor shall provide cleaning and either temporary or permanent restoration where Work is located in or near streets, right of ways, easements, or private property.
- B. Contractor shall backfill, compact, grade, and restore excavation or disturbed area to functional condition to permit pedestrian or vehicular traffic and original use of the area as the Work progresses.
- C. Temporary storage of excavation spoils, including earth, stones, boulders, and debris, shall be removed from the Site or area of disturbance.

3.03 CLOSEOUT CLEANING

- A. Complete the following prior to requesting inspection for Substantial Completion:
 - 1. Clean and remove from the Site rubbish, waste material, debris, and other foreign substances.
 - 2. Sweep paved areas broom-clean. Remove petrochemical spills, stains, and other foreign deposits.
 - 3. Hose-clean sidewalks and loading areas.
 - 4. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - 5. Repair pavement, roads, sod, and other areas affected by construction operations and restore to specified condition; if condition is not specified, restore to pre-construction condition.
 - 6. Clean exposed exterior and interior hard-surfaced finishes to dirt-free condition, free of spatter, grease, stains, fingerprints, films, and similar foreign substances.
 - 7. Leave the Site clean, and in neat, orderly condition, satisfactory to Owner and Engineer.

3.04 WASTE DISPOSAL

- A. General: Except for items or materials to be recycled, or otherwise reused, remove waste materials from the Site and properly dispose of waste in facility such as permitted landfill or incinerator or other method acceptable to authorities having jurisdiction.
 - 1. Except as otherwise specified, remove from the Site all waste and debris from the Work as it accumulates. Upon completion of the Work, remove materials, equipment, waste, and debris and leave the Site clean, neat, and orderly. Comply with the Contract Documents regarding cleaning and removal of trash, debris, and waste.

2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 3. Properly dispose of waste materials, surplus materials, debris, and rubbish off the Site.
 4. Do not discharge volatile or hazardous substances, such as mineral spirits, oil, or paint thinner, into storm sewers or sanitary sewers.
 5. Do not discharge wastes into surface waters or drainage routes.
- B. Burying: Do not bury rubbish and waste materials at the Site.
- C. Burning: Do not burn waste materials at the Site.
- D. Disposal: Transport waste materials to proper location at site other than Owner's property for disposal in accordance with Laws and Regulations. Contractor shall be solely responsible for complying with Laws and Regulations regarding storing, transporting, and disposing of waste.

[END OF SECTION]

SECTION 01782
PROJECT RECORD DOCUMENTS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Requirements for recording changes to record documents.
 - 2. Requirements for electronic files furnished by Engineer.
- B. Contractor shall maintain and submit to Engineer with record documents in accordance with the Contract Documents.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Maintenance of Record Documents:
 - 1. The following record documents shall be maintained in the Contractor's field office:
 - a. Drawings, Specifications, and Addenda.
 - b. Shop Drawings, Samples, and other Contractor submittals, including records of test results, approved or accepted as applicable, by Engineer.
 - c. Change Orders, Field Orders, photographic documentation, survey data, and all other documents pertinent to the Work.
 - 2. Update record documents on a monthly basis, minimum.
 - 3. Provide files and racks for proper storage and easy access to record documents.
 - 4. Make record documents available for inspection upon request of Engineer or Owner.
 - 5. Do not use record documents for purpose other than serving as Project record. Do not remove record documents from Contractor's field office without Engineer's approval.
- B. Submittal of Record Documents:
 - 1. Submit to Engineer the following record documents: Drawings.
 - 2. Prior to readiness for final payment, submit to Engineer one copy of final record documents. Submit complete record documents; do not make partial submittals.

3. Submit record documents with transmittal letter on contractor letterhead complying with letter of transmittal requirements in of the Contract Documents
4. Record documents submittal shall include certification, with original signature of official authorized to execute legal agreements on behalf of Contractor.

C. Electronic Files Furnished by Engineer:

1. CADD files will be furnished by Engineer upon the following conditions:
 - a. Contractor shall submit to Engineer a letter on Contractor letterhead requesting CADD files and providing specific definition(s) or description(s) of how files will be used, and specific description of benefits to Owner (including credit proposal, if applicable) if the request is granted.
 - b. Contractor shall execute Engineer's standard agreement for release of electronic files and shall abide by all provisions of the agreement for release of electronic files.
 - c. Layering system incorporated in CADD files shall be maintained as transmitted by Engineer. CADD files transmitted by Engineer containing cross-referenced files shall not be bound by Contractor. Drawing cross-references and paths shall be maintained. If Contractor alters layers or cross-reference files, Contractor shall restore all layers and cross-references prior to submitting record documents to Engineer.
 - d. Contractor shall submit record drawings to Engineer in same CADD format that files were furnished to Contractor.

1.03 SUBMITTALS

- A. Closeout Submittals: Provide record documentation as specified in this Section.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 GENERAL REQUIREMENTS

- A. At the start of the Project, label each record document to be submitted as, "PROJECT RECORD" using legible, printed letters. Letters on record copy of the Drawings shall be two inches high.
- B. Keep record documents current. Make entries on record documents within two working days of receipt of information required to record the change.
- C. Do not permanently conceal the Work until required information has been recorded.

- D. Accuracy of record documents shall be such that future searches for items shown on the record documents may rely reasonably on information obtained from Engineer-accepted record documents.
- E. Marking of Entries:
 - 1. Use erasable, colored pencils (not ink or indelible pencil) for marking changes, revisions, additions, and deletions to record documents.
 - 2. Clearly describe the change by graphic line and make notations as required. Use straight-edge to mark straight lines. Writing shall be legible and sufficiently dark to allow scanning of record documents into legible electronic files.
 - 3. Date all entries on record documents.
 - 4. Call attention to changes by drawing a “cloud” around the change(s) indicated.
 - 5. Mark initial revisions in red. In the event of overlapping changes, use different colors for subsequent changes.

3.02 RECORDING CHANGES TO DRAWINGS

- A. Record changes on copy of the Drawings. Submittal of Contractor-originated or -produced drawings as a substitute for recording changes on the Drawings is unacceptable.
- B. Record changes on plans, sections, schematics, and details as required for clarity, making reference dimensions and elevations (to Project datum) for complete record documentation.
- C. Record actual construction including:
 - 1. Depths of various elements of foundation relative to Project datum.
 - 2. Field changes of dimensions, arrangements, and details.
 - 3. Changes made in accordance with Change Orders and Field Orders.
 - 4. Changes in details on the Drawings. Submit additional details prepared by Contractor when required to document changes.

3.03 RECORDING CHANGES FOR SCHEMATIC LAYOUTS

- A. In some cases, on the Drawings, arrangements of conduits, circuits, piping, ducts, and similar items are shown schematically and are not intended to portray physical layout. For such cases, the final physical arrangement shall be determined by Contractor subject to acceptance by Engineer.

- B. Record on record documents all revisions to schematics on Drawings, including: piping schematics, ducting schematics, process and instrumentation diagrams, control and circuitry diagrams, electrical one-line diagrams, motor control center layouts, and other schematics when included in the Contract. Record actual locations of equipment, lighting fixtures, in-place grounding system, and other pertinent data.
- C. When dimensioned plans and dimensioned sections on the Drawings show the Work schematically, indicate on the record documents, by dimensions accurate to within one inch in the field, centerline location of items of Work such as conduit, piping, ducts, and similar items
 - 1. Clearly identify the Work item by accurate notations such as “cast iron drain”, “rigid electrical conduit”, “copper waterline”, and similar descriptions.
 - 2. Show by symbol or note the vertical location of Work item; for example, “embedded in slab”, “under slab”, “in ceiling plenum”, “exposed”, and similar designations. For piping not embedded, also provide elevation dimension relative to Project datum.
 - 3. Descriptions shall be sufficiently detailed to be related to Specifications.
- D. Engineer may furnish written waiver of requirements relative to schematic layouts shown on plans and sections when, in Engineer’s judgment, dimensioned layouts of Work shown schematically will serve no useful purpose. Do not rely on waiver(s) being issued.

3.04 REQUIREMENTS FOR SUPPLEMENTAL DRAWINGS

- A. In some cases, drawings produced during construction by Engineer or Contractor supplement the Drawings and shall be included with record documents submitted by Contractor. Supplemental record drawings shall include drawings provided with Change Orders and Field Orders and that cannot be incorporated into the Drawings due to space limitations.
- B. Supplemental drawings provided with record drawings shall be integrated with the Drawings and include necessary cross-references between drawings. Supplemental record drawings shall be on sheets the same size as the Drawings.
- C. When supplemental drawings developed by Contractor using computer-aided drafting/design (CADD) software are to be included in record drawings, submit electronic files for such drawings as part of record drawing submittal.

3.05 RECORDING CHANGES TO SPECIFICATIONS AND ADDENDA

- A. Mark each Section to record:
 - 1. Manufacturer, trade name, catalog number, and Supplier of each product and item of equipment actually provided.

2. Changes made by Addendum, Change Orders, and Field Orders.

[END OF SECTION]

SECTION 01783
SPARE PARTS AND EXTRA MATERIAL

PART 1 – GENERAL

1.01 SUMMARY

- A. Contractor shall furnish spare parts data and extra materials for materials and equipment in accordance with the Contract Documents.
- B. Spare Parts and Extra Materials:
 - 1. Provide spare parts, extra stock materials, maintenance supplies, and special tools required for maintenance (“spare parts and extra materials”) for one year of operation (unless otherwise specified in the individual Specification Section).
 - a. Provide Supplier recommended lubricating oil and grease in accordance with this Section and the Contract Documents.
 - 2. Provide list of Supplier recommended spare parts and extra material.
 - a. Include list of four standard lubricants, minimum, that shall be interchangeable for each type of lubricant required in the Contract Documents.
 - b. Include unit prices in current United States dollars.
 - c. Source(s) of supply for each.
- C. Packaging and Labeling:
 - 1. Furnish spare parts and extra materials in manufacturer's unopened cartons, boxes, crates, or other original, protective covering suitable for preventing corrosion and deterioration for maximum length of storage normally anticipated by manufacturer.
 - 2. Packaging of spare parts and extra materials shall be clearly marked and identified with name of manufacturer, applicable equipment, part number, part description, and part location in the equipment.
 - 3. Protect and package spare parts and extra materials for maximum shelf life normally anticipated by manufacturer.
- D. Finishes: Spare parts and extra material shall have painting, protective coating, and finishes identical to original installed equipment and material. Where painting, protective coating, or finishes are not specified, suitable provisions shall be furnished to protect from corrosion.

- E. Special Tools: Contractor shall provide special tools necessary to operate, disassemble, service, repair, and adjust equipment and material in accordance with the manufacturer's operation and maintenance manual. Special tool requirements shall be the same as spare parts and extra material specified in this Section.
- F. Storage Prior to Delivery to Owner: Prior to furnishing spare parts and extra materials to Owner, store spare parts and extra materials in accordance with the Contract Documents and manufacturers' recommendations.
- G. Delivery Time and Eligibility for Payment:
 - 1. Deliver to Owner spare parts and extra materials prior to date of Substantial Completion for equipment or system associated with the spare parts and extra materials. Do not deliver spare parts and extra materials before commencing start-up for associated equipment or system.
 - 2. Spare parts and extra materials are not eligible for payment until delivered to Owner and Contractor's receipt of Owner's countersignature on letter of transmittal.
- H. Procedure for Delivery to Owner:
 - 1. Deliver spare parts and extra materials to Owner's permanent storage rooms at the Site or area(s) at the Site designated by Owner.
 - 2. When spare parts and extra materials are delivered, Engineer and Owner will mutually inventory the spare parts and extra materials delivered to verify compliance with the Contract Documents regarding quantity and part numbers.
 - 3. Additional procedures for delivering spare parts and extra materials to Owner, if required, will be developed by Engineer and complied with by Contractor.
- I. Transfer Documentation:
 - 1. Furnish on Contractor letterhead a letter of transmittal for spare parts and extra materials furnished under each Specification Section. Letter of transmittal shall accompany spare parts and extra materials. Do not furnish letter of transmittal separate from associated spare parts and extra materials.
 - 2. Furnish three original, identical, signed letters of transmittal for each Specification Section. Upon delivery of specified quantities and types of spare parts and extra materials to Owner, designated person from Owner will countersign each original letter of transmittal indicating Owner's receipt of spare parts and extra materials.
 - a. Owner will retain one fully signed original.
 - b. Contractor shall submit one fully signed original to Engineer.

- c. Contractor shall retain one fully signed original for Contractor's file.
- 3. Letter of transmittal shall include the following:
 - a. Information required by Contract Documents for submittal of letters of transmittal.
 - b. Transmittal shall list spare parts and extra materials furnished under each Specification Section. List each individual part or product and quantity furnished.
 - c. Provide space for countersignature by Owner as follows: space for signature, space for printed name, and date.
- J. Contractor shall be fully responsible for loss or damage to spare parts and extra materials until spare parts and extra materials are received by Owner.

1.02 SUBMITTALS

- A. Action/Informational Submittals: Individual Specification Sections that require spare parts, extra material, or tools, Contractor shall submit inventory checklist for each individual Specification Section that includes the following information:
 - 1. Specification Section number and title.
 - 2. Name of spare parts, extra material, or tools.
 - 3. Manufacturer, part number and description.
 - 4. Quantity specified and furnished.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

[END OF SECTION]

SECTION 01821
INSTRUCTION OF OWNER'S PERSONNEL

PART 1 – GENERAL

1.01 SUMMARY

- A. Contractor shall furnish services of operation and maintenance training specialists to instruct Owner's personnel in recommended operation and maintenance procedures for materials and equipment furnished, in accordance with the Contract Documents.
- B. Contractor shall provide a combination of classroom and field training at the Site, unless otherwise required elsewhere in the Contract Documents.
- C. Owner reserves the right to record training sessions on video for Owner's later use in instructing Owner's personnel.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Definitions:
 - 1. Training -Manufacturer's verbal, visual, and written presentation of materials to Owner's staff to ensure that any Owner personnel undergoing training understand the Manufacturer's recommended procedures to properly operate and maintain the equipment and systems for the expected service life.
- B. Qualifications:
 - 1. Contractor's instructors shall be factory-trained by manufacturer of material or equipment.
 - 2. Contractor's instructors shall be proficient and experienced in conducting training of type required.
 - 3. Qualifications of instructors are subject to acceptance by Engineer. If Engineer does not accept qualifications of proposed instructor, furnish services of replacement instructor with acceptable qualifications.
- C. Scheduling:
 - 1. General:
 - a. Contractor shall coordinate training services with start-up and initial operation of materials and equipment on days and times, and in manner, acceptable to Owner, in accordance with the Contract Documents.

- b. Training may be required outside of normal business hours to accommodate schedules of operations and maintenance personnel. Furnish training services at the required days and times at no additional cost to Owner.
 - c. Prerequisites to Training: Training of Owner's personnel shall commence after acceptable preliminary operation and maintenance data has been submitted and work required in Section 01670 – Checkout and Startup Procedures is complete.
- 2. Training Schedule Submittal:
 - a. Training Schedule Required: Contractor shall prepare and submit proposed training schedule for review and acceptance by Engineer and Owner. Proposed training schedule shall show all training required in the Contract Documents, and shall demonstrate compliance with specified training requirements relative to number of hours of training, number of training sessions, and scheduling.
 - b. Timing of Training Schedule Submittal: Submit initial training schedule at least thirty days before scheduled start of first training session. Submit final training schedule, incorporating revisions in accordance with Engineer's comments, no later than seven days prior to starting the first training session.
 - c. Owner reserved the right to modify personnel availability for training in accordance with process or emergency needs at the Site.

1.03 TRAINING REQUIREMENTS

A. General Lesson Plan Requirements:

- 1. Contractor's lesson plan shall describe specific instruction topics, system components for which training will be furnished, and training procedures. Handouts, if any, to be used in training shall be included with the lesson plan. Describe in lesson plan "hands-on" demonstrations planned for training sessions.
- 2. Submit acceptable lesson plan 7 days prior to starting associated training.
- 3. Lesson plan shall include estimated duration of each training segment.

B. Specific Lesson Plans Requirements:

- 1. Equipment overview shall cover the following:
 - a. Equipment's operating (process) function, performance objectives, and fundamental operating principles.

- b. Equipment's mechanical, electrical, and electronic components and features. Group related components into subsystems and describe function of subsystem and subsystem's interaction with other subsystems.
 - c. Support equipment and appurtenances.
 - d. Safety and potential hazards.
 - e. Safety and control interlocks.
- 2. Operations personnel training shall cover the following:
 - a. Equipment overview: As described in this Section.
 - b. Operation:
 - 1) Principles, operating, start-up, and shutdown procedures.
 - 2) Abnormal or emergency start-up, operating, and shutdown procedures.
 - 3) Alarm conditions and responses.
 - 4) Monitoring and recordkeeping.
 - 5) Housekeeping.
 - c. Troubleshooting: Required corrective maintenance or an operating parameter adjustment.
- 3. Maintenance personnel training:
 - a. Equipment overview: As described in this Section.
 - b. Equipment preventive maintenance:
 - 1) Inspection procedures:
 - a) Operation.
 - b) Trouble symptoms and anticipate breakdowns.
 - c) Predictive maintenance.
 - 2) Preventative maintenance intervals.
 - 3) Lubricant and replacement parts.
 - 4) Cleaning practices and intervals.
 - 5) Special tools required.

- 6) Removal, installation, and disassembly and assembly procedures.
- 7) "Hands-on" demonstrations of preventive maintenance procedures.
- 8) Measuring instruments and procedures.
- 9) Torqueing, mounting, calibrating, and aligning procedures and settings requirements.
- 10) Check and test equipment following corrective maintenance.

4. Equipment Troubleshooting:

- a. Systematic troubleshooting procedures.
- b. Checklists.
- c. Testing and diagnostic procedures.
- d. Corrective maintenance procedures with "hands on" demonstrations.

C. Training Aids:

1. Contractor's instructor shall incorporate training aids as appropriate to assist in the instruction. Provide handouts of text, tables, graphs, and illustrations as required. Other appropriate training aids include:
 - a. Audio-visual aids.
 - b. Equipment cutaways and samples.
 - c. Tools, including special tools.
2. Podium presentation aids: Presentation shall cover equipment, products and materials provided. Provide electronic version of presentation material to Engineer.
 - a. Electronic version of presentation aids shall be Microsoft PowerPoint or equivalent format.
 - b. Presentation shall include the following sections:
 - 1) Complete system overview including, but not limited to, related and associated equipment specific to the system.
 - 2) Specific equipment requirements and how equipment functions within the overall system.
 - 3) Site specific system and equipment requirements.

- c. Hardcopy handouts of the electronic presentation aids shall be provided prior to each training section for review during podium presentation.
- 3. Handouts:
 - a. Contractor's instructor shall distribute and use descriptive handouts during training.
 - b. Handouts should be coordinated with the instruction
 - c. Provide at least ten copies of handouts for each training session
- 4. Audio-visual Equipment: Training provider shall provide audio-visual equipment required for training sessions.

1.04 SUBMITTALS

A. Action/Informational Submittals:

- 1. Training Schedule: Detailed schedule of training sessions, demonstrating compliance with number of training sessions, hours required in the Contract Documents, and complying with the Contract Times. Submit training schedule submittals in accordance with timeframes specified in this Section.
- 2. Lesson Plan: Acceptable lesson plan for training on each material or equipment item, in accordance with the Contract Documents. Lesson plan shall comply with requirements of this Section. Include with lesson plan copy of handouts that will be used during training sessions. Provide lesson plan submittals in accordance with timeframes specified in this Section.
- 3. Podium presentation material, electronic version.

B. Closeout Submittals:

- 1. Trainee sign-in sheet for each training session. Submit to Owner's training coordinator.

C. Quality Assurance Submittals:

- 1. Qualifications: Credentials of Contractor's proposed operations and maintenance instructor(s). Credentials shall demonstrate compliance with requirements of this Section and shall include brief resume' and specific details of instructor's operating, maintenance, and training experience relative to the specific material and equipment for which instructor will provide training.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 “HANDS-ON” DEMONSTRATIONS

- A. Contractor’s instructor shall provide “hands-on” demonstration of operations and maintenance of equipment and materials for each training session.
- B. Contractor shall furnish tools and appurtenances required for demonstrations.

3.02 SCHEDULE

- A. Contractor shall furnish the hours of training and number of sessions indicated in the individual specifications, at a minimum. Travel time and expenses are the responsibility of the manufacturer and are excluded from required training time indicated in the Contract Documents.
- B. Training shall be scheduled during day shift, normal working hours unless otherwise approved by Owner or Engineer.
- C. Training shall be provided for a minimum of two identical sessions, unless otherwise specified, with each session scheduled for different weeks.

[END OF SECTION]

SECTION 02010

SUBSURFACE INVESTIGATION

PART 1 – GENERAL

1.01 RESPONSIBILITY

- A. If subsurface explorations have been performed, copies of the results will be made available for informational purposes only. These test boring logs and geotechnical reports are not part of the Contract Documents.
- B. Subsurface information was obtained primarily for use in preparing foundation design. The Contractor may draw his own conclusions therefrom. No responsibility is assumed by the Owner for subsoil quality or condition. No claim for extra compensation or extension of time will be allowed on account of subsurface conditions inconsistent with the data shown.
- C. Such information and data are not intended as a representation or warranty of continuity of conditions between soil borings or test pits, nor of groundwater levels at dates and times other than date and time when measured, nor that purpose of obtaining the information and data were appropriate for use by Contractor. Owner will not be responsible for interpretations or conclusions drawn therefrom by Contractor.
- D. Soil borings and other exploratory operations may be made by Contractor, at no additional cost to Owner. Coordinate Contractor-performed test borings and other exploratory operations with Owner and utility owners as appropriate. Perform such explorations without disrupting or otherwise adversely affecting operations of Owner or utility owners. Comply with Laws and Regulations relative to required notifications.

PART 2 – PRODUCTS

2.01 SOIL BORINGS

- A. Copies of the following, where available, will be made available for informational purposes only:
 - 1. Geotechnical engineering report(s).
 - 2. Soil boring log(s).

PART 3 – EXECUTION (NOT USED)

[END OF SECTION]

SECTION 02050

DEMOLITION

PART 1 – GENERAL

1.01 WORK INCLUDED

- A. Demolish designated structures.
- B. Remove materials from the site.
- C. Remove foundations.
- D. Remove underground tanks and piping, unless noted otherwise.
- E. Disconnect, cap, remove, and identify utilities.

1.02 RELATED WORK

- A. Section 01510 – Temporary Utilities.
- B. Section 01560 - Temporary Controls.
- C. Section 02100 - Clearing and Grubbing.

1.03 SUBMITTALS

- A. Submit demolition and removal procedures and schedule under provisions of General Conditions.
- B. Demolition and Removal Plan: Not less than ten days prior to starting demolition Work, submit acceptable plan for demolition and removal Work, including:
 - 1. Plan for coordinating shut-offs, capping, temporary services, and continuing utility services.
 - 2. Other proposed procedures as applicable.
 - 3. Equipment proposed for use in demolition operations.
 - 4. Recycling/disposal facility(ies) proposed, including facility owner, facility name, location, and processes. Include copy of appropriate permits and licenses, and compliance status.
 - 5. Planned demolition operating sequences.
 - 6. Detailed schedule of demolition Work in accordance with the accepted Project Schedule.
- C. Copies of all photographs and other records from the joint existing conditions surveys.
- D. Submit notification of intended demolition start in writing at least 48 hours prior to commencing demolition or removal. Do not start removals without permission of Owner.

1.04 EXISTING CONDITIONS

- A. Conduct demolition to minimize interference with adjacent structures.
- B. Provide, erect, and maintain temporary barriers and security devices.
- C. Conduct operations with minimum interference to public or private thoroughfares. Maintain a protected egress and access at all times.
- D. The Owner does not assume responsibility for the actual condition of structures and equipment to be demolished and removed.
- E. Conditions existing at the time of inspection for bidding purposes will be maintained by the Owner so far as practicable.
- F. The information regarding the existing structures and equipment shown on the Drawings is based on visual inspection and a walkthrough survey only. The Owner will not be responsible for interpretations or conclusions drawn therefrom by the Contractor.

1.05 TITLE TO EQUIPMENT AND MATERIALS

- A. Contractor shall have no right or title to any of the equipment, materials, or other items to be removed from the existing buildings or structures unless and until said equipment, materials, and other items have been removed from the premises. The Contractor shall not sell or assign or attempt to sell or assign any interest in the said equipment, materials, or other items until the said equipment, materials, or other items have been removed.
- B. Contractor shall have no claim against the Owner because of the absence of such fixtures and materials.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 PREPARATIONS

- A. Prevent movement or settlement of adjacent structures. Provide bracing and shoring.
- B. Protect existing landscaping materials, appurtenances, structures, which are not to be demolished.
- C. Disconnect, remove, and cap designated utility lines within demolition areas.
- D. Mark location of disconnected utilities. Identify utilities and indicate capping locations on Project Record Documents.
- E. Prior to the execution of the work, the Contractor and Owner shall jointly survey the condition of the adjoining and/or nearby pavements and structures. Photographs and records shall be made of any prior settlement or cracking of structures, pavements, and the like, that may become the subject of possible damage claims. Contractor shall provide Owner a copy of all records of the joint survey of conditions before demolition activities may begin. Contractor shall provide copies of the existing conditions survey report to the Owner before any demolition or construction activities begin.

3.02 PROTECTION

- A. Demolition and removal work shall be performed by competent experienced workmen for the various type of demolition and removal work and shall be carried out through to completion with due regard to the safety of Owner employees, workmen on site and the public. The work shall be performed with as little nuisance as possible.
- B. The work shall comply with the applicable provisions and recommendation of OSHA all governing codes, and as hereinafter specified.
- C. The Contractor shall make such investigations, explorations, and probes as are necessary to ascertain any required protective measures before proceeding with demolition and removal. The Contractor shall give particular attention to shoring and bracing requirements to prevent any damage to new or existing construction.
- D. The Contractor shall provide, erect, and maintain catch platforms, lights, barriers, weather protection, warning signs and other items as required for proper protection of the public, occupants of the building, workmen engaged in demolition operations, and adjacent construction.
- E. The Contractor shall provide and maintain weather protection at exterior openings to fully protect the interior premises against damage from the elements until such openings are closed by new construction.
- F. The Contractor shall provide and maintain temporary protection of the existing structure designated to remain where demolition, removal and new work is being done, connections made, materials handled, or equipment moved.
- G. The Contractor shall take necessary precautions to prevent dust from rising by wetting demolished masonry, concrete, plaster, and similar debris. Unaltered portions of the existing buildings affected by the operations under this Section shall be protected by dust proof partitions and other adequate means.
- H. The Contractor shall provide adequate fire protection in accordance with local Fire Department requirements.
- I. The Contractor shall not close or obstruct walkways, passageways, or stairways and shall not store or place materials in passageways, stairs, or other means of egress. The Contractor shall conduct operations with minimum traffic interference.
- J. The Contractor shall be responsible for any damage to the existing structure or contents by reason of the insufficiency of protection provided.
- K. When structures are adjacent to demolition activities, before commencing demolition, provide surveyed elevation benchmarks on structure at locations directed by Engineer. Record and report the elevation of each benchmark after demolition and at least once a day while demolition is in progress. Should benchmark readings indicate displacement, halt demolition activities until corrective action is provided acceptable to Engineer.

3.03 DEMOLITION

- A. Demolish indicated structures and appurtenances in an orderly and careful manner, and in

accordance with staging requirements.

- B. Work shall be performed in such manner as not to endanger the safety of the workmen or the public or cause damage to nearby structures. Cease operations and notify the Engineer immediately if adjacent structures appear to be endangered. Do not resume operations until corrective measures have been taken.
- C. Except where noted otherwise, immediately remove demolished material from site.
- D. Remove salvage materials to be re-installed or retained in a manner that prevents damage. Store and protect.
- E. Remove and promptly dispose of contaminated, vermin infested, or dangerous materials encountered.
- F. Remove foundation walls and footings to a minimum two feet below finished grade.
- G. Remove concrete slabs on grade in their entirety.
- H. Backfill excavated areas, open pits, and holes caused as a result of demolition. Excavation caused by demolition shall be backfilled with fill free from rubbish and debris.
- I. Keep work sprinkled to minimize dust. Provide hoses and watermain or hydrant connections for this purpose.
- J. Rough grade and compact areas affected by demolition to maintain site grades and contours.
- K. Remove demolished materials from site as work progresses. Leave site in clean condition.
- L. Where parts of existing pavements or structures are to remain in service, demolish the portions to be removed, repair damage, and leave the pavement or structure in proper condition for the intended use. Remove asphalt or concrete pavement, concrete, and masonry to the lines designated by saw-cutting, drilling, chipping, or other suitable methods. Leave the resulting surfaces reasonably true and even, with sharp straight corners that will result in neat joints with new construction and be satisfactory for the purpose intended. Where existing reinforcing rods are to extend into new construction, remove the concrete so that the reinforcing is clean and undamaged. Cut off other reinforcing 1/2-inch below the surface and fill with epoxy resin binder flush with the surface.
- M. Wherever piping is to be removed for disposition, the piping shall be drained by the Contractor and adjacent pipe and headers that are to remain in service shall be blanked off or plugged and then anchored in an approved manner.
- N. The Contractor shall remove temporary work, such as enclosures, signs, guards, and the like when such temporary work is no longer required or when directed at the completion of the work.

3.04 DISPOSAL

- A. All debris resulting from the demolition and removal work shall be disposed of by the Contractor at a properly permitted facility as part of the work of this Contract. Material designated to be salvaged shall be stored on the construction site as directed. All other

material shall be disposed of off-site by the Contractor at his expense.

- B. Burning or burying of any debris resulting from the demolition will not be permitted at the site.

3.05 MAINTENANCE

- A. The Contractor shall maintain the buildings, structures, and public properties free from accumulations of waste, debris, and rubbish, caused by the demolition and removal operations.
- B. The Contractor shall provide on-site dump containers for collection of waste materials, debris, and rubbish, and he shall wet down dry materials to lay down and prevent blowing dust.
- C. At reasonable intervals during the progress of the demolition and removal work or as directed by the Engineer, the Contractor shall clean the site and properties, and dispose of waste materials, debris, and rubbish.

3.06 SALVAGE ITEMS

- A. Materials and equipment to remain Owner's property shall be carefully removed and appropriately handled by Contractor to avoid damage and invalidation of warranties in effect, and shall be cleaned and stored at the Site (or other site specified in the Contract Documents) at place designated by Engineer or Owner.

[END OF SECTION]

SECTION 02064

MODIFICATIONS TO EXISTING STRUCTURES AND EQUIPMENT

PART 1 – GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required to modify, alter, and/or convert existing equipment, structures, piping, and appurtenances as shown or specified, and as required for the installation of new equipment, structures, piping, and appurtenances.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 GENERAL

- A. The Contractor shall cut, repair, reuse, excavate, demolish, or otherwise remove parts of the existing structures or appurtenances, as indicated on the Contract Drawings, herein specified, or necessary to permit completion of the work under this Contract. Dispose of surplus materials resulting from the above work in an approved manner, in accordance with the Contract Documents, and at no additional cost to the Owner. The Work shall include all necessary cutting and bending of reinforcing steel, structural steel, or miscellaneous metal work found embedded in the existing structures.
- B. At the time that a new connection is made to an existing equipment unit, control panel, or structure new work shall be installed to the limits shown on the Drawings, or as specified herein.
- C. No existing structure, equipment, piping, or appurtenance shall be shifted, cut, removed, or otherwise altered except as shown on the Drawings, as specified herein, or approved by Owner in writing.
- D. When removing materials or constructing openings in structures, the Contractor shall take all precautions and use all necessary barriers and other protective devices so as not to damage the structures beyond the limits necessary for the new Work.
- E. Materials and equipment that are removed to accommodate the modifications to existing structures and equipment shall remain the property of the Owner. However, items that are not salvageable, as determined by the Owner, shall become the property of the Contractor to be disposed of offsite.
- F. All alterations to existing equipment and structures shall be done at such time and in such manner that complies with the project schedule. Prior to execution of the Work, all tools, equipment, and materials shall be onsite, assembled, and made ready so that the Work can be completed without delay.
- G. All cutting of existing material shall be done in a manner that provides suitable bonding for the new Work.
- H. Where necessary or required for the purpose of making connections, the Contractor shall cut existing pipelines in a manner to provide an approved joint. Provide flanges or couplings, as

required.

- I. Provide caps, plugs, bulkheads, or other means to provide isolation and flow control in the performance of the Work under this Contract.
- J. Blasting will not be permitted to complete any work under this Contract. Care shall be taken not to damage any part of existing buildings or foundations or outside structures.
- K. The Contractor shall cut out embedded anchorage and attachment items as required to properly provide for patching and repair of the respective finishes.
- L. All supports, pedestals, and anchors shall be removed with the equipment and piping unless otherwise specified or required. Concrete bases, anchor bolts and other supports shall be removed to approximately 1 inch below the surrounding finished area and the recesses shall be patched to match the adjacent areas. Superstructure wall and roof openings shall be closed, and damaged surfaces shall be patched to match the adjacent areas, as specified under applicable Sections of these Specifications, as shown on the Drawings, or as directed by the Owner. Wall sleeves and castings shall be plugged or blanked off, all openings in concrete shall be closed in a manner meeting the requirements of the appropriate Sections of these Specifications, as shown on the Drawings, and as directed and approved by the Owner.
- M. Where alterations occur, or new and old work join, the Contractor shall cut, remove, patch, repair, or refinish the adjacent surfaces to the extent required by the construction conditions, to leave the altered work in as good a condition as existed prior to the start of the work. The materials and workmanship employed in the alterations, unless otherwise shown on the Drawing or specified, shall comply with that of the various respective trades which normally perform the particular items of work.
- N. The Contractor shall finish adjacent existing surfaces to new work to match the specified finish for new work. The Contractor shall clean existing surfaces of dirt, grease, loose paint, etc., before refinishing.

3.02 CLEANING EXISTING STRUCTURES

- A. Before commencing work on any structures, the Contractor shall prepare the Work surfaces by removing and disposing of all liquid, wastewater, settled solids, and debris from within structures.

3.03 CONNECTING TO EXISTING EQUIPMENT AND STRUCTURES

- A. The Contractor shall field verify the properties of existing equipment and structures prior to making the connections indicated in the Drawings. The verifications shall be performed with adequate time to correct any potential alignment or other problems prior to the actual time of connection.

[END OF SECTION]

SECTION 02100

CLEARING AND GRUBBING

PART 1 – GENERAL

1.01 SCOPE OF WORK

- A. The Work to be performed shall include the clearing and grubbing of the area of Work designated on the Drawings.
- B. Clearing shall consist of the cutting, removal, and clearing of the surface of all trees (except for those marked to remain), stumps, bushes, logs, down timber, hedges, snags, brush, undergrowth, grass and weeds, and other encumbrances or loose or projecting material including fences, structures, debris, rubbish from within the limits of disturbance indicated on the Drawings. The grubbing of stumps, roots, foundations shall be required.
- C. Principal items of work also include:
 - 1. Notifying all authorities owning utility lines running to or on the property. Protecting and maintaining all utility lines to remain and capping those that are not required in accordance with instructions of the utility companies, and all other authorities having jurisdiction.
 - 2. Barricading and protecting all trees, shrubs, lawns and the like within areas to be preserved. Relocating trees and shrubs, so indicated on the Drawings, to designated areas.
 - 3. Repairing all injury to trees, shrubs, and other plants caused by site preparation operations. Work shall be completed under the direction of a Certified and Licensed Arborist or Landscape Architect.
 - 4. Removing topsoil to its full depth from designated areas and stockpiling on site for future use.
 - 5. Disposing from the site all debris resulting from work under this Section.

1.02 REFERENCES

- A. Florida Department of Transportation Standard Specifications for Road and Bridge Construction (F.D.O.T.) latest edition.

1.03 STREET AND ROAD BLOCKAGE

- A. Closing of streets and roads during progress of the Work shall be in compliance with the requirements of the Owner and other authorities having jurisdiction. Access shall be provided to all facilities remaining in operation.

1.04 PROTECTION OF PERSONS AND PROPERTY

- A. All Work shall be performed in such a manner to protect all personnel, workmen, pedestrians, and adjacent property and structures from possible injury and damage.

- B. All conduits, wires, cables, and appurtenances above or below ground shall be protected from damage.
- C. Provide warning and barrier fence where shown on the Drawings and as specified herein.

PART 2 – PRODUCTS

2.01 MATERIALS FOR PLACEMENT

- A. All materials required to be brought on to the site for filling of holes caused by grubbing or otherwise shall be consistent with materials of the surrounding area.

PART 3 – EXECUTION

3.01 SCHEDULE

- A. Contractor shall schedule the clearing and grubbing work in advance of the Work and in coordination with the Owner.

3.02 SPOIL MATERIALS REMOVAL

- A. All spoil materials shall be removed from the Site and disposed of by Contractor.

3.03 CLEARING

- A. Clear the area of all objectionable materials. Limbs of trees scheduled for removal that fall outside of the limits of disturbance shall be removed and disposed of in a satisfactory manner. Preserve and protect from injury all trees not scheduled for removal.
- B. The area shall be cut to a height of not more than 12 inches above the ground surface. The grubbing of stumps and roots will be required.
- C. Fences shall be removed and disposed of when directed by Owner. Fence wire shall be neatly rolled and the wire and posts stored on the project if they are to be used again, or stored at a designated location if the fence is to remain the property of Owner.
- D. Before removal of topsoil, and start of excavation and grading operations, the areas within the clearing limits shall be cleared and grubbed.
- E. Clearing shall consist of cutting, removal, and satisfactory disposal of all trees, fallen timber, brush, bushes, rubbish, sanitary landfill material, fencing, and other perishable and objectionable material within the areas to be excavated or other designated areas. Prior to the start of construction, the Contractor shall survey the entire Contract site and shall prepare a plan which defines the areas to be cleared and grubbed, trees to be pruned, extent of tree pruning, and/or areas which are to be cleared but not grubbed. This plan shall be submitted to the Owner for approval. Should it become necessary to remove a tree, bush, brush, or other plants adjacent to the area to be excavated, the Contractor shall do so only after permission has been granted by the Owner.
- F. Excavation resulting from the removal of trees, roots and the like shall be filled with suitable material, as approved by the Engineer, and thoroughly compacted in accordance with Section 02200 - Earthwork.

- G. Unless otherwise shown or specified, the Contractor shall clear and grub a strip at least 15 ft. wide along all permanent fence lines installed under this Contract.
- H. In temporary construction easement locations, only those trees and shrubs shall be removed which are in actual interference with excavation or grading work under this Contract, and removal shall be subject to approval by the Owner. However, the Owner reserves the right to order additional trees and shrubs removed at no additional cost to the Owner, if such, in his opinion, are too close to the Work to be maintained or have become damaged due to the Contractor's operations.

3.04 STRIPPING AND STOCKPILING EXISTING TOPSOIL

- A. Existing topsoil and sod on the site within areas designated on the Drawings shall be stripped to whatever depth it may occur and stored in locations designated by the Owner.
- B. The topsoil shall be free of stones, roots, brush, rubbish, or other unsuitable materials before stockpiling the topsoil.
- C. Care shall be taken not to contaminate the stockpiled topsoil with any unsuitable materials.

3.05 GRUBBING

- A. Grubbing shall consist of the removal and disposal of all stumps, roots, logs, sticks and other perishable materials to a depth of at least 6 inches below ground surfaces.
- B. Large stumps located in areas to be excavated may be removed during grading operations, subject to the approval of the Owner.
- C. All holes remaining after the grubbing operation in embankment areas shall have the sides broken down to flatten out the slopes, and shall be filled with acceptable material, moistened and properly compacted in layers to the density required. The same construction procedure shall be applied to all holes remaining after grubbing in excavation areas where the depth of holes exceeds the depth of the proposed excavation.

3.06 DISPOSAL OF MATERIAL

- A. All debris resulting from the clearing and grubbing work shall be disposed of by the Contractor as part of the work of this Contract. Material designated to be salvaged shall be stored on the construction site as directed for reuse in this Project or removal by others.
- B. Burning of any debris resulting from the clearing and grubbing work will not be permitted at the site.

3.07 WARNING AND TREE PROTECTION BARRIER FENCE

- A. Tree protection barriers shall be as detailed in the City of Largo Engineering Design and Construction Standards (latest edition).

[END OF SECTION]

SECTION 02200

EARTHWORK

PART 1 – GENERAL

1.01 RESPONSIBILITY

- A. The Contractor shall furnish all labor, equipment, and materials required to complete all work associated with excavation (including off-site borrow excavation), fill and backfill placement and compaction, testing of soil materials and compaction by an independent materials testing consultant, constructing embankments, dewatering, construction of drainage layers, installing foundation and backfill aggregate, placing filter and separation fabrics, stockpiling topsoil and any excess suitable material, designing, installing, maintaining and removing excavation support systems, disposing of all excess and unsuitable materials, providing erosion and sedimentation control, encasing utility conduits, site grading, preparation of pavement and structure subgrades, and other related and incidental work as required to complete the work shown on the Drawings and as specified herein.
- B. All excavations shall be in conformity with the lines, grades, and cross sections shown on the Drawings or established by the Engineer.
- C. It is the intent of this Specification that the Contractor conduct the construction activities in such a manner that erosion of disturbed areas and off-site sedimentation be absolutely minimized.
- D. Earthwork performed under this Contract shall be done in conformance with these specifications. Items and activities not addressed herein shall be subject to the limitations of the latest editions of the Florida Department of Transportation Standard Specifications for Road and Bridge Construction. If there is a conflict between this specification and the Standard Specifications for Roads and Structures, the more conservative of the two shall take precedent.
- E. Erosion and Sediment Control shall be performed in accordance with individual specifications, the Drawings, and with the latest edition of the Florida Stormwater, Erosion, and Sedimentation Control Inspector Manual (FSESCI Tier I). If there is a conflict between this specification and the FSESCI, the more conservative of the two shall take precedent.
- F. All fill materials (soil, aggregate, topsoil, etc.) imported to the site and onsite materials to be reused as fill, backfill, or embankment shall be subjected to the testing requirements contained in Part 3.0 of this Section. The Contractor shall retain a materials testing consultant who shall perform all testing. The test results shall be used to determine if a material meets the requirements included herein. The Contractor shall furnish all necessary samples for laboratory testing and shall provide assistance and cooperation during field tests. The Contractor shall plan their operations to allow adequate time for laboratory tests and to permit taking of field density tests during compaction.
- G. Any costs for re-testing required as a result of failure to meet compaction requirements shall be borne solely by the Contractor.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of the other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced Specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Florida Department of Transportation Standard Specifications for Road and Bridge Construction
2. Florida Department of Transportation Section 120 "Excavation and Embankment".
3. American Society for Testing and Materials (ASTM):
 - a. ASTM C 127 – Standard Test Method for Relative Density (Specific Gravity) and Absorption of Coarse Aggregate.
 - b. ASTM C 136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - c. ASTM D 698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft³ (600 kN-m/m³))
 - d. ASTM D 1140 – Standard Test Method for Determining the Amount of Material Finer than 75-μm (No. 200) Sieve in Soils by Washing
 - e. ASTM D 1556 – Standard Test Method for Density and Unit Weight of Soil in Place by Sand Cone Method.
 - f. ASTM D 1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb/ft³ (2,700 kN-m/m³)).
 - g. ASTM D 1883 – Standard Test Method for California Bearing Ratio (CBR) of Laboratory-Compacted Soils.
 - h. ASTM D 2216 – Test for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
 - i. ASTM D 2487 – Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
 - j. ASTM D 4253 – Standard Test Method for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
 - k. ASTM D 4318 – Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
 - l. ASTM D 6913 - Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis
 - m. ASTM D 6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil Aggregate by Nuclear Methods (Shallow Depth).

1.03 SUBSURFACE CONDITIONS

- A. Information on subsurface conditions is referenced under Section 02010 – Subsurface Investigation.
- B. Attention is directed to the possible location of water pipes, sanitary pipes, storm drains, and other utilities located in the area of proposed excavation. In the event that excavation activities disrupt service, the Contractor shall perform all repairs at no additional cost to the Owner. The

Contractor shall contact Sunshine 811 or 1-800-432-4770 to request underground utility location mark-out at least three (3) working days, not including the day the request is called in, but no more than ten (10) working days prior to the beginning of excavation. The Contractor shall also contact and request utility location mark-out from buried utility owners with utilities on the project site that are not participants of Sunshine 811.

1.04 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300 – Submittals, the Contractor shall submit the following:
 - 1. Name and location of all material suppliers.
 - 2. List of disposal sites for waste and unsuitable materials and all required permits for use of those sites.
 - 3. Procedures for dewatering proposed by the Contractor shall be submitted for review and approval prior to any earthwork operations.
 - 4. Temporary excavation support system design engineer qualifications.
 - 5. Construction drawings and structural calculations for any types of excavation support required. Drawings and calculations shall be sealed by a currently registered Professional Engineer licensed in the State of Florida. Contractor shall also submit a monitoring plan developed by the excavation support design engineer.
 - 6. Pre-construction condition inspection and documentation of all adjacent structures, utilities, and roadways near proposed installation of excavation support systems and near areas where dewatering is required to facilitate construction.

1.05 PRODUCT HANDLING

- A. Soil and rock material shall be excavated, transported, placed, and stored in a manner so as to prevent contamination, segregation, and excessive wetting. Materials which have become contaminated or segregated will not be permitted in the performance of the work and shall be removed from the site.

1.06 USE OF EXPLOSIVES

- A. The use of explosives will not be allowed for the prosecution of this work.

PART 2 – PRODUCTS

2.01 FILL MATERIALS

- A. The Contractor shall be responsible for providing fill materials meeting the gradation requirements included herein.
- B. All fill materials shall be free of organic material, environmental contaminants, and other unsuitable material.
- C. Bedding material installed above and below the water table shall meet the requirements of the FDOT Standard Specifications for Road and Bridge Construction.

- D. Below-grade walls shall be backfilled with Select Fill.
- E. When the excavated material from required excavations meets the requirements of Select Fill or Common Fill, but is replaced with off-site borrow material for the Contractor's convenience, the costs associated with such work and material shall be borne by the Contractor.
- F. Where excavated material does not meet requirements for Select Fill or Common Fill, the Contractor shall furnish off-site borrow material meeting the specified requirements herein. Determination of whether the borrow material will be paid for as an extra cost will be made based on the Contract Documents.
- G. Contractor may stockpile excavated material to be used as Select Fill, Common Fill, Drainage Fill or Topsoil on site in areas designated in the Contract Documents. Soil materials may be stockpiled as necessary to sort, segregate, test, and transfer the materials. Excess material and materials considered unsuitable for reuse by the Owner shall be removed from the site for off-site disposal. No stockpiling of excavated material is allowed in a manner or location that would permit erosion and its subsequent sedimentation in wetlands or other natural areas.

2.02 SELECT FILL

- A. Select fill shall be used where shown on the Contract Drawings.
- B. Select fill shall not include particles or lumps larger than 3 inches.
- C. Select fill used as backfill against walls shall not contain any rock larger than 1½ -inches.
- D. Select fill shall consist of non-plastic materials classifying as GW, GW-GM, GP, SW, SW-SM, SP-SM, or SP per ASTM D-2487. Select fill shall be free of organic material, environmental contaminants, or other unsuitable material.
- E. Open-graded and dense-graded FDOT aggregates meeting the gradation requirements above may be used as Select Fill.
- F. Select Fill to be used as pavement subbase material shall be FDOT Aggregate Base Course.
- G. Select Fill shall be placed in 8-inch-thick lifts, with the exception of FDOT No. 57 stone, which may be placed in 12-inch-thick lifts.
- H. Select Fill shall be compacted to not less than 95 percent of the maximum dry density obtainable by ASTM D 698 and does not contain unsuitable material.
- I. Select Fill shall be compacted at a moisture content within 20 percent of the optimum moisture content of the fill material in accordance with the ASTM D 698, Standard Proctor.
- J. All materials used as Select Fill are subject to approval by the Owner.

2.03 DRAINAGE FILL

- A. Drainage Fill shall be used where shown on the Contract Drawings.
- B. Drainage Fill shall consist of FDOT No. 57 stone.

2.04 COMMON FILL

- A. Common Fill shall be used where shown on the Contract Drawings.
- B. Common Fill shall consist of non-organic on-site soils classifying as CH, MH, CL, ML, SC, SM, SP, SW, GC, GM, GP, or GW according to ASTM D 2487.
- C. Common Fill shall be placed in 8-inch-thick loose lifts.
- D. Common Fill shall be compacted to not less than 95 percent of the maximum dry density obtainable by ASTM D 698 and does not contain unsuitable material.
- E. Common Fill shall be compacted at a moisture content within 20 percent of the optimum moisture content of the fill material in accordance with the ASTM D 698, Standard Proctor.
- F. All material used as common fill is subject to approval by the Owner. If there is insufficient suitable material onsite, import whatever additional material is required which conforms to the specifications, at no additional cost to the Owner.
- G. Select Fill may be used as Common Fill, subject to approval by the Owner and at no additional cost to the Owner.

2.05 TOPSOIL

- A. Topsoil shall be friable and loamy (loam, sandy loam, silt loam, sandy clay loam, clay loam). It shall be free of debris, trash, stumps, rocks, roots, and noxious weeds, and shall give evidence of being able to support healthy vegetation. It shall contain no substance potentially toxic to plant growth. All topsoil shall be tested by a recognized laboratory for the following criteria: Organic matter content shall not be less than 1.5% by weight. pH range shall be from 6.0 -7.5. If pH is less than 6.0, lime shall be added in accordance with test results or in accordance with the recommendations of the vegetative establishment practice being used. Soluble salts shall not exceed 500 ppm. If additional topsoil is needed, it must meet the standards stated above.

2.06 GEOTEXTILES

- A. The Contractor shall provide geotextiles as indicated on the Contract Drawings and specified herein.

2.07 UNDERCUT AND STABILIZATION

- A. Where directed by Owner, undercut unsuitable materials and replace with No. 57 stone.

PART 3 – EXECUTION

3.01 STRIPPING

- A. All vegetation such as brush, heavy sods, heavy growth of grass, decayed vegetable matter, rubbish, and any other unsuitable material within the area upon which embankment is to be placed shall be stripped or otherwise removed before the embankment is started, and in no case shall such objectionable material be allowed in or under the embankment.
- B. In all areas to be excavated, filled, or paved, the topsoil shall be stripped to its full depth.
- C. Topsoil may be stockpiled for subsequent reuse on site at locations shown on the Contract Drawings or designated by the Owner. Topsoil shall be kept separated from other excavated materials and shall be piled free of roots and other undesirable materials. Topsoil shall not be

stored in areas where it will interfere with surface drainage or with the conservation of trees, shrubs, and other vegetation to remain. No stockpile shall be placed within 50-feet of a pond, stream, wetland, or stormwater inlet.

3.02 EXCAVATION

- A. All material excavated, regardless of its nature or composition, shall be classified as unclassified excavation. Excavation shall include the removal of all soil, rock, weathered rock, rocks of all types, boulders, conduits, pipe, all other obstacles encountered, and all other obstacles shown to be removed within the limits of excavation shown on the Contract Drawings or specified herein. No additional payment will be made for the removal of obstacles encountered within the excavation limits shown on the Drawings and specified herein.
- B. All suitable material removed in the excavation shall be used as far as practicable in the formation of embankments, subgrades, and shoulders, and at such other places as may be indicated on the Drawings or indicated by the Engineer. No excavation shall be wasted except as may be permitted by the Owner. The Engineer and/or materials testing consultant will designate materials that are unsuitable. The Contractor shall furnish off-site disposal areas for the unsuitable material. Where suitable materials containing excessive moisture are encountered above grade in cuts, the Contractor shall construct above grade ditch drains prior to the excavation of the cut material when in the opinion of the Engineer and/or materials testing consultant such measures are necessary to provide proper construction.
- C. All excavations shall be made in the dry and in such a manner and to such widths as will give ample room for properly constructing and inspecting the structures and/or piping they are to contain and for such excavation support, pumping, and drainage as may be required. Excavation shall be made in accordance with the grades and details shown on the Drawings and as specified herein.
- D. Excavation slopes shall be flat enough to avoid slides that will cause disturbance of the subgrade or damage of adjacent areas. Excavation requirements and slopes shall be as indicated in the Drawings.
- E. The Contractor shall intercept and collect surface runoff both at the top and bottom of cut slopes. The intersection of slopes with natural ground surfaces, including the beginning and ending of cut slopes, shall be uniformly rounded as shown on the Drawings or as may be indicated by the Engineer. Concurrent with the excavation of cuts the Contractor shall construct intercepting berm ditches or earth berms along and on top of the cut slopes at locations shown on the Drawings or designated by the Engineer. All slopes shall be finished to reasonably uniform surfaces acceptable for seeding and mulching operations. No rock or boulders shall be left in place which protrude more than 1 foot within the typical section cut slope lines, and all rock cuts shall be cleaned of loose and overhanging material. All protruding roots and other objectionable vegetation shall be removed from slopes.
- F. It is the intent of these Specifications that all structures shall bear on an aggregate base, crushed stone or screened gravel bedding placed to the thickness shown on the Drawings, specified in these Specifications, or not less than 6-inches. Bedding for buried piping shall be as shown on the Drawings.
- G. The bottom of all excavations for structures and pipes shall be examined by the Engineer and/or materials testing consultant for bearing value and the presence of unsuitable material. If, in the opinion of the Engineer and/or materials testing consultant, additional excavation is required due to the low bearing value of the subgrade material, or if the in-place soils are soft, yielding, pumping, or wet, the Contractor shall remove such material to the required width and depth and

replace it with thoroughly compacted select fill, and/or crushed stone or screened gravel as indicated by the Engineer. Payment for such additional work ordered by the Engineer shall be made as an extra by a Change Order in accordance with Section 01153. No payment will be made for subgrade disturbance caused by inadequate dewatering or improper construction methods.

- H. All cuts shall be brought to the grade and cross section shown on the Drawings, or established by the Engineer, prior to final inspection and acceptance by the Engineer.
- I. Slides and over-breaks which occur due to negligence, carelessness, or improper construction techniques on the part of the Contractor shall be removed and disposed of by the Contractor as indicated by the Engineer at no additional cost to the Owner. If grading operations are suspended for any reason whatsoever, partially completed cut and fill slopes shall be brought to the required slope and the work of seeding and mulching or other required erosion and sedimentation control operations shall be performed.

3.03 EXCAVATION SUPPORT

- A. The Contractor shall furnish, place, and maintain such excavation support which may be required to provide safe working conditions and support sides of excavation or to protect structures, pipes, and utilities from possible. The Contractor shall be exclusively responsible for maintaining safe working conditions and structure integrity without overstressing or damaging existing structures, pipes, and utilities resulting from the Contractor temporarily placing, moving, or removing loads on or adjacent to existing structures, pipes, and utilities. If the Engineer is of the opinion that at any point sufficient or proper supports have not been provided, the Engineer may order additional supports put in at the expense of the Contractor. The Contractor shall be responsible for the adequacy of all supports used and for all damage resulting from failure of support system or from placing, maintaining, and removing the support system.
- B. The selection of and design of any proposed excavation support systems is exclusively the responsibility of the Contractor. Contractor shall submit drawings and calculations to the Engineer on the proposed systems signed and stamped by a licensed Professional Engineer currently registered in the in the State of Florida.
- C. The excavation support system shall be installed by a specialized contractor with a minimum of five (5) years' experience installing the type of excavation support system proposed.
- D. The Contractor shall exercise caution in the installation and removal of supports to ensure no excessive or unusual loadings or vibrations are transmitted to any new or existing structure. The Contractor shall promptly repair at their expense any and all damage that can be reasonably attributed to installation or removal of excavation support system.
- E. Contractor shall monitor movement and vibration in the excavation support systems as well as movement and vibration at adjacent structures, utilities and roadways near excavation supports. Contractor shall submit a monitoring plan developed by the excavation support design engineer. All pre-construction condition assessment and documentation of adjacent structures on-site and off-site shall be performed by the Contractor. If any sign of distress such as cracking or movement occurs in any adjacent structure, utility or roadway during installation of supports, subsequent excavation, service period of supports, subsequent backfill and construction, or removal of supports, Engineer shall be notified immediately. The Contractor shall be exclusively responsible for repair of any damage to any roadway, structure, utility, pipes, etc. both on-site and off-site, as a result of their operations.

- F. All excavation supports shall be removed upon completion of the work except as indicated herein. The Engineer may permit supports to be left in place at the request and expense of the Contractor. The Engineer may order certain supports left permanently in place in addition to that required by the Contract. The cost of the materials so ordered left in place, less a reasonable amount for the eliminated expense of the removal work omitted, will be paid as an extra by a Change Order in accordance with Section 01153. Vibrations of new and existing structures shall be considered when the Contractor decides whether to remove excavation supports or leave them in place. Any excavation supports left in place shall be cut off at least two (2) feet below the finished ground surface or as directed by the Engineer.

3.04 PROTECTION OF SUBGRADE

- A. To minimize the disturbance of bearing materials and provide a firm foundation, the Contractor shall comply with the following requirements:
 - 1. Use of heavy rubber-tired construction equipment shall not be permitted on the final subgrade unless it can be demonstrated that drawdown of groundwater throughout the entire area of the structure is at least 3 feet below the bottom of the excavation (subgrade). Even then, the use of such equipment shall be prohibited should subgrade disturbance result from concentrated wheel loads.
 - 2. Subgrade soils disturbed through the operations of the Contractor shall be excavated and replaced with compacted select fill or crushed stone at the Contractor's expense as indicated by the Engineer.

3.05 PROOF-ROLLING

- A. The subgrade of all structures and all areas that will support pavements or select fill shall be proof-rolled. After stripping of topsoil, excavation to subgrade and prior to placement of fills, the exposed subgrade shall be carefully inspected by probing and testing as needed. Any topsoil or other organic material still in place, wet, soft, or loose soil, and other undesirable materials shall be removed. The exposed subgrade shall be proof-rolled with a heavily loaded tandem-wheeled dump truck to check for pockets of soft material hidden beneath a thin crust of better soil. Any unsuitable materials thus exposed shall be removed and replaced with an approved compacted material, as directed by the materials testing consultant.

3.06 DEWATERING

- A. The Contractor shall perform all dewatering as required for the completion of the work. Procedures for dewatering proposed by the Contractor shall be submitted to the Engineer for review prior to any earthwork operations.
- B. The dewatering system shall be of sufficient size and capacity as required to control groundwater or seepage, to permit proper excavation operations, embankment construction and reconstruction, and subgrade preparation, and to allow concrete to be placed in a dry condition. The system shall include a sump system or other equipment, appurtenances, and other related earthwork necessary for the required control of water. The Contractor shall drawdown groundwater to at least 2 feet below the bottom of excavations (subgrade), over the entire excavation area, at all times in order to maintain a dry and undisturbed condition.
- C. The Contractor shall control, by acceptable means, all water regardless of source. Water shall be controlled, and its disposal provided for at each berm, structure, etc. The entire periphery of the excavation areas shall be ditched and diked to prevent water from entering the excavation. The Contractor shall be fully responsible for disposal of the water and shall provide all necessary

means at no additional expense to the Owner. The Contractor shall be solely responsible for proper design, installation, proper operation, maintenance, and any failure of any component of the system.

- D. The Contractor shall be responsible for and shall repair without cost to the Owner, any damage to work in place and the excavation, including damage to the bottom due to heave and including removal of material and pumping out of the excavated area. The Contractor shall be responsible for damages to any other area or structure caused by their failure to maintain and operate the dewatering system proposed and installed by the Contractor.
- E. The Contractor shall be responsible for and shall repair, without cost to the Owner, any damage to work in place and nearby structures, roadways, and utilities which can be reasonably attributed to dewatering operations. This includes settlement of structures, roadways, and utilities due to dewatering of soils supporting the structures, roadways, and utilities.
- F. The Contractor shall take all the steps considered necessary to familiarize himself with the surface and subsurface site conditions, and shall obtain the data that is required to analyze the water and soil environment at the site and to assure that the materials used for the dewatering systems will not erode, deteriorate, or clog to the extent that the dewatering systems will not perform properly during the period of dewatering.
- G. Prior to the execution of the work, the Contractor, Owner and Engineer shall jointly survey the condition of adjoining structures. Photographs and records shall be made of any prior settlement or cracking of structures, pavements, and the like, that may become the subject of possible damage claims.
- H. If it is necessary to interrupt existing irrigation systems, sewers or under drainage conduits, utilities or similar underground structures, or parts thereof, the Contractor shall be responsible for and shall take all necessary precautions to protect and preserve or provide temporary services. When such facilities are encountered, the Contractor shall, at his own expense, satisfactorily repair all damage to such facilities or structures which may result from any of his operations during the period of the Contract.

3.07 FILL OR EMBANKMENTS

- A. Contractor shall perform the construction of fill or embankments in such a manner that cut and fill slopes will be completed to final slopes and grade in a continuous operation. The operation of removing excavation material from any cut and the placement of embankment in any fill shall be a continuous operation to completion unless otherwise permitted by the Engineer.
- B. Subgrades upon which fill or embankments are to be constructed shall be stripped of topsoil, organic material, rubbish and other extraneous materials. After stripping and prior to placing fill or embankment material, the Contractor shall compact the top 12inches of in-place soil as specified under this Section.
- C. Any soft or unsuitable materials revealed before or during placement fill or embankment placement shall be removed as indicated by the Engineer and/or materials testing consultant and replaced with select fill and compacted as required.
- D. Fill subgrades on which fill or embankment is to be placed, shall be scarified or stepped in a manner which will permit bonding of the embankment with the existing surface. The fill or embankment soils shall be as specified under Part 2 - Products, and shall be deposited and spread in successive, uniform, approximately horizontal layers. The loose thickness of each lift shall not exceed the thickness for each fill type noted herein.

- E. Hauling shall be distributed over the full width of the embankment, and in no case will deep ruts be allowed to form during the construction of the embankment. Fill or embankment subgrades shall be properly drained at all times and kept free of flowing or ponding water. Saturated soils, shall be removed as directed by the Engineer.
- F. Each layer of the embankment shall be thoroughly compacted to the density specified herein
- G. The embankment or fill material in the layers shall be of the proper moisture content before rolling to obtain the prescribed compaction. Moisture conditions and manipulation of the fill or embankment material, when necessary, shall be performed to maintain a uniform moisture content throughout the layer. Should the material be too wet or too dry to permit proper compaction, earthwork operations shall be delayed until the material is adequately moisture conditioned. Samples of all fill or embankment materials for testing, both before and after placement and compaction, will be taken at frequent intervals. From these tests, corrections, adjustments, and modifications of methods, materials, and moisture content will be made to construct the embankment.
- H. Where fill or embankments materials are to be placed and compacted on sloped subgrades steeper than 4:1 shall be benched. Benches shall be at least 6-feet wide.
- I. When rock and other embankment material are excavated at approximately the same time, the rock shall be incorporated into the outer portions of the embankments and the other material which meets the requirements for select fill shall be incorporated into the formation of the embankments. Stones or fragmentary rock larger than 4 inches in their greatest dimension will not be allowed within the top 6 inches of the final grade. Stones, fragmentary rock, or boulders larger than 12 inches in their greatest dimension will not be allowed in any portions of embankments and shall be disposed of by the Contractor as indicated by the Engineer. When rock fragments or stone are used in embankments, the material shall be brought up in layers as specified or directed and every effort shall be exerted to fill the voids with finer material to form a dense, compact mass which meets the densities specified for embankment compaction.

3.08 BACKFILLING

- A. All structures and pipes shall be backfilled with the type of materials shown on the Drawings and specified herein. Fill placed as structure or utility backfill shall be deposited in successive, uniform, approximately horizontal lifts.
- B. Each lift of fill placed backfill shall be thoroughly compacted to the density specified herein for each type of fill.
- C. Where excavation support is used, the Contractor shall take all reasonable measures to prevent loss of support beneath and adjacent to pipes and existing structures when supports are removed. If significant volumes of soil cannot be prevented from clinging to the extracted supports, the voids shall be continuously backfilled as rapidly as possible. The Contractor shall thereafter limit the depth below subgrade that supports will be installed in similar soil conditions or employ other appropriate means to prevent loss of support.
- D. Backfill against concrete or masonry structure shall not be performed until the Work has been reviewed and backfilling permitted. Backfill against walls shall also be deferred until the structural slab for floors above the top fill line have been placed and attained design strength or earlier at the discretion of the Engineer. Partial backfilling against adequately braced wall may be considered by the Engineer on an individual situation basis. Where walls are to be waterproofed, all Work shall be completed and membrane materials dried or cured according to the manufacturer's instructions before backfilling.

- E. Backfill against tanks and other structures which are to retain liquids shall not be performed until leakage tests are completed and accepted.

3.09 COMPACTION

- A. The Contractor shall compact embankments, backfill, crushed stone, aggregate base, and in-place subgrade in accordance with the requirements of this Section. The densities specified herein refer to percentages of maximum density as determined by the noted test methods. Compaction of materials on the project shall be in accordance with the following schedule:

	Density % Standard Proctor (D 698)	Density % Mod. Proctor (D 1557)	Max. Lift Thickness as Compacted Inches
Embankments Beneath Structures, Roadways, and Sidewalks*	98	92	8
Common Fill Areas	95	90	8
Backfill Around Structures	95	90	8
Backfill in Pipe Trenches	95	90	8
Crushed Stone Beneath Structures	**	**	12
Select Sand	98	92	8
Aggregate Base Course (ABC) Beneath Structures, Roadways, and Sidewalks	**	**	8
Crushed Stone Backfill	**	**	12
Crushed Stone Pipe Bedding	**	**	12
In Place Subgrade Beneath Structures, Roadways, and Sidewalks	98	92	Top 12-inches

* Embankments beneath structures shall be considered to include a zone 10 feet out from the foundation of the structure extending down to the natural ground on a 45° slope.

** The aggregate shall be compacted to a degree acceptable to the Engineer by use of a vibratory compactor and/or crawler tractor.

B. Compaction Near Existing Structures

1. Vibratory equipment shall not be used within 25 feet of any existing structure.
2. Within 25 feet of any existing structure, non-vibratory compaction equipment such as a drum roller with a maximum weight of 4 tons should be used. Within 5 feet of any existing structure, a walk behind vibratory sled or roller shall be used.

- C. Field density tests will be made by the materials testing consultant to determine if the specified densities have been achieved, and these tests shall be the basis for accepting or rejecting the compaction. In-place density tests will be performed in accordance with ASTM D 1556, ASTM D 1557, or ASTM D 6938. The Engineer, in conjunction with the materials testing consultant, will be the judge as to which test method will be the most appropriate. Failure to achieve the specified

densities shall require the Contractor to recompact the material or remove it as required. The Contractor shall, if necessary, increase the compactive effort by increasing the number of passes, using heavier or more suitable compaction equipment, or by reducing the thickness of the layers. The Contractor shall adjust the moisture contents of the soils to bring them within the optimum range by drying them or adding water as required.

- D. Testing will be performed as frequently as deemed necessary by the Engineer and/or materials testing consultant. As a minimum, one in place density test shall be performed for each 1000 cubic yards of embankment placed and 500 cubic yards of backfill placed or one test performed each day for either or as directed by the Engineer or recommended by material testing consultant.
- E. Those areas outside of the pavement areas in which the top layer of soil material becomes compacted, due to hauling or to any other activity of the Contractor, shall be scarified to a depth of 4 inches, as directed, to loosen and pulverize the soil.

3.10 VIBRATION MONITORING

- A. Vibration monitoring shall be performed at nearby structures when compaction work is ongoing. A single monitoring point using vibration monitoring equipment capable of detecting velocities of 0.1 inch/second or less and survey measurements shall be used for vibration monitoring at each of the nearest structures. An elevation measurement on nearby structures shall be taken before compaction work starts, and then at least twice a day during the work with one reading taken at the conclusion of the day's operations. Elevation measurements shall be recorded to an accuracy of 0.005 foot. If at any time the Contractor detects settlement or heave of 0.005-feet or more, or vibration levels of 1.0 inch/second or more, the vibratory compaction shall be stopped immediately, and the Engineer notified.

3.11 REMOVAL OF EXCESS AND UNSUITABLE MATERIALS

- A. The Contractor shall remove and dispose of off-site all excess and unsuitable materials. Within thirty (30) consecutive days after Notice to Proceed, the Contractor shall submit to the Engineer for review all required permits and a list of disposal sites for the unsuitable materials. If the disposal site is located on private property, the submittal shall also include written permission from the owner of record.
- B. All excess and unsuitable materials shall be disposed of in locations and under conditions that comply with federal, state/commonwealth and local laws and regulations.
- C. The Contractor shall obtain an off-site disposal area prior to beginning excavation operations.
- D. All excess and unsuitable materials shall be hauled in trucks of sufficient capacity and tight construction to prevent spillage. Trucks shall be covered to prevent the propagation of dust.

[END OF SECTION]

SECTION 02540

SITE GRADING

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

- A. Remove topsoil and stockpile on site for later use.
- B. Excavate sub soil and reform to grades, contours and levels.
- C. Excavate or fill for roadways, walks, curbs, gutters, parking areas, landscaped areas and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02100: Clearing and Grubbing
- B. Section 02222: Excavation and Backfill for Utilities
- C. Section 02224: Excavation and Backfill for Structures
- D. Section 02550: Finish Grading

1.03 EXISTING CONDITIONS

- A. Known underground, surface and aerial utility lines, and buried objects are based on best available data and indicated on the Drawings. Contractor shall verify all locations.

1.04 PROTECTION

- A. Protect trees, shrubs and lawns and other features remaining as part of final landscaping.
- B. Protect bench marks, and existing structures, fences, roads, sidewalks, paving and curbs against damage from equipment and vehicular traffic.
- C. Protect aerial, surface, or underground utility lines or appurtenance which are to remain.
- D. Repair any damage, at no cost to Owner.

1.05 QUALITY CONTROL

- A. Grade the site to the required elevations. Spot elevations are shown on the Drawings and the finished surfaces shall be uniformly sloped between these locations.

PART 2 – PRODUCTS

2.01 FILL

- A. New fill used for site grading shall be noncohesive, nonplastic, granular mixture of local sand and limerock, shall be free from vegetation, organic material or muck and shall contain not more than 8 percent material by weight which passes the No. 200 sieve. Broken concrete shall not be used in the fill. Fill material containing limerock shall have sufficient sand to fill the voids in the limerock,

and no individual rocks or pieces of hard material that will not pass a 6 inch diameter ring shall be used in the fill; except that the upper 4 inches of all backfill or fills shall not contain any rock or hard material that will not pass a 3 inch diameter ring. Provide all fill material from any excess suitable on site material or from off site sources, all subject to review and acceptance by the Engineer prior to use. Determine the volume of material required for the site.

- B. Excavated fill material: Soil free from roots, rocks larger than 3 inches, and building debris. Backfill shall be free of unsuitable material such as large rock, muck and debris.
- C. Additional fill material: Shall meet the requirements in 2.01.A.

PART 3 – EXECUTION

3.01 PREPARATION

- A. Establish and identify required lines, levels, contours and datum.
- B. Maintain bench marks, monuments, and other reference points. Re-establish if disturbed or destroyed, at no cost to Owner.
- C. Before start of grading, establish the location and extent of utilities in the work areas. Notify utilities to remove and relocate lines which are in the way of construction.
- D. Maintain, protect, reroute or extend as required existing utilities to remain which pass through the work area.

3.02 REMOVAL OF TOPSOIL

- A. Topsoil of horticultural value shall be stripped from areas of construction under this contract and stockpiled in area designated by Engineer. Said material shall be stockpiled separately from fill material.
- B. Do not permit topsoil to be mixed with subsoil
- C. Do not strip topsoil when wet.
- D. Do not drive heavy equipment over stockpiled topsoil.

3.03 GRADING AND COMPACTION

- A. Place fill material in lifts not to exceed 6 inches and compact to a density of not less than 95 percent of maximum density at optimum moisture as determined by ASTM D 1557. Fill material shall be within plus or minus 2 percentage points of optimum moisture content.

3.04 ROUGH GRADING

- A. Rough grade site to required levels, profiles, contours and elevations ready for finish grading and surface treatment. Maintain the following:
- B. Sodded areas 4 1/2 inches below finished grade elevation.
- C. Seeded areas 6 inches below finished grade.
- D. Paved areas 18-24 inches based on asphalt thickness below finished grade elevations.

- E. Shrub beds 24 inches below finished grade elevations.
- F. Flower beds 18 inches below finished grade elevations.
- G. Concrete surface 8 inches below finished grade elevations.
- H. Prior to placing fill material over undisturbed subsoil, scarify surface to depth of 6 inches.

3.05 FINE GRADING

- A. After structures, bases and pavements are completed and the yard piping trenches backfilled, fine grade the disturbed areas of the site. Remove all construction debris, regardless of size. Shape and slope the completed surface to drain away from the structures. The completed surface shall be within 0.1 foot of the elevations shown on the Drawings, unless otherwise accepted by the Engineer. Minor adjustments to line and grade may be required as the Work progresses in order to satisfy field conditions.

3.06 SURPLUS MATERIAL

- A. Remove surplus materials from site.
- B. Dispose of surplus material at no cost to Owner.

[END OF SECTION]

SECTION 02550

FINISH GRADING

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

- A. The Contractor shall, under this Section, supply, place, compact and roll finish grade materials prior to landscaping work.
- B. Finish grade sub soil.
- C. Cut out areas to receive stabilizing base course materials for paving and sidewalks.
- D. Place, finish grade and compact topsoil.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02222: Excavation and Backfill for Utilities.
- B. Section 02224: Excavation and Backfill for Structures.
- C. Section 02540: Site Grading.
- D. Section 02560: Sodding, Sprigging, and Seeding.

1.03 PROTECTION

- A. The Contractor shall prevent damage to existing fencing, trees, landscaping, natural features, bench marks, pavement, utility lines, and irrigation piping and control system . Correct damage at no cost to the Owner. Damaged irrigation system control wiring shall be replaced. No splice repairs will be accepted.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Topsoil shall be friable loam free from subsoil, roots, grass, excessive amount of weeds, stones and foreign matter; acidity range (pH) of 5.5 to 7.5; containing a minimum of 4% and a maximum of 25% organic matter. (Use topsoil stockpiled on site if conforming to these requirements, or as directed by the Engineer.)

PART 3 – EXECUTION

3.01 SUB-SOIL PREPARATION

- A. Rough grade sub soil systematically to allow for a maximum amount of natural settlement and compaction. Eliminate uneven areas and low spots. Remove debris, roots, branches, stones, etc., in excess of 2 inches in size. Remove sub soil which has been contaminated with petroleum products.
- B. Cut out areas, to sub grade elevation, which are to receive stabilizing base for paving and sidewalks.

- C. Bring sub soil to required levels, profiles and contours. Make changes in grade gradual. Blend slopes in to level areas.
- D. Slope grade away from building minimum 4 inches in 10 feet (unless indicated otherwise on Drawings).

3.02 PLACING TOPSOIL

- A. Place topsoil in area where seeding, sodding and planting is to be performed. Place to the following minimum depths, up to finished grade elevations:
 - 1. 4 1/2 inches for sodded areas.
 - 2. 6 inches for seeded areas.
 - 3. 24 inches for shrub beds.
 - 4. 18 inches for flower beds.
- B. Use topsoil in relatively dry state. Place during dry weather.
- C. Fine grade topsoil eliminating rough and low areas to ensure positive drainage. Maintain levels, profiles and contours of sub grades.
- D. Remove stones, roots, grass, weeds, debris and other foreign material while spreading.
- E. Manually spread topsoil around trees, plants, buildings and other structures to prevent damage which may be caused by grading equipment.
- F. Lightly compact placed topsoil.

3.03 SURPLUS MATERIAL

- A. Remove surplus sub soil and topsoil from site.
- B. Leave stockpile areas and entire job site clean and raked, ready to receive landscaping.

[END OF SECTION]

SECTION 02604

UTILITY STRUCTURES

PART 1 GENERAL

1.01 SCOPE

- A. Furnish and install, as shown on the Drawings, manholes and vaults including:
 - 1. Precast concrete sections
 - 2. Brick
 - 3. Mortar
 - 4. Cast iron frame and lids

1.02 RELATED WORK

- A. Section 02710 - Underdrain System
- B. Section 02222 – Excavation and Backfill for Utilities

1.03 REFERENCE STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. ASTM C478: Precast Reinforced Concrete Manhole Sections.
 - 2. ASTM C443: Joints for Circular Concrete Sewer and Culvert Pipe Using Rubber Gaskets.
 - 3. ASTM C857: Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
 - 4. ASTM C990: Specifications for Joints in Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
 - 5. FDOT 425: Inlets, Manholes, and Junction Boxes

1.04 SUBMITTALS

- A. Submit samples and/or Shop Drawings in accordance with Section 01300 - Submittals.
- B. In addition to items listed in Section 03400 - Precast Concrete, Shop Drawings shall include, but not be limited to:
 - 1. Complete layout and installation Drawings and schedules with clearly marked dimensions.
 - 2. Material certificates on all piping materials.

3. Structural design calculations sealed by a P.E. registered in the State of Florida. Design calculations for precast manholes and vaults shall include confirmation structures adequately resist flotation when they are totally empty and subjected to groundwater at the full height of structure.
4. Results of leakage test.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Neenah No. R 1712 with Type A Lid.
- B. Russco No. M 510 with Type C lid.
- C. Clark No. R502 with Type A lid.
- D. Or approved equal.

2.02 PRECAST MANHOLES, VAULTS, AND METER BOXES

- A. Precast utility structures shall be furnished with waterstops, sleeves and openings as noted on the Drawings. Box out for wall pipes shall conform accurately to the sizes and elevations of the adjoining pipes. Precast utility structures shall be watertight and conform to the requirements of ASTM C 478 and ASTM C857 with the following modifications there to:
 1. Materials shall conform to Section 03400 - Precast Concrete.
 2. The date and name of manufacturer shall be marked inside each precast section.
 3. Dimensions shall be as shown on the Drawings.
 4. Covers and frames shall be as specified in Section 2.02 H.
 5. Mechanical Details such as piping, electrical, and other details shall be as shown on the Drawings.
- B. Manholes
 1. Manhole section shall have a minimum internal diameter of 4'-0", unless noted otherwise.
 2. Details and dimensions for manhole construction shall be as shown on the Drawings.
 3. Manholes and utility structures shall include ballast concrete and/or other means necessary to ensure manholes resist flotation when empty and subjected to groundwater full height of structure.
 4. Concrete floor slab shall be minimum eight inches thick with #5 bar at 10-inch spacing each way or precast bases.
 5. Manholes shall be concentric unless otherwise indicated on drawings, standards, and specifications.
 6. Joints shall be a compression type, neoprene gasket joint conforming to ASTM C443, of

a design approved by the Engineer.

7. Lifting holes through the structures are not permitted.
8. All grout used for sealing around pipe openings shall be of a non-shrinking type, acceptable to the Engineer, designed for use in water. All openings and joints shall be sealed watertight.
9. Precast manhole tops shall terminate at such elevations as will permit laying up a minimum of five inches of brick under the manhole frame to make allowance for future street grade adjustments.
10. Drop connections, where required on precast manholes, shall be cast monolithically with the manhole elements.
11. Inverts shall be formed of 4,000 PSI concrete with approved coating sealant as described below, to provide a smooth flowing channel of the exact shape of the sewer to which it connects. All inverts of manholes shall be shaped while the manholes are under construction. All inverts shall follow the grades of the pipe entering the manholes. Changes in direction of the sewer and entering branch or branches shall have a true curve of as large a radius as the size of the manhole will permit.
12. Where shown on the Drawings or ordered by the Engineer, the Contractor shall provide manholes with stub lines for connection to future sewer lines. Provide the end of each stub line with a bell and close by means of an approved plug. This plug shall be removed, at some later time, without injury to the pipe. Reference each stub accurately to the center of the manhole and record the actual invert elevation of each end.

C. BRICK

1. Brick shall be sound, hard-burned common brick conforming to ASTM C32, Grade MS.

D. CONCRETE BLOCK

1. Concrete block shall be solid, rectangular concrete masonry units conforming to ASTM C139.

E. JOINT SEALANT

1. Joint sealant shall be a preformed flexible sealant conforming to the requirements of ASTM C990, paragraph 6.2, Butyl Rubber Sealant. Joint sealant shall be Pro-Stik Butyl Sealant by Press-Seal, Butyl-Nek Join Sealant by Henry, CS-102 Butyl Rubber Sealant for all Precast Structures by ConSeal, or equal.

F. FLEXIBLE RUBBER SLEEVE

1. The spring set type shall have a stainless steel interior power sleeve or expander and shall be the PSX assembly by Press-Seal Gasket Corporation, the Kor-N-Seal assembly by National Pollution Control Systems, Lock Joint Flexible Manhole Sleeve by Interpace Corp, or equal.
2. The cast-in-place type shall conform to ASTM C923 and shall include stainless steel take up clamps.

3. Flexible seal assemblies shall permit at least an eight (8) degree deflection from the center line of the opening in any direction while maintaining a watertight connection.

G. RUBBER BLADDER

1. The rubber bladder seal shall conform to ASTM C923 suitable for pressure testing at 10 psi minimum, with a 3/8-inch minimum wall thickness.
2. The rubber bladder seal shall contain an environmentally safe, anti-bacterial compound which turns into a high viscosity gel when in contact with pressurized water.
3. The rubber bladder seal shall be NPC Contour Seal by Kor-N-Seal, or equal.

H. COVERS AND FRAMES

1. Covers and frames shall comply with Section 05540 - Castings and shall be provided by the utility structure manufacturer.
2. Manhole covers and frames shall meet the following requirements:
 - a. Dimensions shall match those indicated on the Drawings.
 - b. All manhole frames and covers shall be US Foundry, Neenah, East Jordan Iron Works or approved equal.
 - c. Storm drain grated inlet frames and grates shall be Neenah, East Jordan Iron Works, or equal.
 - d. Curb inlet frames and grates shall be Neenah, East Jordan Iron Works, or equal, and shall include frame, grate, and hood.
3. Vault covers shall have lifting handles and shall be bolted with stainless steel bolts.
4. Frames and covers shall be identical throughout the Contract.

I. CONCRETE BALLAST

1. Concrete ballast shall be Class B concrete Ballast shall be provided as necessary to ensure manhole resists flotation when empty and subjected to full height groundwater conditions.

J. FLEXIBLE JOINT SEALER

1. Flexible joint sealer shall be a rubber ring waterstop as manufactured by Fernco Joint Sealer Co., or equal.

K. VAULTS

1. Vaults and similar structures shall be constructed as shown on the Drawings of size and shape indicated. The installation shall be in accordance with all other sections of this specification.
2. Pipes entering the vault or structure shall enter through wall sleeves, except for concrete or VCP pipe entering a wet vault, wherein the pipe may be installed as follows:

3. The pipe may be cast into the wall of the structure provided the first three pipe lengths outside the structure shall have minimum laying length, dependent on pipe type and size, with the first point occurring within 12 inches of the structure.
4. Grout the pipe into the structure with a non-shrinking grout, acceptable to the Engineer, designed for use in water. All joints shall be sealed watertight.
5. Utilize a sealing material between the pipe and structure such as Link Seal manufactured by the Thunderline Corporation, or equal when approved by the Engineer.

PART 3 EXECUTION

3.01 DESIGN CRITERIA

- A. Minimum structural design loading for underground precast concrete vaults shall be as indicated in ASTM C857, unless otherwise noted herein. Precast items subjected to vehicular traffic shall be designed for H-20 traffic loading. Other precast items shall be designed for a vertical live load of 300 psf.
- B. Walls of precast items shall be designed for a vertical surcharge of 100 psf.
- C. Precast manholes and vaults shall be designed to resist flotation when totally empty and subjected to groundwater full height of the manhole/vault.

3.02 FABRICATION AND CASTING

- A. Fabrication and casting shall conform to specifications herein.
- B. All base sections designated to receive concrete ballast and all electrical manholes shall extend monolithically a minimum of 6 inches beyond the outside face of the wall for the entire periphery. All other utility structures shall have a standard base.
- C. Utility structures built around existing pipe shall have a cast-in-place base slab.

3.03 HANDLING, TRANSPORTING, AND STORING

- A. Handling, transporting and storing of precast items shall comply with Section 03400 - Precast Concrete.

3.04 INSTALLATION

- A. Installation shall conform with Section 03400 - Precast Concrete.
- B. Frames and covers or grates shall be set so that tops are at elevations indicated on the Drawings or flush with finished grade where no elevation is indicated.
- C. Joints between riser sections shall be sealed with joint sealant.
- D. All openings in utility structures shall have flexible rubber sleeves sized to fit the connecting pipe and installed to provide watertight joints in accordance with the manufacturer's recommendations. The interior of the sleeve shall be filled with Class B concrete.
- E. Openings that are too large for flexible rubber sleeves shall utilize rubber bladder seals which are expanded by water injected using a pressure pump.

- F. All units shall be installed plumb and level.
- G. All lift holes and joints shall be filled with non-shrink grout conforming to Section 03600, grout inside and out.
- H. The manhole frames shall be set to their required elevations either with grade rings or with two or three courses of brick masonry laid around the top of the upper wall section. Such brick work shall be given a 1-inch mortar coat on the inside and out.
- I. Concrete ballast shall be placed so that it bears directly on the utility structure base against the outer wall monolithically encircling the structure for the full height indicated on the Drawings. Additional ballast may be required where the depth or elevation of the structure varies from the Drawings.
- J. Brick or Concrete Block
 - 1. Brick or concrete block shall be laid with broken joints and all horizontal and vertical joints filled with cement-sand mortar. Outside of walls shall be plastered with a minimum 1-inch thick coat of cement-sand mortar troweled smooth.
- K. Connection to Existing Pipe
 - 1. Verify the diameter and invert elevation of existing pipe to be connected to new utility structures prior to beginning work on the structures.
 - 2. Provide adequate protection to prevent damage to the existing pipe.
 - 3. Provide adequate means for plugging and/or transferring the existing flow in the pipe to allow for the construction of inverts and grouting.
 - 4. Cut off the existing pipe sufficiently for connection to the new structure and remove.
 - 5. Thoroughly clean all foreign matter and coat the pipe surface with epoxy adhesive where the pipe joins the new structure.
 - 6. Install a flexible joint sealer around the pipe.
 - 7. Grout inside and outside of wall penetration with nonshrink grout.
- L. Backfill structures in accordance with Section 02200 - Earthwork.
- M. Clean all structures of any accumulation of silt, debris, or foreign matter and keep clean until final acceptance of the work.
- N. Excavation shall conform to Section 02200 - Earthwork.
- O. Structure bases shall bear on a minimum of 12 inches of compacted stone unless otherwise indicated on the Drawings. Compacted stone shall be wrapped when under parking lot or roadways or when weepholes are present.
- P. Channel Inverts
 - 1. Inverts shall be placed using Class B concrete with forms sufficient to provide a smooth half-round shape as shown on the Drawings. Manhole bases employing full depth

precast inverts are acceptable.

2. Where the slope of the line does not change through a manhole, a constant slope shall be maintained in the invert. Where slope changes occur within a given manhole, the transition shall be smooth and shall occur at the approximate center of the manhole.
 3. Inverts shown on the Drawings are taken at the center of the manhole unless otherwise noted.
- Q. No backfilling of excavation, above elevation of top of interior concrete fill, shall be performed until waterproof coating has been cured for at least twenty-four (24) hours and inspected and approved by the Engineer. Any defective coverage shall be repaired to the satisfaction of the Engineer before backfilling is performed.

3.05 LEAK PROOFING

- A. Walls shall be sealed against leakage by the application on the complete exterior surface of a plaster coat of cement mortar of approximately the same composition as mortar for masonry joints, applied not less than 1/2 inch in thickness at any point by steel trowel as the wall is built. Precast manholes shall be sealed at ring joints.
- B. Walls alternatively may be sealed against leakage by a heavy brush coat application of an approved waterproofing compound, mixed and applied in accordance with manufacturer's recommendations. Not less than 50 pounds of compound shall be used on each 125 square feet of exterior surface area, and the coverage of block and joints shall be continuous and uniform. Joints must be struck and troweled flush and dried for at least twenty-four (24) hours under good curing conditions, before seal coat is applied.

3.06 ADJUSTMENTS TO EXISTING UTILITY STRUCTURES

- A. Adjust structures as indicated on the Drawings using concrete or cast iron adjustment rings by approved methods.
- B. Clean covers and inlet castings of all foreign material and paint with one coat of coal tar epoxy.

3.07 ADJUSTING COLLARS AND FINAL ADJUSTMENTS

- A. Adjusting collars shall be as shown on the Drawings. Final adjustments shall be made so that the manhole ring and cover will be smooth and flush with the finished grade of the adjacent surface, or as otherwise indicated on the Drawings for manholes shown above grade.

3.08 LEAKAGE TESTING FOR MANHOLES

- A. All manholes shall be vacuum tested as specified below.
- B. Manhole vacuum testing shall include the following minimum requirements:
- C. Testing shall be done in accordance with ASTM C1244-05 (or latest revision).
- D. Prior to testing all pipes, holes, and vents entering manhole shall be plugged and braced.
- E. Contractor shall have an approved test head and copy of instructions for use by the

manufacturer.

F. Test will be conducted with Pinellas County potable water.

3.09 FLUSHING AND TESTING OF SEWERS

- A. Obstruction – After backfilling, all sewers shall be inspected for obstructions and shall be flushed with water. Flushing shall be a minimum velocity of 2.5 feet per second for a duration acceptable to the Engineer. Flushing shall remove all dirt, stones, pieces of wood and other debris which accumulated in the sewer during construction. The Contractor shall provide a means acceptable to the Engineer for removal of debris flushed from each section of sewer. If after flushing, any obstructions remain, they shall be removed at the Contractor's expense.
- B. Visual Inspection – All pipe lines of 8 inch or larger shall be CCTVed. All piping shall be laid, true to lines and grades given, with hubs (bells) upgrade and tongue end (Spigot) fully entered into the hub (homed). Do not allow departure from and return to plan alignment and grade to exceed 1/16th of an inch per foot of nominal pipe length, with total of not more than 1" inch departure from theoretical line and grade. Mirror inspections are acceptable for lines 6-inch and smaller. For lines 8-inch and larger, CCTV inspection are required.
- C. Leakage – Sewers shall be tested for leakage. The program of testing shall fit the conditions as mutually determined by the Engineer and the Contractor. The Contractor shall take all necessary precautions to prevent any joints from drawing while the sewers or their appurtenances are being tested. The Contractor shall, at his own expense, correct any excess leakage and repair any damage to the pipe and their appurtenances, or to any structures resulting from or caused by these tests.
- D. Leakage Test Procedure – Each section of sewer shall be tested by closing the lower end of the sewer to be tested and the inlet sewer of the upper manhole with stoppers and filling the pipe and manhole with water to a point 6 feet above the crown of the open sewer in the upper manhole, or, if ground water is present, 6 feet above the sections average adjacent ground water level as indicated by a monitor well installed adjacent to each manhole. The line shall be filled with water prior to testing and allowed to stand until the pipe has reached its maximum absorption, but not less than two (2) hours. After maximum absorption has been reached, the head shall be reestablished and tested for at least six (6) hours maintaining the head specified above by measured additions of water. The sum of these additions shall be the leakage for the test period.
 - 1. If ground water is present to a height of at least 6 feet above the crown of the sewer at the upper end of the pipe section to be tested, the leakage test may be made by measuring the rate of infiltration using a suitable weir or other measuring device approved by the Engineer. Whether the test is made by infiltration or exfiltration, the allowable leakage shall not exceed 100 gallons per day per inch of diameter per mile of sewer being tested.
 - 2. Where the actual leakage exceeds the allowable, the Contractor shall discover the cause and correct it before the sewer will be accepted. For the purpose of this subsection, a section of sewer is defined as that length of sewer between successive manholes or special structures or stub-outs for future connections.
- E. Low Pressure Compressed Air Test – If the leakage cannot be located by infiltration or exfiltration testing, this type test may be used. The pipeline shall be considered acceptable, when tested at an average pressure of 3.0 psi greater than the average back pressure of any groundwater that may submerge the pipe, if the section under test does not lose air at a

rate greater than 0.0030 cfm per sq. ft. of internal pipe surface.

- F. Deflection Test – No sooner than thirty (30) days after final backfill installation, each section of PVC pipe shall be checked for vertical deflection using an electronic deflectometer or a rigid "GoNoGo" device. Vertical deflection shall not exceed five (5) percent of the inside pipe diameter for PVC pipe.
1. Where the actual deflection exceeds the allowable, the Contractor shall discover the cause and correct it before the pipe will be acceptable. For the purpose of this subsection, a section of sewer is defined as that length of sewer between successive manholes or special structures or stubouts for future connections.
 2. Cost of Testing and Repairs – Any and all work necessary to bring the line into conformance with the infiltration and deflection specifications shall be performed by the Contractor at no extra cost to the Owner. All apparent sources of infiltration and excessive deflection shall be repaired by the Contractor.
- G. The Contractor shall provide all water, plugs, hoses, pumps, equipment, etc. necessary for the proper flushing and testing of the sewers.

[END OF SECTION]

SECTION 02607

MANHOLE HEIGHT ADJUSTMENT

PART 1 GENERAL

1.01 GENERAL

- A. Furnish all materials, labor, equipment, tools, and incidentals required to adjust the height of manholes in accordance with the Drawings and as specified herein.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of the other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
- B. ASTM C478 Standard Specification for Precast Reinforced Concrete Manhole Sections
- C. ASTM D149 Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies
- D. ASTM D256 Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics
- E. ASTM D570 Standard Test Method for Water Absorption of Plastics
- F. ASTM D638 Standard Test Method for Tensile Properties of Plastics
- G. ASTM D648 Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position
- H. ASTM D790 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
- I. ASTM D955 Standard Test Method of Measuring Shrinkage from Mold Dimensions of Thermoplastics
- J. ASTM D1000 Standard Test Methods for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications
- K. ASTM D1002 Standard Test Method for Apparent Shear Strength of Single-Lap-Joint Adhesively Bonded Metal Specimens by Tension Loading (Metal-to-Metal)
- L. ASTM D1044 Standard Test Method for Resistance of Transparent Plastics to Surface Abrasion
- M. ASTM D2240 Standard Test Method for Rubber Property – Durometer Hardness
- N. ASTM D2671 Standard Test Methods for Heat-Shrinkable Tubing for Electrical Use
- O. ASTM D4976 Standard Specification for Polyethylene Plastics Molding and Extrusion Materials

- P. ASTM E28 Standard Test Methods for Softening Point of Resins Derived from Naval Stores by Ring-and-Ball Apparatus
- Q. ASTM G17 Standard Test Method for Penetration Resistance of Pipeline Coatings (Blunt Rod)

1.03 SUBMITTALS

- A. The Contractor shall submit the following shop drawings and product data in accordance with requirements of Section 01300 – Submittals:
 - 1. Proposed method of height adjustment for each manhole to be adjusted in height
 - 2. Design and construction details of all manhole grade rings, including details of joints between grade rings and existing manhole top cone/slab and between grade rings and existing cover and frame, all with clearly marked dimensions
 - 3. Design and construction details of all precast concrete manhole components (riser sections and top cones), including materials, reinforcement, and details of joints between manhole components and existing manhole components, all with clearly marked dimensions
 - 4. Manufacturer's installation instructions, procedures, and materials for external manhole sleeves
 - 5. Manufacturer's certification indicating external manhole sleeves are manufactured in an ISO 9002 registered facility

1.04 QUALITY ASSURANCE

- A. External Manhole Sleeve Manufacturer Qualifications:
 - 1. External manhole heat-shrink sleeves shall be manufactured in an ISO 9002 registered facility.
 - 2. Manufacturer shall have the capability of producing irradiated and cross-linked polyethylene coating to allow shrinking of coating material in circumferential direction under influence of heat.
 - 3. Manufacturer shall have the capability of providing manufacturer-employed field service personnel for onsite assistance as required.
- B. External Manhole Sleeve Installer Qualifications:
 - 1. Installer shall be experienced with installation techniques.
 - 2. Installer shall have attended a minimum of one (1) day of training at the external manhole sleeve manufacturer's facility or onsite with the external manhole sleeve manufacturer's representative.
- C. Pre-Installation Meeting: External manhole sleeve manufacturer's representative and external manhole sleeve installer shall attend a pre-installation meeting with the Contractor and Engineer one (1) week prior to the start of installation of the initial external manhole

sleeve. At the meeting, the attendees shall review surface preparation, installation, field quality control, backfilling, protection, and coordination with other work.

1.05 DELIVERY, STORAGE, AND HANDLING

A. External Manhole Sleeve Delivery:

1. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name, manufacturer, batch or lot number, and date of manufacture.
2. Protect individual sleeves to prevent adherence to other sleeves, packing material, and containers in accordance with manufacturer's instructions.

B. External Manhole Sleeve Storage:

1. Store materials in accordance with manufacturer's instructions.
2. Keep containers sealed until ready for use.
3. Do not store at temperatures above 95 degrees Fahrenheit (35 degrees Celsius) or below -4 degrees Fahrenheit (-20 degrees Celsius).
4. Protect materials and containers from exposure to direct sunlight, rain, snow, dirt, and dust.
5. Store materials off ground or floor in ventilated area.

C. External Manhole Sleeve Handling: Protect materials during handling and installation to prevent damage or contamination in accordance with manufacturer's instructions.

D. Delivery, storage, and handling of all other materials specified herein, other than the external manhole sleeves, shall be in accordance with the manufacturer's requirements.

1.06 WARRANTY

A. Warranty period for high density polyethylene (HDPE) and concrete grade rings shall be for five (5) years from the date of acceptance.

PART 2 PRODUCTS

2.01 MANHOLE GRADE RINGS

A. Round manhole grade rings shall be used to set manhole frames to their required elevations by methods approved by the Owner and/or Engineer. Manhole grade rings shall be composed of either precast concrete or high density polyethylene (HDPE).

1. All manhole grade rings shall be composed of precast concrete in accordance with ASTM C478 and Section 03400 – Precast Concrete.

B. All manhole grade rings shall be of approved design and of sufficient strength to withstand the typical loads that will be imposed upon them after installation. For manholes located in pavement that are adjusted in height, manhole grade ring shall be rated for an AASHTO live HS-20 traffic load at a minimum.

- C. Prior to reinstallation of an existing manhole cover and frame, Contractor shall clean cover and frame of all foreign material and shall paint cover and frame with one (1) coat of coal tar epoxy.

2.02 PRECAST CONCRETE MANHOLE COMPONENTS

- A. Precast concrete manhole components (riser sections or top cones) shall be used to set manhole frames to their required elevations by methods approved by the Owner and/or Engineer in accordance with Section 02604 – Utility Structures.

2.03 JOINT GASKET AND WATERSTOP

- A. Joints between manhole components, grade rings, and covers and frames shall be sealed as follows:
 - 1. Existing Top Cone/Slab and New Precast Concrete Manhole Grade Ring: Waterstop
 - 2. Adjacent New Precast Concrete Manhole Grade Rings: Waterstop
 - 3. New Precast Concrete Manhole Grade Ring and Existing (Reinstalled) Manhole Cover and Frame: Waterstop
 - 4. Existing Precast Manhole Component (Riser Section or Top Cone) and New Precast Manhole Component (Riser Section or Top Cone): Gasket and waterstop
 - 5. Pre-lubricated profile gaskets and hydrophilic waterstop rings shall be as specified in Section 02604 – Utility Structures.

2.04 GASKETS

- A. Gaskets between covers and frames shall be in accordance with the requirements of Section 02604 – Utility Structures.
 - 1. Prior to reinstalling an existing manhole cover and frame, Contractor shall install a new gasket between the cover and frame in accordance with the gasket manufacturer's recommendations. Gaskets shall be secured to the seating surface of the frame with a non-degrading glue as recommended by the gasket manufacturer.
 - 2. New manhole covers and frames shall be shipped from the factory with gaskets already installed in the seating surface of the frame.

2.05 EXTERNAL MANHOLE SLEEVES

- A. Heat-shrinkable, wrap around sleeves shall be provided on the exterior of manholes to create a barrier to water infiltration and effectively protect the manholes' support structures and frames from ground moisture, thus preventing corrosion and freeze-thaw damage. Sleeves shall accommodate ground movement and resist soil stress. External manhole sleeves shall be WrapidSeal Manhole Encapsulation System by Canusa-CPS (a division of ShawCor Inc.), Riser-Wrap Sealing System by Pipeline Seal and Insulator, Inc. of Houston, TX, or Engineer-approved equal.
 - 1. Material: Irradiated and cross-linked polyethylene impermeable backing, coated with a protective heat-activated adhesive

2. Bonding: Bond to primed concrete, metal, and fiberglass surfaces
3. Compatibility: Compatible with concrete, steel, iron, and fiberglass
4. Closure: Separate closure seal to secure sleeve in place during installation and seal overlap area
5. Functional Performance of Heat-Shrinkable Sleeves:
 - a. Minimum Peel Strength per ASTM D1000: 9 pounds/linear inch (15 N/cm)
 - b. Lap Shear per ASTM D1002: 1.5 psi (1.0 N/cm²)
 - c. Maximum Water Absorption per ASTM D570: 0.05 percent
 - d. Low Temperature Flexibility per ASTM D2671: -40 degrees Fahrenheit (-40 degrees Celsius)
 - e. Penetration Resistance per ASTM G17: Pass
6. Physical Properties of Heat-Shrinkable Sleeves:
 - a. Type: High shrink
 - b. Supplied Thickness: 101 mils (2.5 mm)
 - c. Fully Recovered Thickness: 125 mils (3.2 mm)
 - d. Minimum Shrink Factor: 40 percent
7. Sleeve Adhesive:
 - a. Minimum Softening Point per ASTM E28: 212 degrees Fahrenheit (100 degrees Celsius)
 - b. Minimum Lap Shear Strength per ASTM D1002: 12 psi (8 N/cm²)
8. Sleeve Backing:
 - a. Minimum Tensile Strength per ASTM D638: 2,900 psi (20 MPa)
 - b. Minimum Elongation per ASTM D638: 600 percent
 - c. Minimum Hardness per ASTM D2240: 46 Shore D
 - d. Abrasion Resistance per ASTM D1044: 45 mg
 - e. Shrink Force per ASTM D638: 38 psi (26 N/cm²)
 - f. Dielectric Strength per ASTM D149: 500 KV/inch (20 KV/mm)
9. Primer shall be suitable for priming steel, concrete, and fiberglass surfaces for installation of sleeve, shall be compatible with common substrates and sleeve adhesive, and shall be the WrapidSeal Manhole Encapsulation System primer, Polyken #1027 or #1039

liquid adhesive primers for Riser-Wrap Sealing System, or as recommended by the equivalent external manhole sleeve manufacturer.

PART 3 EXECUTION

3.01 MANHOLE ENTRY

- A. The Contractor shall exercise extreme caution during any manhole entry operations on live sewer lines. Particular attention shall be paid while working on larger diameter sewers. The Contractor shall implement all necessary safety precautions, in accordance with OSHA regulations, to give maximum protection at all times to persons or property at or near the work area.

3.02 MANHOLE GRADE RINGS AND PRECAST MANHOLE COMPONENTS

- A. Manhole grade rings or precast manhole components shall be used for all precast concrete manholes to adjust the height of the manhole frame casting where required. If the Contractor locates and uncovers an existing manhole composed of masonry/brick, Contractor shall notify the Engineer, who shall instruct the Contractor how to proceed with adjusting the height of the masonry/brick manhole.
 - 1. Individual grade rings shall be a maximum of 10 inches in height and shall be installed on the existing top cone/slab of the manhole to be adjusted in height after removal of the existing manhole cover and frame. The existing manhole cover and frame shall subsequently be reinstalled on top of the grade rings.
 - 2. The height of the grade ring(s) shall be such as is necessary to bring the manhole frame to the proper grade.
 - 3. HDPE rings shall be used for grade adjustment from 2 inches to a maximum of 6 inches in height.
 - 4. Precast concrete rings shall be used for grade adjustments 4 inches to a maximum of 12 inches in height.
 - 5. Precast concrete manhole components (riser sections or top cones) with joints in accordance with Section 02604 – Utility Structures shall be used for grade adjustment measuring 16 inches and greater.
 - 6. For all grade adjustments using a precast concrete riser section, the existing top cone/slab with cover and frame shall be removed and then reinstalled after installation of the new riser section.
 - 7. For all grade adjustments using a precast concrete top cone, the existing top cone/slab with cover and frame shall be removed and properly disposed of and a new top cone with new cover and frame shall be installed. New frames shall be attached to the new top cone using four (4) 5/8-inch diameter stainless steel.
 - 8. Rings shall be set concentrically on top of the existing top cone/slab.
 - 9. The joints of all precast concrete manhole grade rings, HDPE grade rings, and precast concrete manhole components (riser sections or top cones) shall be sealed in accordance with Article 2.03 herein.

10. Manhole grade rings and precast concrete manhole components shall be installed in accordance with the manufacturer's recommendations.

B. Existing casting frames shall be reinstalled on the new grade ring(s).

3.03 PROCEDURES FOR MANHOLE HEIGHT ADJUSTMENT

A. Height adjustment of manholes shall conform to the Owner's standards as noted herein and as shown on the drawings.

B. The Contractor shall utilize maps, surveys, sounding instruments, or information from local residents to determine approximate location of buried manholes. Manholes shall be exposed utilizing hand techniques or by carefully probing with mechanical equipment. Manhole exposure in pavement shall be accomplished by making a square cut in the surface with sufficient width to allow for the excavation of the material around the manhole to expose it to a depth necessary for adequate adjustments.

C. The Contractor shall adjust the top of the manhole frame to its required elevation as directed by the Owner or Engineer using manhole grade rings or precast manhole components (riser sections or top cones) conforming to the requirements of this Section. For manholes located in unpaved areas (lawns, wooded areas, other inaccessible areas, etc.), their frames and covers shall be adjusted to be either two (2) feet above the surrounding ground surface or as otherwise directed by the Owner and/or Engineer. For manholes located in pavement (roads, parking lots, sidewalks, etc.), their frames and covers shall be adjusted to be smooth and flush with the finished grade of the adjacent pavement, and sloping grade rings shall be provided as required to match the surrounding road grade if necessary.

1. Both reinstalled covers and frames and new covers and frames shall be positioned so the existing manhole steps can be readily and easily accessed.

D. Existing Concrete Manholes Located in Pavement: All adjustments measuring less than 12 inches shall be performed using manhole grade rings. All adjustments measuring 12 inches and greater shall be performed using only precast manhole components by one of the following methods:

1. Removing the existing top cone/slab with cover and frame, installing a new appropriate precast manhole riser section, and reinstalling the existing top cone/slab with cover and frame

2. Removing and properly disposing of the existing top cone/slab with cover and frame and installing a new appropriate precast manhole top cone with new cover and frame

E. Existing Concrete Manholes Located in Unpaved Areas: All adjustments shall be performed using only precast manhole components by one of the previous methods.

F. Contractor shall be solely responsible for the proper height of all manholes necessary to reach the final grade at all locations. Contractor is cautioned that Engineer's review of shop drawings for manhole grade rings and precast manhole components will be general in nature, and Contractor shall provide an adequate supply of random length manhole grade rings and precast manhole components to adjust any manhole to meet field conditions for final grading.

G. Contractor shall also install an external manhole sleeve as specified herein for the following existing manholes that are adjusted in height by the Contractor:

1. Manholes adjusted in height under this Project using either precast concrete grade rings
2. Manholes that have been previously rehabilitated prior to this Project
3. Manholes adjusted in height under this Project using new precast concrete top cones and new covers and frames.

External manhole sleeve shall cover the exterior of the existing manhole frame (after re-installation) or new manhole frame (after installation), the new grade rings (if installed), and the upper portion of the existing or new manhole top cone/slab as recommended by the manufacturer. Size and width of external manhole sleeve shall be as recommended by the manufacturer.

- H. After a manhole is adjusted in height as specified herein, Contractor shall backfill the area around the existing manhole in accordance with Section 02200 – Earthwork.
1. Manholes Located in Unpaved Areas: After backfilling, the portion of the surrounding ground surface that is disturbed during height adjustment shall be graded at a 1:5 (1 vertical to 5 horizontal) slope to provide surface drainage away from the manhole and subsequently grassed in accordance with Section 02910 – Final Grading and Landscaping.
 2. Manholes Located in Pavement: After backfilling, the portion of the surrounding ground surface that is disturbed during height adjustment shall be repaved in accordance with Section 02575 – Pavement Repair.

3.04 EXTERNAL MANHOLE SLEEVES

- A. Examination: Examine surfaces to receive external manhole sleeve. Notify the Engineer if surfaces are not acceptable. Do not begin surface preparation until unacceptable conditions have been corrected.
- B. Surface Preparation:
1. Prepare surfaces in accordance with manufacturer's instructions.
 2. Brush exterior of manhole using broom or hand wire tools to ensure surfaces are clean, dry, and free of loose cement, dust, small rock particles, frost, surface rust, foreign objects, sharp edges, and projections that could damage external manhole sleeve.
 3. Cleaned surfaces of precast manhole components and grade rings shall not remain overnight or for extended periods under wet or humid conditions prior to the application of the external manhole sleeve.
 4. Inspection by Owner and/or Engineer:
 - a. Give the Owner and/or Engineer a minimum of twenty-four (24) hours advance notice of start of installation of external manhole sleeve at any specific manhole.
 - b. Before installation, surfaces to be covered by the external manhole sleeve will be inspected by the Owner and/or Engineer.
 - c. Do not begin installation until defects or deficiencies identified by the Owner and/or Engineer have been corrected.

C. Installation:

1. Install external manhole sleeve in accordance with manufacturer's instructions.
2. Install sleeve to create barrier to water infiltration and protect manhole support structure and frame from ground moisture, preventing corrosion and freeze-thaw damage.

D. Field Quality Control:

1. Sleeve Inspection: Visually inspect installed sleeve to ensure:
 - a. Sleeve is in full contact with substrate, including top cone/slab, grade rings (if installed), and manhole frame
 - b. There are no cracks or holes in polyethylene backing
 - c. There are no voids below sleeve
 - d. Adhesive has flowed beyond sleeve edges
2. Site Adhesion Testing: Peel tests
 - a. Frequency of Test: 1 in every 10 sleeves
 - b. Surface Temperature at Time of Test: 77 degrees Fahrenheit +/- 10 degrees Fahrenheit (25 degrees Celsius +/- 5 degrees Celsius), unless environmental conditions will not allow and continuation of test is approved by the Engineer
 - c. Peel Rate: 4 inches/minute (100 mm/minute)
 - d. Perform testing using hand peel gauge on 1-inch (25-mm) wide strip.
 - e. Cut strip and induce initial failure by undercutting and peeling back strip until 2-inch (50-mm) flap is created.
 - f. Attach clamp to strip and hand peel gauge to clamp and peel back at a 90 degree angle to surface at specified peel rate.
 - g. Passing Minimum Peel Strength: 8.6 pounds/linear inch (15 N/cm) with cohesive failure of adhesive
3. Contractor shall be responsible for verifying the integrity of the installed external manhole sleeve prior to proceeding with backfilling. Damaged sleeves shall be repaired in accordance with the manufacturer's recommendations at the Contractor's expense.

E. Backfilling and Protection:

1. Allow sleeve to cool before backfilling manhole. Water quenching shall be permissible to expedite backfilling.
2. Prevent damage to sleeve by backfilling with select backfill or material with no sharp stones or large particles, or protect sleeve with extruded polyethylene mesh or other suitable protective shield as approved by the Engineer.

3. Backfill manhole as specified in Section 02200 – Earthwork.

[END OF SECTION]

SECTION 02710

UNDERDRAINS, STORM DRAINS AND ROOF DRAINS

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

- A. Furnish all labor, equipment and materials in connection with the installation and testing of exterior underground Storm drains and Roof drains as shown on the Contract Drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02100 – Clearing and Grubbing
- B. Section 02222 – Excavation and Backfill for Utilities

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. ASTM C76 Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
- B. ASTM C361 Standard Specification for Reinforced Concrete Low-Head Pressure Pipe
- C. ASTM C443 Standard Specification for Joints in Concrete Pipe and Manholes, Using Rubber Gaskets
- D. ASTM C478 Standard Specification for Precast Reinforced Concrete Manhole Sections
- E. ASTM C857 Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
- F. ASTM C969 Standard Practices for Infiltration and Exfiltration Testing of Installed Precast Concrete Pipe Sewer Lines
- G. ASTM C990 Standard Specification for Joints in Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
- H. ASTM C1103 Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
- I. ASTM C1619 Standard Specification for Elastomeric Seals for Joining Concrete Structures
- J. ASTM C1628 Standard Specification for Joints for Concrete Gravity Flow Sewer Pipe, Using Rubber Gaskets
- K. ASTM D 2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and other Gravity-Flow Applications.

L.	ASTM D 3350	Standard Specifications for Polyethylene Plastic Pipe and Fitting Material.
M.	AWWA C 110	Standard Specification for Ductile Iron Pipe & Fittings for Water and Other Liquids.
N.	ASTM C 150	Standard Specification for Portland Cement
O.	AWWA C 151	American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
P.	ASTM F 447	Standard Specifications for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
Q.	AASHTO R82-17	
R.	AASHTO M 198	Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
S.	AASHTO M 294	Standard Specifications for Corrugated Polyethylene Pipe (12" to 36").
T.	AASHTO Section 30	Thermoplastic Pipe.

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300 – Submittals.
 - 1. Submit shop drawings for underdrain pipe, storm drain pipes and culverts, roof drains, filter fabric, filter aggregate.
 - 2. Special care shall be exercised during delivery, distribution and storage of the pipe and fittings to prevent damage. Damaged pipe will be rejected and shall be replaced at the Contractor's expense. Storage of pipe and fittings, prior to use, shall be in such a manner as to keep the materials clean and dry.

PART 2 – PRODUCTS

2.01 REINFORCED CONCRETE PIPE (RCP) – STORM DRAINS AND CULVERTS

- A. Pipe and Joints
 - 1. Reinforced concrete pipe for storm drains and culverts shall conform to ASTM Standard C76, Class III, Wall thickness B, unless otherwise noted on the Contract Drawings. Elliptical reinforcement will not be permitted. All pipe shall be aged at the manufacturing plant for at least fourteen (14) days before delivery to the job site. All pipe shall be of the sizes indicated on the drawings
 - 2. Pipe joints shall be designed per ASTM C-443-19a and ASTM C-1628 –19. Pipe shall be provided with bell and spigot ends.
- B. Gaskets

1. Gaskets shall be leak-resistant with elastomeric seals (gaskets) made of natural rubber, synthetic rubber, or a blend of both meeting the physical requirements prescribed in Specification ASTM 1619-19 for Class A, C, or E gaskets.
2. Gaskets showing prior use or damage will be rejected. If gasket shows signs of wear or cracking, a replacement shall be provided at no additional cost.

C. Joint Lubricant

1. Joint lubricant shall be of the type recommended by the manufacturer. Use of petroleum-based lubricants is not permitted.

2.02 Ductile Iron Pipe (DIP) – ROOF DRAINS

A. Pipe

1. Shall be centrifugally cast in metal molds or sand lined molds in accordance with ANSI A21.51 (AWWA C151) of grade 70 50 05 ductile iron. The above standard covers ductile iron pipe with nominal pipe sizes from three (3) inches up to and including fifty four (54) inches in diameter.
2. Shall have a rated working pressure of 150 psi.
3. Shall be a minimum PC 150.

B. Fittings

1. Shall be manufactured in accordance with ANSI A21.10 (AWWA C110).
2. Shall be manufactured of grade 70-50-05 ductile iron.
3. Shall have a rated working pressure of 250 psi.
4. Grey iron fittings which conform to the specifications contained herein may be used with ductile iron pipe providing the piping systems minimum working pressure is met or exceeded, and only where ductile iron fittings are not manufactured for a specific fitting.

C. Coatings and Linings for Pipe and Fittings

1. Protecto 401 asphaltic coating shall be applied to the exterior wall of the pipe and fittings in accordance with ANSI A21.51 (AWWA C151).
2. The pipe and fittings shall be cement mortar lined to twice the standard thickness in accordance with ANSI A21.4 (AWWA C104) except as specified in the pipe schedule. A seal coat of Protecto 401 shall be applied to the mortar lining.

D. Joints

1. Joints shall be push on type in accordance with ANSI A21.11 (AWWA C111).

2.03 SMOOTH LINED CORRUGATED HIGH-DENSITY (HDPE) POLYETHYLENE PIPE - STORM DRAINS AND CULVERTS

A. General

1. Smooth lined corrugated high-density polyethylene (HDPE) pipe shall be used for storm drains and shall be BLUE SEAL watertight HDPE pipe as manufactured by Hancor, Inc., N-12 WT IB (Watertight) Pipe by ADS, Inc., or approved equal.

B. Pipe and Fittings

1. Smooth lined HDPE pipe and fittings shall conform to AASHTO M252-TYPE S for 4" to 10" diameter and AASHTO M294 - TYPE S for 12" to 36" diameter. All pipes shall be of the sizes indicated on the drawings.

C. Joints

1. Joints shall be watertight bell and spigot type; Hancor, Inc. BLUE SEAL, ADS, Inc. N-12 WT IB, or approved equal.

D. Foundation Drains

1. Foundation drains shall conform to AASHTO M252-TYPE C. Drains shall have drilled perforations and be Heavy Duty-AASHTO Pipe as manufactured by Hancor, Inc., Single Wall Corrugate Pipe by ADS, Inc., or approved equal.

2.04 BACKFILL MATERIAL

- A. The material obtained from excavation of the pipe trench or elsewhere on site with a particle size not greater than 3 inches shall be used for pipe backfill if they conform with the soil classes given in Table 1. Imported materials meeting the criteria of Table 1 may also be used.

TABLE 1 – ACCEPTABLE BACKFILL MATERIAL

SOIL CLASSIFICATIONS			
DESCRIPTION	ASTM D 2321	ASTM D 2487	AASHTO M 43
Graded or crushed, crushed stone, gravel	Class I	--	5 56
Well-graded sand, gravels and gravel/sand mixtures, poorly graded sand, gravels and gravel/sand mixtures; little or no fines	Class II	GW GP SW SP	57 6
Silty or clayey gravels, gravel/sand/silt or gravel and clay mixtures; silty or clayey sands, sand/clay or sand/silt mixtures	Class III	GM GC SM SC	Gravel and Sand (<10% fines)

2.05 UNDERDRAIN PIPE

- A. Pipe for use as underdrain shall be 6" diameter minimum, perforated PVC, per ASTM F758, F949, or equal.

- B. Pipe shall be perforated per manufacturers specifications and shall be 3/16" to 3/8" in size.

2.06 FILTER FABRIC

- A. Filter fabric shall be non-degrading fibrous filter type material, Mirafi 140 N or approved equal.

2.07 FILTER AGGREGATE

- A. Aggregate shall be as specified in the F.D.O.T. standard specifications, section 901, and shall be size 57.

PART 3 – EXECUTION

3.01 INSPECTION

- A. Each length of pipe and fittings delivered to the property shall be inspected by the Contractor, in the presence of the Engineer, for flaws, cracks, dimensional tolerances and compliance with the referenced Standards. The Contractor shall provide the Engineer with suitable templates or calipers for checking pipe dimensions. Only lengths of pipe and fittings accepted by the Engineer and so marked may be installed in the work.

3.02 INSTALLATION

- A. Trenching, bedding and backfilling shall be as specified in Section 02200 - Earthwork of these Specifications and Section 2.04 Backfill Material of this Specification. Under no condition shall pipe be laid in water or when trench conditions or weather are unsuitable for such work.
- B. The trench shall be excavated carefully, to such depth to allow for the installation of the filter fabric, filter aggregate, and PVC underdrain pipe as shown in the plans.
- C. All pipes and fittings shall be handled carefully in loading and unloading. They shall be lifted by hoists or lowered on skidways in such a manner as to avoid shock. Derricks, ropes or other suitable equipment shall be used for lowering the pipe into the trench. Pipe and fittings shall not be dropped or dumped.
- D. Each pipe and fitting shall be inspected before it is lowered into the trench. The interior of the pipe and all joint surfaces shall be thoroughly cleaned and shall thereafter be maintained clean. The open ends of pipe shall be securely plugged whenever pipe laying is not in progress.
- E. Pipe and fittings shall be selected so there will be as small a deviation as possible at the joints and so inverts present a smooth surface. All joints shall be installed, made up, and inspected in accordance with approved printed instructions of the manufacturer. Pipe and fittings which do not fit together to form a tight joint will be rejected.
- F. Cutting of reinforced concrete pipe will be permitted only at connections to structures and be accomplished by abrasive saws. Cutting of other pipe materials shall be done only with mechanical cutters and in accordance with the manufacturer's recommendations.
- G. Lay all pipe, true to the lines and grades give, with hubs (bels) up and tongue end (spigot) fully entered into the hub (homed). Do not allow departure from the return to plan alignments and grade to exceed 1/16 inch per foot of nominal pipe length with total of not more than 1 inch departure from theoretical line and grade.

- H. If an adequate foundation for the pipe is not available at the desired depth, additional excavation shall be required, and the foundation brought to desired grade with suitable granular material.
- I. Rock outcroppings, very soft soils such as muck, and other similar materials not providing proper foundation support shall be removed/replaced with suitable granular material.
- J. Structures shall be bedded a minimum of 1 foot below and 1 foot around pipe. Piping shall be laid in a dry or dewatered trench line. Place rock bedding material under piping to stabilize at a minimum of 6 inches.
- K. Class I materials may be dumped around pipe. Voids shall be eliminated by knifing under and around the pipe or by other approved technique.
- L. Inorganic silts, and gravelly, sandy, or silty clays, and other Class IV materials (not shown in Table 1) shall not be used for pipe backfill.
- M. Any section of the pipe found defective in material, alignment, grade, joints, or otherwise, shall be satisfactorily corrected by the Contractor at no additional cost to the Owner.
- N. After the pipe has been laid and approved by the Engineer, the trench shall be backfilled with the filter aggregate to the depth shown on the plans and the filter fabric shall overlap no less than 18" across the top of the aggregate.
- O. For underdrain installation in the roadway, backfill in the trench above the underdrain system, shall be ready-mixed flowable fill as per Section 2224 of the specifications.

3.03 COMPACTION

- A. General
 - 1. Place and assure backfill and fill materials achieve an equal or higher degree of compaction than undisturbed materials adjacent to the work.
 - 2. In no case shall degree of compaction below "Minimum Compactions" specified be accepted.
- B. Compaction Requirements: Unless noted otherwise on the Drawings or more stringently by other sections of these Specifications, comply with following trench compaction criteria:

TABLE 2 – - MINIMUM COMPACTIONS

LOCATION	SOIL TYPE	DENSITY
1. Compacted select backfill:		
All applicable areas	Cohesive soil	98 percent of maximum dry density by ASTM D698
	Cohensionless soils	75 percent of maximum relative density by ASTM D4253 and ASTM D4254
2. Common trench backfill:		
Under pavements roadways surfaces, D698 within highway right-of-	Cohesive soils	98 percent of maximum dry density by ASTM D698

ways, adjacent to retaining walls		
	Cohesionless soils	75 percent of maximum relative density by ASTM D4253 and ASTM D4254
Under turfed, sodded plant seeded, non-traffic areas	Cohesive soils	95 percent of maximum dry density by ASTM D698
	Cohesionless soils	75 percent of maximum relative density by ASTM D4253 and ASTM D4254

- C. Ensure backfill materials have moisture content within one (1) percent of optimum moisture content at the time of placement.

3.04 INSPECTION AND TESTING

A. General

1. The Contractor shall provide at his own expense, all labor, material, video and measuring devices, water, plugs, or other equipment necessary to perform the required tests. All tests shall be performed in the presence of the Engineer. Disposal of water shall be in accordance with Section 01010 – Summary of Work.

B. Tests by Manufacturer

1. Reinforced Concrete Storm Drains and Culverts - An infiltration and exfiltration test for the pipe shall be made at the place of manufacture. Certified test results shall be submitted. The infiltration or exfiltration allowance shall not exceed the limits as set in the "Performance requirements for Joints" paragraph in ASTM C443 – 12 (2017) or ASTM C990-09 (2014), depending on the type of gasket specified.
2. DIP and HDPE - An infiltration and exfiltration test for the pipe shall be made at the place of manufacture. Certified test results shall be submitted. The infiltration or exfiltration allowance shall not exceed 250 gallons per inch of pipe diameter per mile per day. One joint test for each two hundred feet of pipe to be furnished.

C. Field Test - Visual Inspection

1. Examine structures and pipes for:
 - a. Physical damage.
 - b. Indication of displacement of pipes or structures, reinforcement, forms, or bedding.
 - c. Porous areas or voids.
 - d. Proper placement of seals, gaskets, and embedments.
 - e. Visible infiltration.
2. Verify structures and pipes are set to proper line, grade as per the Contract Drawings, and are plumb.

3. Verify structure and pipe dimensions and thickness match Contract Drawings.
4. Measure inside dimensions of all flexible (HDPE) pipe prior to installation. Use these dimensions when sizing the mandrel should deflection testing be required.
 - a. Using light to inspect pipe shall be done after pipe trench backfill is compacted and brought to grade or pavement base.
 - b. Full pipe diameter shall be visible for entire length of each section between structures.
 - c. No less than half pipe diameter shall be visible for horizontal alignment.
5. The Contractor shall be responsible to provide video recording of the all installed storm sewer systems at least 30 days after completion of backfill and one month before Owner or Engineer gives final acceptance for the two-year warranty. The recording shall be made using a color camera, self-propelled or other, having sufficient light to show detail of problem areas and joints. Camera speed shall not exceed 3 feet per second. If problems or concerns are seen by the operator, then the camera shall be reversed and an extended look at the area will be recorded. All recordings will have time, date, and footage displayed. Supplement the video recording with a written log or orally recorded tape log noting observations, findings, and deficiencies shown on the video tape.
 - a. The video recording inspection shall be performed by an outside independent testing agency acceptable to the Owner or Engineer.
 - b. The video tape and log will be given to the Engineer for review. If the Engineer finds any problems with the storm sewer, the Contractor will repair the problem and re-camera the repaired area before final acceptance will be given, at no added cost to the Owner.
 - c. Video recording of storm sewer may be waived if pipe diameter is sufficient for human access, as determined by the Engineer. A log shall be developed for such inspection.
 - d. One copy of the video tape and log will become permanent property of the Engineer and Owner as record.

D. Field Test - Manhole Testing

1. The finished manholes shall be as watertight as the pipe system of which it is part. See Specification 02604 – Utility Structures for manhole testing criteria.
2. Observed leaks (infiltration or exfiltration) at any time within the warranty period shall be cause for rejection.

E. Field Test - Storm Drains and Culverts less than 30" diameter

1. If, after the visual inspection and video recording of the storm trunk or lateral lines, the Engineer finds there is a potential joint tightness problem, or excessive deflection, and the Contractor does not agree to repairing defects in pipe based on visual inspection, he/she may require leakage testing of the line.

- a. Reference ASTM C696, latest revision. Test shall be used if the groundwater level is less than 2 ft. above the crown of the pipe measured from the highest elevation of the pipe length being tested.
 - b. Leakage rate testing applies to only circular pipe less than 30". The length of pipe tested shall not exceed 700 ft.
 - c. The leakage testing shall occur at least 30 days after completion of the backfilling and compaction.
 - d. If the Engineer determines reliable and uniform results are produced by the Contractor's construction techniques, the leakage testing may occur after initial backfill and compaction.
2. The Contractor shall provide all equipment and personnel to perform the leakage testing.
 3. The Engineer shall record times and calculation leakage rates during the test period.
 4. The leakage test shall be performed as follows:
 - a. Plug all pipe outlets discharging into the upstream manhole and the test section outlet. Fill the pipe with water.
 - b. At the upstream manhole the test head shall be established as minimum of 2 ft above the crown of the pipe, or at least 2 ft above existing groundwater, whichever is higher.
 - c. Allow the pipe to remain saturated for a period long enough to allow water absorption in the pipe, a minimum of 4 hours and up to a maximum of 72 hours. After the absorption period, refill the pipe to the required test head.
 - d. Measure the leakage loss over a timed test period. The minimum test period shall be 15 minutes and the maximum shall not exceed 24 hours.
 5. The allowable leakage limit including manholes is 250 gal/(in. of internal diameter) (mile of sewer) (24 h) when the average head on the test section is 6 ft or less.
 6. When the average head on the test section is greater than 6 ft, the allowable leakage shall be multiplied by the ratio of the square root of the average test head and the square root of the base head of 6 ft.
 7. Manholes shall be tested separately and independently or with the pipeline with an allowance of 0.1 gal/(ft of diameter) (ft of head) (h).
 8. Sections of the pipe which fail the air test, shall have the defects repaired, and the test shall be repeated.
 - a. The initial leakage testing, repair, and repeat testing of the failed section of pipe shall be repeated at no added cost to the Owner until the testing requirements are met.

F. Field Test - Storm Drains and Culverts 30" diameter and greater

1. If, after the visual inspection and video recording of the storm trunk or lateral lines, the Engineer finds there is a potential joint tightness problem, or excessive deflection, and the

Contractor does not agree to repair defects in pipe based in visual inspection, he/she may require air or water pressure testing of individual pipe joints.

- a. Reference ASTM C1103, latest revision. The following procedures apply to testing with either air or water.
 - b. Pressure testing applies to only circular pipe 30" or greater and not elliptical, arch or box sections.
 - c. The pressure test shall occur at least 30 days after completion of the backfilling and compaction.
 - d. If the Engineer determines reliable and uniform results are produced by the Contractor's construction techniques, the pressure test may occur after initial backfill and compaction.
2. The Contractor shall provide all equipment and personnel to perform the pressure testing.
 3. The Engineer shall record times and observe pressure losses during the test period.
 4. If the groundwater pressure is equal to or greater than the test pressure, and the storm drain or joint is not leaking, the storm drain or joint is acceptable in accordance with ASTM C969 and no additional testing is required. If one or more joints are leaking, but the total amount of leakage in the storm drain being tested is equal to, or less than, the allowable leakage rate established in accordance with ASTM C969, the line is acceptable and no additional testing is required provided visible leaks are repaired. Moisture or beads of water appearing on the surface of the joint will not be considered as visible leakage.
 5. The pressure test shall be performed as follows:
 - a. Move the joint test apparatus into the pipe to the joint to be tested and position it over the joint. The end element sealing tubes must straddle both sides of the joint and the hoses are attached. For the water test, the bleed-off petcock must be located at top dead center.
 - b. Inflate end element sealing tubes with air or water in accordance with equipment and manufacturer's instructions.
 - c. All test pressures are measured as gauge pressure, defined as any pressure greater than atmospheric pressure. Test observer shall note water produces a pressure of 0.43 psi for every foot of depth, and therefore test pressures must be increased to offset the depth of groundwater over the pipe. If the groundwater level is 2 ft or more above the top of the pipe at the upstream end or if the pressure required for the test is greater than 6-psi gauge, the joint test method shall not be used and the infiltration test may be used (see ASTM C969).
 - d. An air or water reservoir shall be included in the joint test system. By maintaining a constant supply of air or water in a reservoir, continuous pumping of air or water is not required, and any variances in test equipment and joint space will be negated. The reservoir shall have a minimum volume of 2.5 ft³.
 6. The joint air pressure test shall be performed as follows

- a. Pressurize the void volume with air to 3.5 psi greater than the pressure exerted by groundwater above the pipe. Allow the air pressure and temperature to stabilize before shutting off the air supply and start of test timing.
 - b. If pressure holds, or drops less than 1 psi in 5 seconds, the joint is acceptable.
 - c. If the joint being tested fails, it shall be retested, or repaired if necessary, and retested.
 - d. After the joint test is completed, exhaust void volume, then exhaust end element tubes prior to removal of apparatus.
7. The joint water pressure test shall be performed as follows
- a. Introduce water into void volume until water flows evenly from open petcock. Close the petcock and pressurize with water to 3.5 psi above the pressure exerted by groundwater above the pipe. Shut off the water supply.
 - b. If pressure holds, or drops less than 1 psi in 5 seconds, the joint is acceptable.
 - c. If the joint being tested fails, it shall be retested, or repaired if necessary, and retested.
 - d. After the joint test is completed, exhaust end element tubes which will automatically release the water from the void volume, prior to removal of apparatus.

G. Deflection Test – Flexible Pipe

- a. If after the visual or video inspection of the storm trunk or lateral lines, the Inspector finds there is “egging or deflection” of a section of pipe, a deflection test shall be performed on the defective section of pipe installed. Test shall be performed using an odd-legged mandrel pulled through the pipe without mechanical assistance or by laser profiling. The mandrel size shall be the measured inside diameter of the subject pipe minus 5% of the measured diameter. The mandrel shall have no less than nine legs.
- b. Any pipe failing any deflection test shall be removed, replaced, and retested.
- c. At the end of the two-year warranty period, the flexible storm pipe will be visually inspected for “egging or deflection”. If excess deflection is observed, the Owner/Warranty Holder will, at his/her expense, retest questionable portions per this section.

H. Repair

1. Repair or replace any unacceptable work at no additional cost to the Owner.
2. Repair all visible leaks.
3. Remove any concrete webs or protrusions.
4. Remove form ties and repair tie holes.

3.05 RESPONSIBILITY

- A. The Contractor shall be held strictly responsible for all parts of the work that bear the load of the backfill. If structural failures in the underdrain or appurtenances develop within one (1) year from the date of final acceptance of the work, the Contractor shall be required to replace all faulty material at his full expense. To this end, the Contractor is advised to purchase material under a guarantee from the manufacturer, guaranteeing proper service under conditions which are established by the drawings, specifications and local conditions.

[END OF SECTION]

SECTION 02720

SEGMENTAL REPLACEMENT (PIPE AND TAP CONNECTIONS)

PART 1 -- GENERAL

1.01 SCOPE OF WORK

- A. The work specified in this Section includes all labor, materials, accessories, equipment, and tools necessary to install and test the segmental replacements (SRs) of pipe and tap connections where shown and dimensioned on the Drawings and as specified herein.
- B. SRs shall include the following:
 - 1. Pre-excavation video or pictures of surface features in the immediate area surrounding the SR (particularly sidewalks and driveways)
 - 2. Exposing the section of defective pipe in accordance with Section 02200 – Earthwork
 - 3. Ensuring the SR excavation has sufficient length to install new pipe at a positive slope
 - 4. Dewatering the excavation in accordance with Section 02200 – Earthwork
 - 5. Installing the SR pipe or tap, coupling, and bedding
 - 6. Replacement and reinstatement of all tap connections within the limits of the SR
 - a. When an SR on a main line pipe is performed, each service lateral that falls within the limits of the main line SR shall only be connected to the main line using a factory-fabricated tee or wye on the main line. Using a Romac-type coupling, Inserta Tee to connect a new main line pipe to a service lateral is not acceptable.
 - 7. Testing the SR pipe as specified
 - 8. Backfilling and restoring surface features in accordance with Section 02200 – Earthwork and the Owner's guidelines
 - 9. CCTV inspection of SR segments from manhole to manhole after installation for acceptance

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01010 – Summary of Work
- B. Section 01300 – Submittals

- C. Section 02050 – Building Demolition
- D. Section 02200 – Earthwork
- E. Section 02731 –Sewer Inspection
- F. Section 15006 – Ductile Iron Pipe

1.03 SUBMITTALS

- A. The Contractor shall submit Shop Drawings of pipe and couplings and other information in accordance with the requirements set forth in Section 01300 – Submittals.
- B. Construction video shall be taken in accordance with the requirements of Section 01010 – Summary of Work.

PART 2 -- PRODUCTS

2.01 GENERAL

- A. Main line pipes, tees, wyes, laterals, service connections, and service connection fittings shall be ductile iron or PVC of a minimum SDR 26 or as specified elsewhere in the Contract Documents.
- B. Bedding, aggregate, backfill, and surface restoration shall be as specified in Section 02200 – Earthwork.
- C. Concrete collars shall be Class B as specified in Section 03300 – Cast-in-Place Concrete.

2.02 PIPE COUPLINGS

- A. Couplings for joining existing pipes to proposed emergency point repair (EPR) pipes shall be specifically designed and rated for joining sewer pipes composed of different materials and/or having varying diameters.
- B. All couplings shall have Type 304 stainless steel clamps, one on each side.
- C. All couplings shall have Type 304 stainless steel shear rings.
- D. All couplings shall be as manufactured by Fernco, Mission, or Engineer-approved equal.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. All EPRs shall be performed in accordance with the drawings and the following:

1. Contractor shall mark off extents of SR and limits of excavation.
2. Contractor shall take pre-excavation video of surface features (sidewalks, driveways, etc.) adjacent to the limits of excavation.
3. Contractor shall excavate in accordance with Section 02200 – Earthwork. Under no circumstances will the Contractor be allowed to remove concrete or asphalt without cutting it prior to removal. The saw cutting shall be deep enough to produce an even, straight cut.
4. Contractor shall expose the defective pipe so that undamaged sections of the existing pipe are visible on both sides of the proposed SR and shall confirm the required limits of the SR with the Owner and/or Engineer. At a minimum, a total of eight (8) feet of piping shall be replaced by the Contractor at each SR. Pipe and laterals (if present) shall be removed by cutting the pipe or lateral on each side along lines perpendicular to the longitudinal axis of the pipe so "spigot ends" remain in place to be connected to the replacement pipe. Disposal of pipe and excavated material shall be in accordance with Section 02050 – Building Demolition and Section 02200 – Earthwork.
 - a. If the existing line to be repaired has been CIPP-lined and the host pipe is composed of brittle material (clay or concrete), it shall be removed to expose the CIPP liner so the liner can be securely anchored at the repair location.
5. Contractor shall confirm with Owner and/or Engineer that each proposed EPR will have a positive slope. Pipe sags shall be prohibited. Reverse grades shall be prohibited unless approved by the Owner and/or Engineer. If additional excavation and pipe removal is needed to achieve a positive slope, Contractor shall confirm length of additional footage required with Owner and/or Engineer.
6. Contractor shall dewater, sheet, and/or brace all excavations in accordance with Section 02200 – Earthwork. Well points, pumps, sump pits, sheeting, bracing, and/or sock drains shall be used to provide a safe, dry, open trench for all repairs or replacements specified herein. There shall be no sitting water in the trench bottom prior to laying new pipe. Erosion and sedimentation controls shall be provided for all SRs.
7. Contractor shall install pipe bedding and compact in accordance with Section 02200 – Earthwork.
8. New pipe shall be installed using the specified couplings. Gaps between existing pipe and new pipe shall be minimized. Couplings shall be installed in accordance with the manufacturer's guidelines, including those related to pre-cleaning, installation direction, nut torque, etc.
9. If present, service laterals shall be reconnected at the edge of the trench. Shear rings shall be used on all lateral couplings.
10. Contractor shall confirm positive slope prior to backfilling.

11. Contractor shall flush or clean SR pipe.
12. Contractor shall backfill and compact in accordance with Section 02200 – Earthwork.
13. CCTV inspection after SR is completed shall be performed in accordance with Section 02731 –Sewer Inspection. Owner and/or Engineer shall confirm visible acceptance of EPR.
14. Contractor shall restore any surface features including roadway and driveway pavement, sidewalks, and grass. Surface features shall be restored to at least the same condition as existed before construction began.

- END OF SECTION -

SECTION 02731

TELEVISION INSPECTION

PART 1 GENERAL

1.01 SCOPE

- A. The work covered by this Section includes furnishing all labor, competent certified technicians, equipment, tools, accessories, and materials required to perform closed-circuit television (CCTV) inspection of specific sanitary sewer pipes as shown on the Drawings and as specified as follows:
 - 1. The existing sanitary sewer pipes designated for heavy cleaning after they are cleaned
 - 2. All new sanitary sewer pipes and tap connections after they are installed
 - 3. Additional sanitary sewer pipes as directed by the Owner or Engineer
- B. Digital videos, data, and photos shall be delivered to the Engineer on external portable hard drive, which shall become property of the Owner. Data files shall be named in accordance with required standards, which will allow video files to be directly linked to pipe assets.

1.02 SUBMITTALS

- A. Contractor shall submit a Traffic Control Plan.
- B. Contractor shall submit schedules of work on a weekly basis. Provide 24-hour notice for deviations from the schedule that are not caused by weather or natural causes.
- C. Contractor shall submit a confined space entry plan.
- D. Informational Submittals: Prior to beginning CCTV inspection work, Contractor shall submit the following in accordance with Section 01300 – Submittals:
 - 1. References: Contact names and telephone numbers of CITYs where the Contractor has performed similarly sized and type projects in the last five years
 - 2. List of staff and equipment to be used on Project
 - 3. Crew chief qualifications
 - 4. Confined space entry and hazardous atmosphere training certifications
 - 5. Submit a written description of procedures to be used to the Engineer, including product literature for all digital video equipment including, but not limited to, cabling, camera, monitor, footage counter, digital video tilting device, and recorder.
 - 6. Proposed door hanger for public notification
- E. Contractor shall furnish all labor, materials, machinery, equipment, and incidentals required to perform thorough CCTV inspection of the designated sewers.

- F. Contractor shall send an email on a daily basis to the Owner and Engineer that lists the manholes that may be accessed during the next 24-hour period. A weekly list of manholes may be submitted in lieu of a daily list, subject to the Engineer's written approval.
- G. Contractor shall keep, and submit to the Engineer weekly, daily work logs describing the work location, manhole numbers, work times, labor requirements, personnel names, equipment used (including identification numbers), fire hydrant and other required permits, and work progress. Work logs shall be kept independent of any other required logs.
- H. The work described in this Section, including any internal sewer inspections, shall meet the minimum requirements as presented in the OSHA Standard, Title 29 CFR 1910.146, Permit Required Confined Spaces. Contractor shall notify the Owner and Engineer each day by phone or email when it is necessary for Contractor to enter a manhole(s). Contractor shall identify all manholes that he plans on entering that day by street location and manhole number.
- I. Contractor shall submit final sewer inspection digital video and data as previously listed herein and as required per Article 3.05 of this Section.

1.03 QUALIFICATIONS

- A. Contractor
 - 1. Successfully performed work on at least three other projects within the last five years and at least 500,000 linear feet of CCTV experience
- B. CCTV Operator: Successfully performed work on at least three other projects within the last five years and at least 250,000 linear feet of CCTV experience
- C. Crew Chief: Minimum of five years' experience on projects similar to this Project and experienced using all proposed equipment for this Project

1.04 NOTIFICATIONS

- A. Contractor's Notification of Owner and Engineer:
 - 1. A minimum of five days prior to the anticipated commencement of inspections in any one area and 24 hours in advance of actual start
 - 2. When an obstruction that is restricting flow in the sewer pipelines is discovered
 - 3. If the conditions for CCTV inspection are found to be unsafe or impractical
 - 4. Each week, Contractor shall send an email to the Owner's and Engineer's designated contacts that lists the location(s) of work, the pipe segments and manholes that will be accessed each day.
- B. Contractor's Notification of the Public:
 - 1. Between 24 hours and 48 hours prior to the inspection of any line segment, Contractor shall distribute door-to-door a door hanger, approved by the Owner and Engineer, describing the work to be performed to notify every residence and business that may be affected. Door hangers shall be double-sided with the notification information in the English language on one side and in the Spanish language on the reverse side.

PART 2 PRODUCTS

2.01 TELEVISION INSPECTION EQUIPMENT

- A. Video inspection shall utilize PACP (Pipeline Assessment and Certification Program) certified software.
- B. CCTV inspection equipment shall produce a color recording
- C. Contractor shall provide a mobile vehicle with video monitoring equipment specifically compatible with the camera equipment being used. The vehicle shall be large enough to accommodate at least three people at any time for viewing of the monitor. Owner and Engineer shall have unrestricted access to observe the television screen and all other operations at all times.
- D. The television camera used for the inspection shall be specifically designed and constructed for such inspection. Adjustable light source to allow an even distribution of lighting for the camera shall be suitable to allow a clear color picture of the entire periphery of the pipe. The camera shall be capable of panning 360 degrees and tilting 270 degrees to facilitate the inspection of all laterals, with optimum picture quality provided by focus and iris adjustment. The camera, television monitor, and other components of the video system shall be capable of producing a minimum 600 line resolution picture. Backup camera shall be available on the Project site. The camera shall be operative in 100 percent humidity conditions and in a hazardous and corrosive environment. The camera shall be capable of zooming at least 10:1 for looking further down the pipe or up into the laterals.
- E. The camera, television monitor, and other components of the video system shall be capable of producing picture quality to the satisfaction of Owner and/or Engineer.
- F. The television inspection equipment shall have an accurate footage counter that shall display on the monitor the exact distance of the camera from the centerline of the starting manhole.
- G. A slope indicator shall be included on the camera and be accurately calibrated per manufacturers specifications for measurement of pipe slope.
- H. The camera shall be capable of height adjustment so that the camera lens is always centered at one half the inside diameter, or higher, of the pipe being inspected.
- I. Lighting for the camera shall be suitable to allow a clear picture of the entire periphery of the pipe. A reflector, in front of the camera, may be required to enhance lighting in dark or large diameter pipes. The image shall be clear and bright enough to allow the reviewer to discern even small defects in the pipe being inspected Video that does not meet this requirement, or fails to meet PACP specifications, shall be cause for the Contractor to reinspect the pipe.
- J. Video data will be PACP compliant and compatible with the Owner's existing software database system.
- K. Video data shall be provided to the Owner in a digital format such as MPEG or WMV, as well as on an external device, such as a USB thumb drive or similar format approved by the Owner. CDs or DVDs are not approved.

PART 3 EXECUTION

3.01 PREPARATION

- A. Contractor shall, in the presence of Owner's and/or Engineer's inspector, calibrate the camera footage every week with an aboveground tape measure and simultaneous CCTV footage counter.
- B. Contractor shall not float the camera unless permitted by the Owner or Engineer.
- C. See Article 3.04 herein for conditions under which flow control is required.

3.02 TELEVISION INSPECTION

- A. Contractor is required to complete the standard National Association of Sewer Service Companies (NASSCO) industry standard Pipeline Assessment and Certification Program (PACP) forms using the standard NASSCO PACP coding during filming of the CCTV videos.
- B. Obstructions that cause a stuck camera shall be the responsibility of the Contractor, and the retrieval of equipment or cameras shall be the responsibility of the Contractor and shall be performed at the Contractor's expense.
- C. Adjust the camera height such that the camera lens is always centered in the pipe being televised.
- D. Provide a lighting system adequate for good quality pictures. A reflector in front of the camera may be required to enhance lighting in black pipe.
- E. Perform CCTV inspections as follows:
 - 1. Before insertion of the camera into the sewer, the camera operator shall record, on the video, the upstream and downstream pipe sizes, inverts, and material, the specific location of the sewer (the standard data field in NASSCO PACP header), the direction in which the camera will travel, and all other mandatory NASSCO fields. The camera shall move through the line, in either direction, at a moderate rate, stopping when necessary to permit proper documentation of the sewer's condition. Maintain copies of video and reports for reference by the Owner for the duration of the contract
 - 2. Collect post-cleaning inspection video at each lateral for an extended period to better understand the flow from each individual lateral. The camera shall be positioned at each lateral for sufficient duration determine the nature of the flow and condition of the lateral (Minimum 30 seconds). Any lateral inspection deemed unacceptable by the Owner shall be re-televised by the Contractor at no additional cost to the Owner.
 - 3. Videos shall pan beginning and ending manholes to verify that all debris has been removed.
 - 4. The Camera operator shall make a thorough video inspection of all clamped joint in the line, sectional liners and points where pipe material transitions from one material to another.
 - 5. A video inspection report shall be prepared by the Contractor, and submitted to the Owner, for each line segment that is CCTV inspected.

6. The accuracy of the measurements for location of defects, service connections, changes in pipe materials, and all other PACP recognized conditions is paramount. Marking on cable, or the like, which would require interpolation for depth of manhole shall not be allowed. Measurement meters shall be accurate to one-tenth of a foot over the entire length of the sewer line section being inspected. Prior to recording the location of defect, service connection, etc., slack in the cable of the television inspection camera shall be taken up to assure metering device is designation proper footage. Accuracy of the measurement meters shall be checked daily by use of a walking meter, roll-a-tape, or other suitable device satisfactory to the Owner.
7. Camera distortions, in adequate lighting, dirty lens, or blurred/hazy picture will be cause for rejection of a video and rejection of the associated line segment. Any pipeline reach television inspection deemed unacceptable by the Owner shall be re-televised by the Contractor at no additional cost to the Owner. Payment for televised inspection shall not be made until the Owner approves the quality of the video and logs.
8. CCTV inspection video shall be continuous for pipe segments between manholes. The Contractor shall not leave gaps in the video of a segment between manholes.
9. The goal of the cleaning is to sufficiently remove debris, roots, and deposits to inspect the pipeline and provide at least 95 percent capacity of the pipeline. Sewers that are not sufficiently cleaned to permit television inspection shall be re-cleaned and re-inspected at no additional cost to the Owner.

3.03 PASSAGE OF TV CAMERA

- A. The camera shall not be propelled through the line at a rate greater than 30 feet per minute, stopping when necessary to permit proper documentation of the condition of the sewer line section. Digital video shall be captured at a minimum video bit rate of 4,000 kbps. In no case shall the television camera be pulled at a speed greater than 30 feet per minute unless permitted by the Owner or Engineer.
- B. The intention shall be to inspect the full length of sewer between each manhole and not in multiple files, unless specifically approved by Engineer. If during TV inspection of a pipe line, the camera is unable to pass an obstruction, even though flow is not obstructed, televise the remainder of the line from the other direction (reverse setup) in order to obtain a complete video of the line. If a reverse setup is conducted, then two separate video files are allowable; the two separate files shall have the same filename but with a different direction of survey, etc. in the filename or as otherwise directed by the Owner or Engineer, so that it is clear there are multiple files and videos for the same pipe segment.
- C. When a line is being videoed from the opposite direction, in order to survey on either side of an obstruction, and a second obstruction is encountered, the Contractor shall notify the Owner immediately.
- D. Contractor can televise multiple upstream and/or downstream sewer segments from a single manhole setup location as long as each video of sewer section from one manhole to the immediately adjacent manhole is submitted as a separate file.
- E. The television camera shall travel through the lines using its own power. The pictures taken of the entire inside periphery of the pipe shall be clear and visible. Picture quality and definition shall be to the satisfaction of Engineer, and if unsatisfactory, the equipment shall be removed, and no payment shall be made for the unsatisfactory inspection.

- F. Stop the camera at all service laterals and pan at such an angle that an internal view of the service lateral is available.
- G. All sanitary sewer pipes (lines) 48" in diameter, or less, shall be dewatered for cleaning and inspection purposes. Exceptions to the dewatering requirement will be considered on a case by case basis. The Contractor will assume that dewatering will be required for bidding purposes.
- H. Dewatering may be accomplished by pumping water around the work area or by plugging off pipes to isolate the portion of the system being worked on while cleaning and performing inspection. If plugging the line is used for dewatering purposes, the system must be properly monitored so that no overflows occur. If a pipe that has been rehabilitated by the installation of a liner is plugged, the liner must be braced at the manhole to prevent movement of the liner.

3.04 SEWER FLOW CONTROL

- A. At all times during CCTV inspection, the flow in the sewer line section(s) undergoing inspection shall be suitably controlled in accordance with the drawings. The depth of wastewater flow shall not exceed the following:

24-inch Pipe or Less:	10 percent of pipe diameter
Over 24-inch Pipe:	20 percent of pipe diameter
- B. When the depth of flow in the section(s) (including sags) being inspected is above the maximum allowable percentage specified above for the television inspection, the flow shall be reduced to allowable levels by performing the inspection during periods of minimum flow, with bypass pumping, or by pulling the camera with swab or a high velocity jet nozzle, as approved by the Engineer.
- C. When flow in a sewer line is plugged, blocked, or bypassed, sufficient precautions must be taken to protect the sewer lines from damage that might result from sewer surcharging. Further, precautions must be taken to ensure that sewer flow control operations do not cause flooding or damage to public or private property being served by the sewers involved.

3.05 SEWER INSPECTION REPORTS

- A. Summary reports shall indicate individual survey results in tabular form and shall provide a sortable list of surveys based on a user-defined description field. It shall include starting and ending manhole numbers, depths, pipe material, total survey length, and pipe diameter.
- B. Contractor shall submit, in electronic format, digital videos, photos, and evaluation reports to Engineer on an external hard drive or USB stick. DVDs or CDs are not acceptable.
- C. If digital videos are of such poor quality that Engineer is unable to evaluate the condition of the sanitary sewer main, locate the sewer service connections, or verify the proper installation, Contractor shall be required to re-televise the sanitary sewer and provide new digital videos of good quality, at no additional cost to Owner or Engineer.
- D. All digital videos shall become the property of Owner.
- E. Data to be provided weekly to Engineer shall either be recorded on a portable external hard

drive or directly copied to Engineer's portable external hard drive. Each hard drive shall be filled with as much data as practical to minimize the number of hard drives submitted. Sections of a single segment of sewer main shall not be recorded to more than one hard drive. Video footage of recorded segments shall be grouped by area and shall be submitted in sequential order relating to the area mapping designation. The footage counter reading from the camera equipment shall appear on all videos. Contractor shall review each submittal of CCTV inspection data to assure its quality and accuracy and shall revise the CCTV inspection data as needed to correct any inaccuracies prior to providing each submittal to the Engineer. Throughout the duration of the Project, should Engineer discover inaccuracies in any of the videos, Contractor shall re-inspect those segments at no additional cost to the Owner or Engineer. The Engineer will require a 30-day period to perform a quality review of sewer inspection data/videos after each submittal of data/videos has been received from the Contractor. The Contractor is encouraged to submit sewer inspection data/videos in a timely manner as payment will not be processed until the sewer inspection data/videos have successfully passed the quality review and been accepted by the Engineer. This 30-day review period applies to both the initial submittal of data/videos for a segment of sewer main and any subsequent resubmittals of data/videos originally determined to be unacceptable by the Engineer.

- F. Contractor shall provide to Engineer CCTV inspection data via external hard drive on a weekly basis and on a monthly basis. The data shall specifically include video indexing for all observations. Prior to beginning the CCTV inspection work, Contractor shall submit a sample deliverable of CCTV inspection data for a single length of sewer pipeline obtained from a past CCTV inspection project performed by the Contractor; Contractor shall not proceed with the CCTV inspection work until this sample deliverable has been submitted to the Engineer for review and the Engineer has subsequently approved its format and contents. Data to be submitted with sample deliverable and weekly/monthly submittals shall include:

1. Database file
2. Videos for each pipe segment in MPEG-1 format or greater
3. An inspection report for each pipe segment as a .pdf file

Files shall be named in accordance with the Owner's and Engineer's requirements. Each video file and inspection report file name shall be composed of Asset ID to Asset ID, starting with upstream Asset (MH20-2005_to_MH20-2010_Pre.pdf or MH20-2005_to_MH20-2010_Post.pdf). All submitted video and inspection report files will follow this naming convention.

- G. The camera equipment/software shall be capable of producing digitized images of all sewer mainlines and service connections in .jpg format. Contractor may be instructed to take digital still images of each mainline sewer joint and service connection to clearly depict it. The digital photographs (.jpgs) shall be at least 50 kilobytes in size. The screen capture shall include an onscreen display with date, reach number, and footage. The photographs shall become the property of the Owner.
- H. Upon approval by the Engineer of all, or portions of, the data delivered via the portable external hard drives, the approved CCTV data shall be delivered to Engineer on portable external hard drives. Each portable external hard drive shall be labeled to clearly indicate the date of the inspection, the designated segment(s) of sewer main(s) contained on the portable external hard drive, the name of the Project, the Project CIP number, Contractor name, and the index number of the portable external hard drive. The portable external hard drives shall contain separate digital files for each manhole-to-manhole section. The index

number shall indicate the sequential number of the portable external hard drive followed by the mini-basin number.

- I. The database shall be comprehensive for the entire Project, and additional data shall be added to the database each week. Each manhole has been given a unique manhole identification (Asset ID) per the Owner's guidelines, and the name of each database file shall be either that unique upstream Asset ID followed by the unique downstream Asset ID or as otherwise directed by the Owner or Engineer.
- J. There may be situations that require Contractor to televise an individual pipe segment from more than one direction (i.e. the camera is only able to televise 75 percent of the segment heading downstream, and the remaining 25 percent must be televised heading upstream). The name of additional database files, etc. produced in these circumstances shall be as shown below or as otherwise directed by the Owner or Engineer.

Examples:

Initial file name:

Asset Id_ Direction of Survey

MH20-2005_to_MH20-2010_Post _Downstream

Additional file name(s):

MH20-2005_to_MH20-2010_Post _Upstream

- K. The name of each digital still image, if required, shall be based on the video/data file name of the sewer reach in which the image was taken. The name shall be either recorded as the video/data file name, followed by the footage at which the mainline sewer joint or service connection was encountered (i.e. (File Name) @(Footage).jpg) or as otherwise directed by the Owner or Engineer.
- L. Contractor shall provide a typewritten summary that lists the contents of each portable external hard drive. The inspection logs shall be submitted on portable external hard drive in Adobe .pdf format with the pipe ID included in the filename, such as MH20-2005_to_MH20-2010_Post.pdf, and shall include color still photos (.jpg format) of mainline sewer joints and service connections encountered during the television inspection.
- M. At the end of the Project, Contractor shall provide a digital and written summary listing of all videos provided under this Project. Digital version shall be developed and submitted in current version of either Microsoft® Excel or Microsoft® Access software. Acceptance of this portion of the Work shall be dependent upon the results of the television inspection.

[END OF SECTION]

SECTION 02740

CURED-IN-PLACE PIPE

PART 1 GENERAL

1.01 SCOPE

- A. It is the intention of this specification to provide for the trenchless restoration of gravity sanitary and storm sewers by the installation of a resin-impregnated, flexible tube which is inverted or inserted into the existing conduit and inflated by use of a hydrostatic head or air pressure. The resin is cured by elevating the temperature and circulating the fluid (water/air) used for the inflation to a proper level per manufacturer's recommendations for the thermosetting reaction. When cured, the finished pipe will be continuous and tight-fitting from manhole to manhole.
- B. The work covered by this section of the specifications includes the furnishing of all labor, tools, equipment, and materials, and performing all operations in connection with lining of existing sewers with a continuous cured in place (CIPP) pipe liner. The CIPP liner will be as specified herein. The work shall also include all necessary maintenance of traffic provisions, host pipe preparatory work required in advance of the lining operation, including, cleaning and removal of all debris, removal of protruding service connections, complete maintenance of all wastewater flows, reinstatement of service connections and sealing of liner ends at manholes, and the cleanup of the work site, including restoration of surfaces such as paving, and seeding, sodding and graveling, as needed, if damaged. When completed, the formed liner should extend from end-to-end of the section being lined in a continuous, tight fitting, pipe-within-a-pipe as specified herein.
- C. The bidder's attention is directed to the general conditions, section 6.31, SPILL OR DISCHARGE OF WASTEWATER OR RECLAIMED WATER.

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01300 – Submittals
- B. Section 01510 – Temporary Construction Utilities
- C. Section 02650 – Sewer Cleaning
- D. Section 02731 –Television Inspection
- E. Section 02750 – Chemical Grouting
- F. Section 02762 – Sewer Service Lateral CIPP Lining

1.02 REFERENCES

- A. This specification references ASTM standards and other related standards, which are made a part hereof by reference and shall be the latest edition thereof.
 - 1. ASTM D-543 Standard Test Methods for Resistance of Plastics to Chemical Reagents

2. ASTM D-638 Standard Test Method for Tensile Properties of Plastics
3. ASTM - 695 Standard Test Method for Compressive Properties of Rigid Plastics
4. ASTM D790 Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
5. ASTM D903 Standard Test Method for Peel or Stripping Strength of Adhesive Bonds
6. ASTM D2290 Standard Test Method for Apparent Hoop Tensile Strength of Plastic or Reinforced Plastic Pipe
7. ASTM D2412 Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
8. ASTM D5813 Standard Specification for Cured-In-Place Thermosetting Resin Sewer Piping Systems
9. ASTM F1216 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube
10. ASTM F1743 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-In-Place Installation of Cured-In-Place Thermosetting Resin Pipe
11. ASTM F2019 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pulled in Place Installation of Glass Reinforced Plastic (GRP) Cured-in-Place Thermosetting Resin Pipe (CIPP)
12. ASTM F2561 Standard Practice for Rehabilitation of a Sewer Service Lateral and Its Connection to the Main Using a One Piece Main and Lateral Cured-in-Place Liner

1.03 SUBMITTALS

- A. After the award of the contract or issuance of work order, and before any materials are delivered to the job site, the Contractor shall submit the following in accordance with the requirements set forth in Section 01300 - Submittals:
 1. Performance Work Statement (PWS) summarizing the work to be completed. PWS shall include verification of conformance to these Specifications and a detailed description of the work plan including product delivery, installation schedule, cleaning operations, CCTV inspection, bypass pumping, traffic control, provisions for pipes with sags too large for lining, curing method, repair methods, service reconnections, third party testing laboratory, as-built procedures, warranty, Quality Control Plan (QCP), etc. The QCP shall define the Contractor's, Owner's, Engineer's, and testing labs' role in quality control.
 2. Detailed installation procedures; lining production schedule and location; testing procedures and schedule; quality control procedures; liner curing procedures including heat-up and cool-down rates, curing temperature and duration; and shipping and storage requirements, schedule, and procedures
 3. A complete list and description of all equipment and materials to be used during the lining operation.

4. Name of resin supplier and liner fabric supplier.
 5. Manufacturer's certification that all materials to be used meet the referenced standards and these specifications.
 6. Certification showing that the proposed installer is currently licensed by the Manufacturer to install the products referenced in this Specification.
 7. Manufacturer's approved procedure for material storage and handling, temperature control, liner insertion, curing requirements and trimming and finishing.
 8. Contractors procedure for sealing the CIPP liners from groundwater infiltration at manholes/access structures and service laterals
 9. Manufacturer's approved guidelines for minimum and maximum pressures, temperatures, and time durations to be used during liner inversion, cure, and cool down.
 10. Data on Contractor's monitoring equipment to be used during curing, type and tolerance of temperature gauges and thermocouples.
 11. Procedure for cool down and relieving static head after the CIPP liner is cured.
 12. Manufacturer's approved guidelines for factory and/or field (whichever applies) wet out procedures, including volume of resin per unit of liner, roller gap setting, mixing ratios and procedures for resin and catalyst/hardener, shelf life of resin, pot life of resin, and required wet out procedure to insure full saturation
 13. Design calculations, prepared by a professional Engineer, for the minimum liner thickness. Calculations shall be submitted at least two weeks prior to mobilization. All designs calculations shall reflect protocol outlined in ASTM F-1216 or ASTM F2019 and ASTM D2412 for "fully deteriorated gravity pipe conditions". The calculations shall demonstrate the appropriate wall thickness for each pipe segment and that the liner has been properly undersized to avoid the creation of wrinkles or folds. Tabular liner wall thickness calculations shall be provided for each pipe diameter in no less than 1-foot increments from 3 to 6 feet cover depth and in 2-foot increments thereafter. Special liner wall thickness calculations shall be submitted for installations with less than 3 feet of cover. The liner wall thickness shall be increased as required based on actual pipe ovality, as determined by the pre-installation CCTV inspection.
 14. A detailed resume of the field superintendent who will direct the work. The field superintendent shall have at least two- (2) year's field supervisory experience in trenchless pipeline reconstruction. The field superintendent shall be on the job full-time during all steps of the pipe installation.
- B. After installation of the liner, the Contractor shall submit the following in accordance with the requirements set forth in Section 01300 – Submittals and in Part 3 herein:
1. Cure Report, including the following documentation:

- a. Curing log, including temperatures, pressures, and times during the curing process to document that a proper cure has been achieved. Curing log shall be submitted immediately after the curing is complete for each line segment that is rehabilitated.
2. Pre and Post rehabilitation digital CCTV videos and NASSCO PACP data with proper PACP coding.

1.04 SAFETY

- A. The Contractor shall be aware that this contract requires work in active sewers and shall perform the work in compliance with all federal, state, and local requirements for safety in confined spaces, work zone safety, and hazardous materials. The Contractor shall conform to all guidelines set forth by the Occupational Safety and Health Administration (OSHA) and Federal Regulations 29 CFR Ch. XVII, Section 1910.146, Confined Space Entry.
- B. The Contractor shall not enter into any sewer segment where hazardous conditions may exist until such time as the source of those conditions are identified and eliminated. The Contractor will report any condition to the Owner of Largo which may pose a threat to the health and welfare of employees of the Owner, Contractor, or the general public.
- C. The Contractor will use employees that are properly trained and who are aware of possible work, materials, and job-site related hazards.
- D. The Contractor shall take satisfactory precautions to protect the sewer segments and appurtenances from damage that might be inflicted upon them by the lining operations. Any damage caused to the sewer segment or other public or private property as a result of the grouting operations shall be repaired at the Contractor's expense.
- E. The Contractor will ensure that waste material is properly disposed in accordance with applicable regulations and safety precautions.

1.05 QUALIFICATIONS

- A. The Owner requires a proven and extensive track record for the CIPP liner system to be used under this agreement. All Contractors submitting bids must exhibit satisfactory experience in the installation of the proposed liner system and satisfactory evidence that the proposed liner system has been extensively and successfully installed in the United States and the State of Florida.
- B. The qualifications of the Contractor shall be submitted with the Bid Proposal. These qualifications shall include detailed descriptions and verification of the following requirements:
 1. At a minimum, the Contractor must have three (3) years of CIPP installation experience in the state of Florida
 2. Contractor shall have successfully installed at least 300,000 linear feet of CIPP lining in pipelines 12-inch diameter or less and 50,000 linear feet of CIPP lining in pipelines greater than 12-inch diameter, as applicable, using the specified method of installation and curing.
 3. The installer must be certified by the liner system manufacturer for installation of the liner system and shall submit a certified statement from the manufacturer that the Contractor

is a certified and/or licensed installer of the CIPP lining

4. An installation reference list of a minimum of three municipal clients that the Contractor has performed this type of work for, including contact names, phone numbers, pipeline diameter, linear footage of pipeline rehabilitated, and a description of the actual work performed.
 5. Contractors using subcontractors shall submit information about the sub-contractor (i.e. Name, experience records, jobs on which the general and sub-contractor have worked jointly, etc.).
- C. The Owner reserves full and complete authority to approve the satisfactory nature of both the liner system and the installer.

1.06 DELIVERY STORAGE AND HANDLING

- A. Care shall be taken in shipping, storage, and handling to avoid damaging the liner. Any liner damaged in shipment shall be replaced at no cost to the Owner and as directed by the Owner and/or Engineer.
- B. All materials shall be accompanied by test reports certifying that the material conforms to the specifications listed herein.
- C. Materials shall be shipped, stored, and handled in a manner consistent with the written recommendations of the Manufacturer.
- D. Any liner showing a split or tear, or which has otherwise received damage, shall be marked as rejected and immediately removed from the site.
- E. The liner shall be maintained at a proper temperature in refrigerated facilities to prevent premature curing at all times prior to installation. The liner shall be protected from UV light prior to installation. Any liner showing evidence of premature curing shall be rejected for use and shall be immediately removed from the site.
- F. The Contractor shall use all means necessary to protect pipe materials before, during and after installation and to protect the installed work and materials of all other trades.
- G. In the event of damage caused to materials, the Contractor shall make all repairs and replacement necessary to the approval of the Engineer at no additional cost to the Owner.

PART 2 MATERIALS

2.01 LINER

- A. The liner material shall meet the ASTM D-5813, Standard Specification for Cured-In-Place Thermosetting Resin Sewer Piping Systems
- B. Inversion: The sewed tube shall consist of one or more layers of absorbent non-woven felt fabric in accordance with the requirements of ASTM F1216.
- C. Pulled-in-Place: The tube shall consist of one or more layers of fiberglass laminate in accordance with the requirements of ASTM F2019 and ASTM F1743.
- D. The tube shall consist of one or more layers of a flexible needled felt or an equivalent

nonwoven or woven material, or a combination of nonwoven and woven materials, capable of carrying resin and withstanding the installation pressures and curing temperatures. The tube should be compatible with the resin system to be used on this project. The material should be able to stretch to fit irregular pipe sections and negotiate bends.

- E. The tube should be fabricated to a size that, when installed, will tightly fit the internal circumference for the length of the original conduit without any annular spaces between the liner and host pipe and be able to bridge short areas of missing pipe. Allowances should be made for the longitudinal and circumferential stretching that occurs during placement of the tube.
- F. The wet-out tube shall be uniform in thickness and when subjected to the installation pressures will meet or exceed the designed finish wall thickness.
- G. The outside layer of the tube (before wet-out) shall be coated with an impermeable, flexible membrane that shall contain the resin and facilitate monitoring of resin saturation during the resin impregnation (wet-out) procedure.
- H. The tube shall be homogeneous across the entire wall thickness containing no intermediate or encapsulated elastomeric layers. No material shall be included in the tube that may cause delamination in the cured CIPP. No dry or unsaturated layers shall be evident.
- I. The wall color of the interior pipe surface of CIPP after installation shall be a light reflective color so that a clear detailed examination with closed circuit television inspection equipment may be made.
- J. Seams in the tube shall be stronger than the seamless felt and shall meet the requirements of ASTM D5813.
- K. Any plastic film applied to the tube on what will become the interior wall of the finished CIPP shall be compatible with the resin system used, translucent enough that the resin is clearly visible, and shall be firmly bonded to the felt material.
- L. The tube shall be marked for distance at regular intervals along its entire length, not to exceed 5 feet. Such markings shall also include the lining manufacturer's name or identifying symbol.
- M. The liner shall be fabricated from materials which, when cured, will be chemically resistant to internal exposure to constituents normally present in sanitary sewer and stormwater.
- N. Chemical grout designed for injection shall be: AV-100 chemical grout as manufactured by Avanti International, or approved equal.
- O. The CIPP shall have a minimum design life of fifty (50) years. The minimum design life shall be documented by submitting life estimates by national and/or international authorities or specifying agencies.
- P. The Contractor shall have performed long term testing for flexural creep of the CIPP material installed by his company. These testing results shall be used to determine the long term, time-dependent flexural modulus to be utilized in the product design. This testing shall include demonstration of performance of the materials (tube and resin) and general workmanship of the installation and curing. A percentage of the instantaneous flexural modulus value (as measured by ASTM D790 testing) shall be used in design calculations for external buckling. The percentage, or the long-term creep retention value, utilized shall be

verified by this testing. Values more than 50 percent shall not be applied unless substantiated by qualified third-party test data. The materials utilized for this Project shall be of a quality equal to or better than the materials used in the long-term test with respect to the initial flexural modulus used in design.

2.02 RESIN SYSTEM

- A. The resin system shall be a corrosion resistant polyester, vinyl ester, or epoxy and catalyst system that when properly cured meets the minimum requirements given herein or those that are to be utilized in the design of the CIPP for this project.
- B. The quantity of resin used for tube impregnation shall be sufficient to fill the volume of air voids in the tube with additional allowances for polymerization shrinkage and the potential loss of resin during installation through cracks and irregularities in the original pipe wall, as applicable. A vacuum impregnation process shall be used in conjunction with a roller system to achieve a uniform distribution of the resin throughout the tube.

2.03 STRUCTURAL REQUIREMENTS

- A. The CIPP shall be design in accordance with the requirements of ASTM F1216 or ASTM F2019 or ASTM F1743, Appendix X1, has such an acceptable methodology that may be used where applicable. The long-term flexural modulus to be used in the design shall be verified through testing. The long-term modulus shall not exceed 50% of the short-term value for the resin system unless the tube contains reinforcements. If a reinforced tube is utilized, the long-term flexural modulus shall be the percentage of the short-term modulus as determined by the above referenced testing.
- B. The minimum CIPP wall thickness for any mainline sewer pipe shall be 6 millimeters.
- C. The layers of the finished CIPP shall be uniformly bonded. It shall not be possible to separate any two layers with a probe or point of a knife blade so that the layers separate cleanly or such that the knife blade moves freely between the layers. If separation of the layers occurs during testing of the field samples, new samples will be cut from the work.
- D. Any layers of the tube that are not saturated with resin prior to insertion into the existing pipe shall not be included in the structural CIPP wall thickness computation.
- E. Any reoccurrence may be cause for rejection of the work. The finished CIPP shall fit tightly to the host pipeline at all observable points and shall meet or exceed the minimum thickness established by the design process. The materials properties of the finished CIPP shall meet or exceed the following structural standards:

MINIMUM PHYSICAL PROPERTIES				
Property	ASTM Test Method	Polyester System	Filled Polyester System	Vinyl Ester System
Flexural Strength	D790	4,500 psi	4,500 psi	5,000 psi
Flexural Modulus (Initial)	D790	250,000 psi	400,000 psi	300,000 psi

Flexural Modulus (50 yr)	D790	125,000 psi	200,000 psi	150,000 psi
Tensile Strength	D638	3,000 psi	3,000 psi	4,000 psi

PART 3 EXECUTION

3.01 GENERAL

- A. Contractor shall clean the pipeline with a high-pressure water jet and hydraulically-powered root cutting equipment to remove all internal debris from the pipeline in accordance with Section 02731 – Television Inspection.
- B. Hydraulic cementitious patching material used for flow channel construction shall be installed as directed by the manufacturer.
- C. Sectional repairs will not be permitted

3.02 SEWER REPAIRS

- A. Any protruding pieces of concrete, dropped joints, or broken pipe shall be subjected to point repairs so that the pipe is left in a clean, smooth condition in all respects ready for lining, unless otherwise jointly determined by the Contractor, Engineer, and the Owner that the defect will not compromise the integrity of the liner.
- B. If conditions such as broken pipe and major blockages are found that will prevent proper cleaning, or where additional damage would result if cleaning is attempted or continued, the Contractor shall notify the Engineer immediately. The Contractor shall not line through pipe sagging more than 20 percent without written permission from the Engineer.

3.03 JOINT, CRACK, ANNULAR SPACE, AND LINER END CHEMICAL SEALING

- A. Prior to CIPP liner installation, all active leaks of a magnitude that will compromise the integrity of the liner shall be stopped at least one hour prior to installation of the liner using chemical seal grout, at no additional cost to the Owner.
- B. Chemical seal grout shall have the following properties:
 - 1. Chemical seal grout shall react quickly to form a permanent watertight seal.
 - 2. Resultant seal shall be flexible and immune to the effects of wet/dry cycles.
 - 3. Chemical seal grout shall be non-biodegradable and immune to the effects of acids, alkalis, and organics in sewage.
 - 4. Component packaging and mixing shall be compatible with field conditions and worker safety.
 - 5. Extraneous sealant left inside pipe shall be readily removable.
 - 6. Chemical seal grout shall be compatible with the CIPP liner resin system utilized.

The chemical sealing materials shall be acrylic resin-type and shall be furnished with activators, initiators, inhibitors, and any other materials recommended by the manufacturer for a complete grout system. Sealing grout shall be furnished in liquid form in manufacturer's standard containers. Sealing grout shall be AV-100 by Avanti International or Engineer-approved equal.

- C. The Contractor shall modify his equipment as necessary to seal the leaks. The Contractor's equipment and sealing method shall be approved by the Owner and Engineer prior to use. Extreme caution shall be utilized during leak sealing (pressure) operations to avoid damaging the already-weakened sewer pipe. If any damage occurs, it shall be repaired at the Contractor's expense and to the satisfaction of the Owner and Engineer. Excessive pumping of grout which might plug a service lateral shall be avoided. Any service laterals blocked by the grouting operation shall be immediately cleared by the Contractor at no expense to the Owner.

3.04 FLOW CONTROL

- A. Any layers of the tube that are not saturated with resin prior to insertion into the existing pipe shall not be included in the structural CIPP wall thickness computation.

3.05 LINER INSTALLATION

- A. The work to be performed under this specification shall be performed Monday through Friday, 7:00 a.m. through 5:00 p.m. The Owner acknowledges that the work to be performed may require performance of work outside of this time frame. All work performed outside of the stipulated time frame must be requested and approved in writing by the Owner a minimum of 72 hours in advance of performing such work. Communication, coordination, and other work-hour-related procedures shall be discussed as part of the preconstruction conference.
- B. Preparation
 - 1. It shall be the responsibility of the Owner to make all manhole access points open and accessible for the work, and to provide rights of access to these points. The Contractor shall immediately notify the Engineer of access points that cannot be opened due to obstruction by permanent structures. The Contractor shall be responsible to make all necessary provisions to ensure service conditions and structural conditions of the host pipe are suitable for installation and warranty of the liner. If a street must be closed to traffic because of the orientation of the pipeline, the Contractor shall be responsible for Maintenance of Traffic.
 - 2. The Contractor, when required, shall remove all internal debris out of the pipeline that will interfere with the installation of the CIPP. Cleaning shall conform to the requirements of Section 02731 –Television Inspection.
 - 3. Potable water from the Pinellas County water system shall be used for pipe cleaning and lining operations. The Contractor will obtain a portable potable water meter from the Pinellas County Utility (PCU) department and abide by all requirements set forth by PCU, as well as all applicable state and local regulations, regarding the use of the meter. The Contractor will be responsible for all water use fees, at no cost to the Owner. The Contractor is responsible for any damage resulting from improper use of hydrants. The Contractor will not use or obstruct fire hydrants in the event of a fire in the area. The Contractor shall not waste water from the Pinellas County system because of improper connections or hydrants left open

4. It shall be the responsibility of the Contractor to clear the line of obstructions such as solids and roots that will prevent the insertion of CIPP and a tight fit with the host pipe. If pre-installation inspection reveals an obstruction such as a protruding service connection, dropped joint, or a collapse that will prevent the installation process, and it cannot be removed by conventional sewer cleaning equipment, then the Contractor shall suspend lining operations and notify the Engineer.
5. The pre-installation CCTV inspection of the pipeline shall be performed by experienced personnel trained in locating breaks, obstacles, and service connections, in accordance with the Technical Specification Section titled Sanitary Sewer Line Cleaning and Sanitary Sewer Television Inspection. The interior of the pipeline shall be carefully inspected to determine the location of any conditions that may prevent proper installation of the CIPP into the pipelines, and it shall be noted so that these conditions may be corrected. A videotape and suitable log shall be kept for later reference by the Owner.
6. The Contractor, when required, shall provide for the flow of sewage around the section, or sections, of pipe designated for rehabilitation. The bypass shall be made by plugging the line at the existing upstream manhole and pumping the flow into a downstream manhole or adjacent system. The pump and bypass lines shall be of adequate capacity and size to handle the anticipated flow. The Contractor will be required to submit a detail of the bypass plan to the Engineer for prior approval.
7. The Contractor shall verify all existing pipe diameters prior to ordering liner materials.
8. The Contractor shall make every effort to maintain service usage throughout the duration of the project. In the event that a service will be temporarily out of service, the maximum amount of time of no service shall be 16 hours for any property served by the sewer. The Contractor shall be required to notify the Owner and all affected properties whose service laterals will be out of commission and to advise against water usage until the sewer main is back in service. Such notification shall be provided to the Owner at least one week prior to service disconnecting.
9. A public notification program shall be implemented, and shall as a minimum, require the Contractor to be responsible for contacting each home or business connected to the sanitary sewer and informing them of the work to be conducted, and when the sewer will be off-line. The Contractor shall also provide the following:
 - a. Written notice to be delivered to each home or business describing the work, schedule, how it affects them, and a local telephone number of the Contractor they can call to discuss the project or any problems that could arise.
 - b. Personal contact and attempted written notice the day prior to the beginning of work being conducted on the section relative to the residents affected.
 - c. Personal contact with any home or business that cannot be reconnected within the time stated in the written notice.

C. Installation of Full Liner

1. Tube Insertion
 - a. The wet-out tube shall be inserted/inverted into the pipeline using as defined within relevant ASTM standards previously stipulated. The tube should be

inserted/inverted through an existing manhole or approved access point and fully extend to the next designated manhole or termination point.

- b. The application of hydrostatic head, compressed air, or other means shall fully extend the liner to the next designated manhole or termination point and inflate and firmly adhere the liner to the pipe wall.
- c. The liner is to be install in a controlled manner at a rate sufficient to prevent damage to the tube. The installation rate shall not exceed 32 feet per minute. The installation head shall be such that, allowing for minor impact, at no tome shall the hoop tension in the felt exceed 500 psi or the hoop stress in the polyurethane membrane exceed 8,000 psi

D. Curing

- 1. The Contractor shall provide a suitable heat source and distribution system capable of delivering hot water, air and/or steam throughout the entire length of the liner to quickly and uniformly raise the temperature in the liner above the temperature required to commence the exothermic reaction of the resin, as determined by the catalyst system employed.
- 2. The heat source shall be fitted with suitable monitors to gauge the temperature of the incoming and outgoing water/steam supply to determine when uniform temperature is achieved throughout the length of the liner. Temperature in the liner during the initial and post cure period shall be as specified by the resin supplier. In addition to the gauges on the incoming and outgoing water/steam supply, there shall be thermo couples placed between the liner and the sewer pipe at the end of the liner being cured to accurately measure the liner temperature. The Contractor shall submit, in writing, for approval, his method of monitoring line curing temperatures.
- 3. A record every 15 minutes of the temperature reading of the thermocouple shall be kept and submitted for each section lined to the inspector or Engineer.
- 4. Initial cure shall be deemed to be completed when inspection of the exposed portions of liner appear to be hard and sound and the remote temperature sensor indicates that the temperature is of a magnitude to realize an exotherm. The cure temperature shall be held for the period recommended by the resin manufacturer, during which time the distribution and control of the curing medium shall continue. The curing process for the CIPP shall consider the host pipe material, resin/catalyst system, ambient temperature, moisture level and thermal conductivity of the soil.

E. Cool-Down

- 1. The hardened liner shall be cooled at rate that is no faster than the resin manufacturer's recommendations. If no guidance is available, no faster than 10 degrees per hour should be performed. The liner shall reach a temperature below 100 degrees F before relieving the static head or pressure in the lined pipe and returning normal flow back into the system. The cool down may be accomplished by introducing cool water or air into the lined pipe. Super cold air shall not be utilized to increase the cooling rate. Care shall be taken in the release of the static head or pressure so that a vacuum will not develop which could damage the newly installed liner.

3.06 FINISH

- A. The finished pipe liner shall be continuous over the entire length of an insertion run and be as free as, commercially practicable, from visual defects such as foreign inclusions, pinholes, and de-lamination. The pipe liner shall be impervious and free of any leakage from the pipe to the surrounding ground or from the ground through the sidewall of the lined pipe.
- B. Any defects which will, or could, affect the integrity of strength of the liner shall be repaired at the Contractor's expense, in a manner approved by the Owner.
- C. The beginning and end of the new CIPP pipe liner shall have manufacturer approved end restraints installed and be sealed to the rehabilitated host pipe using a product equal to "3M 5600 Polyurethane Grout" and a compatible acrylic additive. At the time of final inspection, there shall be no evidence of groundwater infiltration through the annular space between the liner and the host pipe. All manhole terminations sealed by grout shall also require a smooth, uniformed concrete transition between the manhole wall, bench, and invert.

3.07 SERVICE REINSTATEMENT

- A. After the pipe liner has been cured, the Contractor shall internally reconnect the existing service connections. The Contractor shall be responsible to confirm the active laterals prior to reconnection. In the case of non-man entry pipes, reconnection shall be performed from the interior of the pipeline by means of the television camera and a cutting device that re-establishes them to not less than 98 percent diameter. All reinstated services shall be cut neat and smooth and shall be wire brushed and smoothed to prevent collection of solids and potential blockages at service connections.

3.08 LATERAL SEALING

- A. Prior to starting work, the Contractor shall determine if leaks at service laterals can be fixed from the pipe interior. If excavation at the service lateral within the right-of-way is required, the Owner reserves the right to delete the sewer span between manholes from the work assignment at its discretion. If the service lateral is leaking upstream of the right-of-way line, the Contractor shall notify the Engineer.
- B. Sewer service reconnections shall be sealed with the use of equipment which consists of a closed-circuit television system and a special sealing packer device, along with the necessary chemical sealant containers, pumps, controls, regulators, valves hoses, etc. The special lateral sealing packer with an inversion tube or bladder, 36 inch minimum length, to reach up into the service pipe shall be so constructed that it can straddle four (4) to six (6) inch diameter service connections in eight (8) inch or larger main sewer lines. When properly positioned, and with the end elements inflated, a special inflatable sealing tube shall be extended up the service connection, thereby isolating a portion of the service connection containing one or more pipe joints for sealing. The control unit for the device shall have provisions for accurately controlling the packer functions in addition to monitoring the inflation pressure and the void pressure in the isolated area to sealed.
- C. After the packer device has been properly positioned in the main line, with the inflatable tube extended into the service connection, the connection shall be sealed by the injection of the chemical sealant. The chemical sealant shall be injected through the special packer device into the annular space between the inflatable tube and the service connection. The injection of the chemical sealant shall continue until the chemical fluid back pressure is enough to insure the complete sealing of all the defects along the length of the inflatable tube.
- D. After the service connection has been successfully sealed, the following procedures shall

be performed to ensure that the sealing operation did not block the service connection.

1. The inflatable tube shall be removed from the connection.
 2. The packer and elements shall be deflated.
 3. The special packer shall be moved forward, and the 360° CCTV camera shall be positioned in the center of the service connection and rotated to look up the service connection to insure that the chemical sealant did not cause blockage.
- E. If blockage is observed, the chemical sealant shall be removed to ensure the service connection is free flowing.
- F. The chemical sealant used shall be in accordance with the requirements set forth in the specifications, or as approved by the Engineer.
- G. At the time of final inspection, there shall be no evidence of groundwater infiltration entering the lined pipe from between the liner and the host pipe at the service laterals.
- H. Lateral Seal Test
1. At the direction of the Engineer, the Contractor shall pressure test the lateral connection seal.
 2. The Contractor shall position a bladder packer over the lateral opening and inflate the inversion tube to isolate the lateral. The bladder shall be pressurized to four (4) PSI plus 0.5 PSI for each foot of groundwater above the sewer invert. Maximum pressure shall be nine (9) PSI.
 3. Once the required pressure has been achieved, the air supply shall be disconnected, and the time required for the void pressure to drop 0.5 PSI shall be recorded. If the pressure drops more than 0.5 PSI in less than ten (10) seconds, the lateral shall be regouted and retested.

3.09 FIELD QUALITY CONTROL

- A. For all runs of CIPP liner and where the thickness of the liner changes, the Contractor shall take samples and shall test them in accordance with Article 3.07 herein.
- B. Where the pipe diameter is less than or equal to 15 inches, the samples shall be restrained-type samples made by extending the liner through a form with a diameter as close as possible to the existing pipeline. The formed sample shall be provided with insulation to contain cure heat as well as a heat sink, such as sandbags, for cool down. The length of the tube shall be large enough to provide at least five samples.
- C. Where the pipe diameter is greater than 15 inches, a plate sample shall be prepared. The test sample shall be fabricated from the material taken from the liner and cured in a clamped mold with the resin used in the liner construction placed in the down tube.
- D. Test specimens shall be clearly marked in indelible ink to identify the name of the Project, location, appropriate lateral or main section, work order number, date of installation, and orientation to the top of the pipe (direction of up) so the results can be correlated to the work performed. All test results shall use this designated labeling as a reference.

- E. The extraction and labeling of test specimens shall be performed by the Contractor in the presence of the Owner and/or Engineer. The Owner and/or Engineer and Contractor shall, upon completion of sample extraction and labeling, all sign a chain-of-custody form that shall subsequently accompany the sample at all times and shall ultimately be received and signed at the testing laboratory. Test reports shall include a copy of the chain-of-custody form with all signatures to ensure that reported test results are for the correct sample.
- F. Each sample shall be large enough to provide at least five total specimens for testing. One test for thickness, flexural strength, and flexural modulus shall be conducted in accordance with ASTM F1216 or ASTM F2019, ASTM D790, and ASTM D2290 for each run of lines. The material shall meet the initial strength requirements of Table 1 of ASTM F1216 or ASTM F2019 (UV cured).

3.10 WET-OUT AND CURE REPORT

- A. The Contractor shall submit wet-out and cure reports documenting the specific details of the liner's vacuum impregnation and saturation with resin and the CIPP installation of the liner. A report shall be generated for each liner installation. Copies of all wet-out and cure records shall be submitted to the Owner and Engineer on a weekly basis and prior to submitting an Application for Payment on which payment for the specific liner(s) included in the wet-out and cure records is requested. If the wet-out and cure reports are not submitted prior to the associated Application for Payment, payment for the work will not be made and the Application for Payment will be rejected. At a minimum, the report shall include:

1. Contractor name
2. Owner's Contract number
3. Line identification and location
4. Date and time of wet-out
5. Identification of sample(s) and name of technician(s)
6. Date of installation in sewer
7. Inside diameter of host sewer pipe
8. Liner thickness
9. Liner length
10. Liner and resin batch numbers
11. Resin type
12. Wet-out length
13. Roller spacing
14. Vacuum setting
15. Quantity of resin and catalyst utilized

16. Name of wet-out technician(s)

17. Time wet-out started and completed

18. Applicable remarks

19. Heat Cure: Boiler and liner heating fluid (water or steam) pressure and temperature versus time log during cure period

20. Cool down report

3.11 TESTING REQUIREMENTS

- A. Testing on physical samples from a random 20 percent of cured lines shall be performed, unless a pattern of failure occurs, at which point the Owner or Engineer can request additional testing at no cost to the Owner. All of the costs for sample collection and testing shall be included in the amount bid for the applicable Bid Item for CIPP lining, and no separate payment shall be made.
- B. For each inversion length, one CIPP sample shall be cut from a section of cured CIPP that has been inverted through a like-diameter pipe at an intermediate manhole or at the termination point. This sample pipe shall have been held in place by a suitable heat sink such as sandbags. Other sampling techniques may be required for special situations.
- C. The Contractor shall submit a method to the Owner and Engineer for review and approval for obtaining representative samples from the installed liners in accordance with Article 3.06 herein. These samples shall be tested by a third-party ASTM-certified testing laboratory at the Contractor's expense to verify compliance with the installed material specifications. The Contractor shall produce these test samples when directed by the Owner and/or Engineer.
- D. The CIPP shall meet the chemical resistance requirements of ASTM F1216 or ASTM F2019. CIPP samples for testing shall be of a tube and resin system similar to that proposed for actual construction. CIPP samples, both with and without plastic coating, shall meet these chemical testing requirements. The CIPP samples shall be prepared and the samples' physical properties tested in accordance with ASTM F1216, ASTM F2019, or Section 8 of ASTM F1743 using either proposed method. Wall thickness of samples shall be in accordance with paragraph 8.1.6 of ASTM F1743.
- E. The installed CIPP liner shall be leakage tested in accordance with ASTM F1216. The leakage testing shall be conformed before the service connections are re-instated. The Contractor may perform air testing in lieu of water leakage test. The Contractor shall perform a 4 psi air test on the segment after curing the CIPP and prior to internally re-instating laterals on 18-inch and smaller diameter sewers. The CIPP shall be able to hold a 4 psi pressure for a 5-minute minimum duration after a 2-minute stabilization period. Any lining not able to meet the water leakage test or air test shall be repaired and retested at no additional cost to the Owner.
- F. When post-installation thickness measurements and/or physical property testing is performed, installed liners which do not pass these material tests will be accepted at reduced payment or rejected as follows:
 - 1. Full Payment: If the thickness, flexural strength, and flexural modulus of elasticity of installed liner are all equal or greater than 95 percent of specified values, full payment will be made.

2. Reduced Payment: If the thickness, flexural strength, or flexural modulus of elasticity of installed liner is between 90 and 94.9 percent of specified value, payment will be made based on an adjusted amount, which shall equal the appropriate unit price bid multiplied by a Value Factor calculated as follows:

Value Factor = Thickness x Flexural Strength x Flexural Modulus of Elasticity (all percentages expressed as decimals)

3. Rejected: If the thickness, flexural strength, or flexural modulus of elasticity of installed liner is 89.9 percent or less of specified value, product may be rejected.

3.12 FINAL ACCEPTANCE

- A. The finished liner shall be continuous over the entire length of the installation. The liner shall be free from visual defects, damage, deflection, holes, delaminations, uncured resin, etc. No pinholes, splits, cracks, thin spots, dry spots, lifts, ridges, or other defects in the CIPP liner shall be permitted. There shall be no visible infiltration through the liner or from behind the liner at manholes and service connections. Wrinkles in the finished liner that cause backwater, reduce the pipe's hydraulic capacity or structural stability, or create voids between the liner and pipe wall are unacceptable. Wrinkles shall neither exceed 10 percent of the diameter of the host pipe nor impede flow at any time, as determined by the Owner's Representative.
- B. Cut ins and attachments at service connections shall be neat and smooth. All service connections shall be open, clear, and watertight. The liner opening shall neatly conform to the opening in the host pipe and shall be free of burrs or debris.
- C. The Contractor shall prepare a sample for each installation of CIPP. The samples shall be restrained samples for diameters of CIPP less than 18"; and flat plate samples for diameters of CIPP 18" and larger. The flat plate samples shall be taken directly from the wet-out tube, clamped between flat plates, and cured in the downtube. The restrained samples shall be tested for thickness and initial physical properties; flat plate samples shall be tested for initial physical properties only.
- D. After installation of the pipe liner and reinstatement of service connections, the Contractor shall perform a TV inspection in the presence of the Owner's Representative. A radial view TV camera shall be used. The finished pipe liner shall be continuous over the entire length of each installation. The pipe liner shall be free of significant visual defects, damage, deflection, holes, and the like, other than in areas of reduced host pipe cross section, wherein a minor longitudinal fold may have formed. Any deformities in the liner, not caused by irregularities in the host pipe that significantly restrict the sanitary sewer flow as determined by the Engineer, shall be repaired by the Contractor at no cost to the Owner. Reinstated service connections shall be neat, smooth, and properly grouted to prevent infiltration of groundwater.
- E. Defective lining shall be removed and the pipe re-lined at no additional cost to the Owner. If the host pipe is damaged during the removal process, Contractor shall perform a point repair at Contractor's expense. Prior to removing or repairing any defective lining, the Contractor shall supply a complete CCTV inspection of the CIPP segment to the Engineer.
- F. Preliminary field acceptance of the liner shall be based on the Owner's and/or Engineer's evaluation of the installation and curing data, results of air testing where required, and review of the digital CCTV recordings.
 1. Groundwater infiltration shall not be observed through the liner.

2. There shall be no evidence of splits, cracks, breaks, lifts, kinks, delaminations, or crazing in the liner.
 3. If any defective liner is discovered after it has been installed, it shall be removed and replaced with either a sound liner or a new pipe at no additional cost to the Owner.
- G. Final acceptance of the liner shall be based on the preliminary field acceptance of the liner by the Owner and/or Engineer as previously listed and on the results of the certified laboratory tests on the liner specimens as previously listed.
- H. Liners meeting or exceeding the certified thicknesses and specified strengths, as evidenced by the certified laboratory testing results, shall be paid for as specified above.

3.13 CLEAN-UP

- A. After the pipe liner installation has been completed and inspected, the Contractor shall clean up the project area. All excess material and debris not incorporated in the permanent installation shall be disposed of by the Contractor. The Contractor, in accordance with State and Federal laws and regulations shall dispose of all excess material and debris not incorporated in the permanent installation. The project area affected by the Contractor's operations shall be restored to original condition, or better.

3.14 WARRANTY

- A. The manufacturer shall warrant the pipe liner to be free from defects in raw materials for one (1) year from the date of delivery. The Contractor shall warrant the pipe liner installation for a period of two (2) years from the date of acceptance described above. During the Contractor warranty period, any defect, which materially affects the integrity or strength of the pipe liner, shall be repaired at the Contractor's expense in a manner mutually agreed to by the Owner and the Contractor.
- B. If a liner fails to reform, the Contractor shall be required to remove the failed liner at no additional cost to the Owner. This shall include, but not be limited to, all material, excavation, backfilling, cutting concrete, pipe, shoring, temporary pavement, permanent pavement, permits, and other incidental work required to remove the liner from the host pipe. If removal is not feasible, or if removal will cause more harm than acceptable to the host pipe, alternatives may be proposed by the Contractor to the Engineer for review and approval. The integrity of the existing pipe, where the liner was removed, shall be rehabilitated by installing another new pipe section. There shall be no direct payment for this work

[END OF SECTION]

SECTION 02750

CHEMICAL GROUTING

PART 1 GENERAL

1.01 SCOPE

- A. It is the intent of this Specification to provide for the rehabilitation of defective pipe joints, some circumferential pipe cracks and other small pipe defects by the application of chemical grouting materials in accordance with ASTM F-2304-03 Standard Practice for Rehabilitation of Sewers Using Chemical Grouting.
- B. The work covered by this section of the specifications includes the furnishing of all labor, tools, equipment and materials, and performing all operations in connection with sealing sewer pipe joints, cracks, holes and similar defects, including, but not limited to, cleaning and CCTV inspection of the pipe, pressure testing sewer pipe joints, and sealing pipe joints with chemical grout. The work shall also include all necessary maintenance of traffic provisions, host pipe preparatory work required in advance of the lining operation, including, removal of all debris, removal of protruding service connections, complete maintenance of all wastewater flows, and the cleanup of the work site, including restoration of surfaces such as paving, and seeding, sodding and graveling, as needed, if damaged.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of the other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. ASTM F2304 Standard Practice for Sealing of Sewers Using Chemical Grouting
 - 2. ASTM F2414 Standard Practice for Sealing Sewer Manholes Using Chemical Grouting
 - 3. ASTM F2454 Standard Practice for Sealing Lateral Connections and lines from the mainline Sewer Systems by the Lateral Packer Method, Using Chemical Grouting
 - 4. NASSCO Specification Guidelines - Specification for Sewer Line Cleaning
 - 5. NASSCO Specification Guidelines - Specification for Television Inspection Main Sewer
 - 6. NASSCO/ICGA Suggested Standard Specification for Pressure Testing and Grouting of Sewer Pipe Joints, Laterals and Lateral Connections Using the Packer Method with Solution Grouts

1.03 SUBMITTALS

- A. After the award of the contract or issuance of work order, and before any materials are delivered to the job site, the Contractor shall submit to the Engineer the following:
 - 1. A complete list and description of all equipment and materials to be used during the grouting operation.
 - 2. Pump calibration information, field sealing records, certification of pressure

sensing/monitoring equipment, and a list of chemicals to be used together with information on toxicity and hazardous nature of chemicals.

3. Manufacturer's certification that all materials to be used meet the referenced standards and these specifications.
4. Information on recommended or required safe storage and handling of each chemical and evidence that chemicals are approved by OSHA and U.S. Environmental Protection Agency.
5. Manufacturer's approved procedure for material storage and handling, temperature control, liner insertion, curing requirements and trimming and finishing.
6. Contractors procedure for sealing the CIPP liners from groundwater infiltration at manholes/access structures and service laterals
7. Detailed plans for maintenance of wastewater flows including pumps, plugs, pipe size, tank trucks, material, locations, calculations, noise control methods, etc., to the Engineer for approval.

1.03 QUALIFICATIONS

- A. The Owner requires a proven and extensive track record for the chemical grouting system to be used under this agreement. All Contractors submitting bids must exhibit extensive satisfactory experience with the equipment and materials used, and satisfactory evidence that the proposed grouting system has been extensively and successfully used in the United States and the State of Florida. The installer must be certified by the grouting system manufacturer for use of the system. Contractors using subcontractors shall submit information about the subcontractor (i.e. Name, experience records, jobs on which the general and subcontractor have worked jointly, etc.). The Owner reserves full and complete authority to approve the satisfactory nature of both the grouting system and the installer.
- B. The qualifications of the Contractor shall be submitted with the Bid Proposal. These qualifications shall include detailed descriptions of the following:
 1. Name, business address, and telephone number of the Contractor
 2. Name(s) of all supervisory personnel that will be directly involved in the Project
 3. Proposed product information showing compliance with the specified requirements listed herein, including chemical grouts, additives, and packers
 4. Documentation of certification of Contractor by the chemical grout manufacturer and/or its authorized representative
 5. A reference list of previous projects on which the Contractor has provided chemical grouting over the last five years, including project name, project number, customer name, and Owner's contact information (name and phone number)
 6. To be acceptable, the Contractor must have had a minimum of five (5) years of active experience in chemical grouting.
 7. The chemical grout shall have documented service of successful performance in similar usage, with a minimum of 10,000 joints, laterals, and manholes grouted in the United

States.

8. The Contractor shall sign and date the information provided and certify that, to the extent of his knowledge, the information is true and accurate and that the supervisory personnel will be directly involved with and used on the Project. Substitutions of personnel and/or methods will not be allowed without written authorization by the Owner and/or Engineer.

1.04 SAFETY

- A. The Contractor shall be aware that this contract requires work in active sewers and shall perform the work in compliance with all federal, state, and local requirements for safety in confined spaces, work zone safety, and hazardous materials. The Contractor shall conform to all guidelines set forth by the Occupational Safety and Health Administration (OSHA) and Federal Regulations 29 CFR Ch. XVII, Section 1910.146, Confined Space Entry.
- B. The Contractor shall not enter into any sewer segment where hazardous conditions may exist until such time as the source of those conditions are identified and eliminated. The Contractor will report any condition to the Owner which may pose a threat to the health and welfare of employees of the Owner, Contractor, or the general public.
- C. The Contractor will use employees that are properly trained and who are aware of possible work, materials, and job-site related hazards.
- D. Mixing and handling of chemical grout may be toxic by passing through unbroken skin, by inhalation of dust or droplets of the materials or by swallowing. Therefore, mixing, handling, and pumping of the chemicals shall be done by personnel thoroughly familiar with the handling of the chemicals involved. All chemicals shall be subject to the approval of the Engineer.
- E. The Contractor shall take satisfactory precautions to protect the sewer segments and appurtenances from damage that might be inflicted upon them by the use of grouting equipment. Any damage caused to the sewer segment or other public or private property as a result of the grouting operations shall be repaired at the Contractor's expense.
- F. The Contractor will ensure that waste material is properly disposed in accordance with applicable regulations and safety precautions.

PART 2 PRODUCTS

2.01 CHEMICAL GROUT

- A. The Contractor shall provide a chemical sealant solution containing principal chemical sealant constituent, initiator (trigger) and catalyst specifically recommended for the purpose of sealing leaks in sanitary sewer lines and manholes. Chemical sealant constituent, initiator (trigger) and catalyst shall be compatible when mixed. Solution shall have ability to tolerate dilution and react in moving water. After final reaction, it shall be a stiff, impermeable, yet flexible gel. The grout proportions shall be such that dilute aqueous solutions, when properly catalyzed, will form stiff gels. Grout shall make true solution at concentrations as high as three pounds per gallon of water. Solutions shall have ability to accept dilution by groundwater of at least 50% by volume, without significantly changing sealing ability of the gel when at rest or in motion. Solutions shall gel in a predetermined time when exposed to normal groundwater pH ranges and be capable of formula adjustments to compensate for changing conditions. Final reaction shall produce a continuous, irreversible, impermeable stiff gel at chemical concentrations as low as 0.4 lbs per gallon of water. Gel shall not be

rigid or brittle. Gel shall have negligible corrosion rate on mild steel plates.

- B. For main lines and laterals, chemical grout shall be a minimum of 10 percent acrylamide base material by weight.
- C. Chemical grout shall have the ability to tolerate dilution and react in moving water.
- D. Chemical grout shall have the ability to increase viscosity, density, and strength with the use of approved additives.
- E. Chemical grout shall have an initial viscosity of approximately 2 centipoise.
- F. Chemical grout shall have a controllable reaction time of 10 seconds to 60 minutes

2.02 ADDITIVES

- A. The following additives, in quantities as recommended by the manufacturer and as approved by the Engineer, shall be used for all grouting applications:
 - 1. Strengthening Agents: For joint grouting, a latex or diatomaceous earth additive shall be added to increase compressive and tensile strength. The strengthening agent shall be Avanti AV-257 Icoset or Engineer-approved equal.
 - 2. Root Inhibitor: A root deterrent chemical shall be added to control root re-growth. The root inhibitor shall be Avanti AC-50W or Engineer-approved equal.
- B. If required by field conditions, the following additives, in quantities as recommended by the manufacturer, may be used at the Contractor's discretion:
 - 1. Dye: A manufacturer-approved water soluble dye without trace metals may be added to the grout tank(s) for visual confirmation.
 - 2. Gel Time Modifier: A gel time extending agent may be used to extend gel time as necessary.
 - 3. Freeze/Thaw: In those lines where the grouting material may be exposed to a freeze-thaw cycle, ethylene glycol or an alternative Engineer-approved additive shall be used to prevent chemical grout cracking once set.
- C. When using non-soluble additives, the grout tanks shall have mechanical mixing devices to keep the additives in suspension and maintain a uniform solution of grout and additive.

2.03 ROOT INHIBITOR

- A. Root inhibitor shall be dichlorobenil (2-6-dichlorobenzonitrile)
- B. The Contractor shall add root inhibitor to the chemical grout mixture at a safe level of concentration having the ability to remain active within the grout for a minimum of 12 months.

2.04 EQUIPMENT

- A. The Contractor shall provide equipment consisting of closed-circuit television systems, necessary chemical sealant containers/tanks, pumps, regulators, valves, hoses, etc. and joint sealing packers for appropriate sizes of pipe designated to receive chemical grouting.

The packer shall be cylindrical and have a diameter less than the pipe size. The packer shall be constructed in a manner to allow restricted amounts of sewage to flow and shall be pneumatically operated. Hydraulically or mechanically expanded devices shall not be permitted.

- B. To test the accuracy, integrity, and performance capabilities of sealing equipment units, The Contractor shall perform a demonstration test in a test cylinder constructed so that a minimum of two known leak sizes can be simulated. The Contractor shall provide test cylinders and pressure gauges. Contractor shall perform the demonstration test for each chemical sealing unit prior to beginning work. This technique will establish test equipment performance capability in relationship to test criteria and ensure that there is no leakage of the test medium from the system or other equipment defects that could affect joint testing results. Tests may be required at any other time during joint testing work if the Engineer suspects testing equipment is not functioning properly. All testing costs shall be borne by the Contractor.

PART 3 EXECUTION

3.01 CLEANING AND INSPECTION

- A. Prior to the application of chemical grouting materials, the Contractor shall thoroughly clean and inspect the sewer designated to receive the chemical grouting. Cleaning shall constitute removal of all debris, solids, roots, and other deposits in the sewer line; particularly at the sewer pipe joints. Sewer cleaning and inspection requirements are in accordance with Section 02650 – Sewer Cleaning.

3.02 SEWAGE FLOW CONTROL

- A. The Contractor shall provide for maintenance of flow in the affected portions of the sewer system during grouting of the sewer line. Requirements for sewage flow control and bypass pumping are contained in the Technical Specification titled Sanitary Sewer Line Cleaning and Closed-Circuit Television Inspection.
- B. Sewage flow control shall be employed by the Contractor when sewer line depth of flow at the upstream manhole of the sewer line section being worked is above the maximum allowable for joint testing and sealing. Flow control shall be accomplished by bypass pumping of flow from upstream of the sewer segment to be grouted to a point downstream of the sewer segment to be grouted. Depth of flow shall not exceed that shown below for respective pipe sizes as measured in the upstream and downstream manholes when performing joint testing and sealing.

Maximum Depth of Flow for Joint Testing/Sealing

24 in. Dia. Pipe or less	10% of Pipe Dia.
>24 in. Dia. Pipe	20% of Pipe Dia.

- C. When required, the Contractor shall provide for the transfer of flow around a section or sections of pipe to be grouted. The proposed bypassing system shall be approved in advance by the Owner and Engineer. The approval of the bypassing system shall in no way relieve the Contractor of his responsibility and/or public liability.
 - 1. If the grouting can be completed in a few hours, bypass pumping may not be required. The placement carriage shall be equipped with a bypass section to allow flow once

grouting is completed.

3.03 PRESSURE TESTING JOINTS IN SEWER LINES

A. Preconstruction Testing

1. The Contractor shall provide equipment such as pumps, gauges, regulators, and hoses, necessary to perform air tests of each joint in those sewer line sections designated for grouting work. Equipment configuration shall be such that there are no valves on or along the air line between the measuring point at the joint and the pressure transducer or sensing device located in the control unit on the surface. Systems which incorporate bladders, hoses, or the like for monitoring the pressures and which have questionable accuracy shall not be allowed. The amount of pressure being exerted on the joint shall be readable above ground on a pressure gauge.
2. The accuracy and calibration of pressure sensing/monitoring system shall have been certified by an independent testing firm within a one-month period preceding the use of equipment. Proof of certification shall be submitted to the Engineer.
3. To confirm that joint testing is not a more severe test than the pipe itself can pass, the Contractor shall perform an on-job barrel test between joints in each pipe line to be tested to determine that the pipe barrel can pass the test criteria. If the pipe barrel will not pass decay rate limits, adjustment of maximum pressure levels will be evaluated jointly between the Contractor and Engineer. Engineer shall render final written decision on each such situation.

B. Sewer Pipe Joint Testing

1. The Contractor shall test each joint by isolating the area to be tested within the testing device and applying positive pressure into the joint and void area created by the test device. The Contractor shall then introduce pressurized air into the isolated void created by testing device. Pressure shall be applied until it is determined that the pressure cannot be built in the void or until the test pressure of 5 psi is reached as recorded by the void pressure monitor. When either of these conditions is reached, the Contractor shall shut off the air supply.
2. If the required pressure cannot be developed, joint shall have failed the test. If the required test pressure in the void was increased to 5 psi, rate of decay of this pressure shall not exceed 1 psi in 30 sec. The joint being tested will also have failed if the pressure drops more than 1 psi in 30 sec. Failure of the joint indicates the need for sealing. Sealing shall be accomplished by the Contractor as specified elsewhere in these Technical Specifications

C. Test Records

1. During grout testing, records shall be kept which include identification of the sewer line section tested, test pressure used, location (footage) of each grouted defect tested and location of grouted defects not tested due to close proximity to building service connections and sanitary sewer manholes, a statement indicating test results (passed or failed) for each grouted defect tested, test pressure achieved and maintained for each grouted defect passing air test, weekly equipment pressure test results, sewer line section barrel test results, daily gel check results, and air temperature at time of testing joints

3.04 CHEMICAL GROUT APPLICATION

- A. The entire chemical grouting process shall be performed in strict accordance with the manufacturer's current guidelines. If any deviations from the guidelines are proposed, Contractor shall submit explanation and approval from grout and/or packer manufacturer(s).
- B. Repairs shall take place at joints, generally small circumferential cracks, small holes, or similar points of infiltration as identified. The repair shall be such that the original cross-sectional area and shape of the interior of sewer pipe shall not be permanently reduced or changed.
- C. Sewer Pipe Joints or Defects
 - 1. Placement of Chemical Grout
 - a. The Contractor shall position the sealing packer over the area of infiltration by means of a metering device at the surface and closed-circuit television camera in the line.
 - b. Accurate measurement of the location of the defect to be sealed shall be made, using the portion of sealing packer as "Datum" or measurement point or target.
 - c. A similar measurement to the target shall also be used to obtain necessary measurement for positioning the injection area of sealing packer over area to be sealed.
 - d. The Contractor shall expand the sealing packer sleeves using controlled pressures.
 - e. Expanded sleeves shall seal against the inside periphery of pipe to form a void area at the point of infiltration, completely isolated from the remainder of pipe the line.
 - f. The Contractor shall pump sealant materials into this isolated area through hose systems at controlled pressures which are in excess of groundwater pressures. Under pressure, the grout shall then be forced out into the soil through any leaking joints and pipe defects. No more than 20 gallons of grout shall be pumped into a single sewer section. If a sewer section requires more than 20 gallons of grout to achieve an effective seal, the Engineer shall be notified and shall approve the use of the additional grout before pumping is continued.
 - g. Upon completion of injection, the Contractor shall retest the point of repair. If retesting shows the seal was not completely effective, the Contractor shall repeat the sealing process until the defect successfully passes the pressure test. After sealing the entire sewer line section, the Contractor shall remove surplus grouting material from the line section at the immediate downstream manhole. If surplus grouting materials left in the sewer line section by the Contractor results in sewer surcharging and subsequent damage to public or private property, the Contractor shall be responsible for damage to property and expenses incurred by the Owner.
 - 2. Gel Checks
 - a. The Contractor shall make gel checks daily for each sealing vehicle to monitor both induction period and gel characteristics. The Contractor shall also make checks for every mixed batch or at least twice per day if only one batch is used. The Engineer reserves the right to request adjustment of gel times or reject the entire batch if

acceptable gel characteristics do not exist. Periodic gel checks shall also be made in the pipe (at request of the Engineer) by seating the sealing packer on the pipe barrel and filling the packer void with grout solutions. Pressure will then be monitored until a rise in pressure is observed, indicating that grout has gelled in the packer void. The Contractor shall certify, for each of the sealing vehicles, results of required gel checks.

D. Lateral Connections

1. All lateral connections that are not designated on the Drawings or directed by the Owner and/or Engineer to be replaced via excavation or rehabilitated with a full-circle lateral liner shall be chemically grouted after the CIPP liner is installed and lateral opening has been reinstated in accordance with Section 02740 – Cured-in-Place Pipe. The grout shall extend a minimum of 6 inches up the lateral pipe. If a minimum of 6 inches of grout in the lateral cannot be achieved due to blockages, the Contractor shall proceed to the next connection and shall immediately inform the Engineer of the location and cause of the blocked connection.
2. The lateral packer shall remain in position during the sealing of the connection so the isolated void is maintained. Grout shall be pressure-injected through the lateral packer into the annular space between the inversion tube and the lateral pipe. Under pressure, the grout shall then be forced out into the soil through any leaking joints and pipe defects. No more than 20 gallons of grout shall be pumped through a single lateral connection. If a connection requires more than 20 gallons of grout to achieve an effective seal, the Engineer shall be notified and shall approve the use of the additional grout before pumping is continued.
3. Upon completion of the lateral sealing procedure, the lateral shall be air-tested to confirm the sealing of the connection. If the lateral fails the air test, the grouting procedure shall be repeated at no additional cost to the Owner. This sequence of grouting and subsequent air testing shall be repeated until either the lateral is sealed or it is determined that the grout consumption is too high and may result in the blockage of the lateral pipe. The final determination to stop subsequent attempts to seal a lateral will be jointly made by the Engineer and the Contractor.
4. The Contractor shall confirm lateral flow after the successful sealing of each lateral tap. With the lateral packer in position, the inversion tube shall be retracted and air shall be pressure-injected into the lateral. If a pressure builds in the lateral and does not drop to approximately zero in a few seconds, the packer shall be moved off the connection and the connection shall be viewed with a television camera. With the camera viewing the connection point, an attempt shall be made to obtain a water flush by the property Owner served by the lateral. If water is not visible during this flushing procedure, it shall be assumed that the building sewer connection is blocked with grout and the Contractor shall clear the lateral at no additional cost to the Owner. Contractor shall not be responsible for clearing blockages in the lateral that are not due to grouting operations.

E. Curtain Grouting (Manholes):

1. The entire manhole shall be sealed with grout, including the corbel, wall, pipe seals, bench, and invert using the manufacturer's recommended material(s) and method(s).
2. Drilling grout injection holes in the manhole in strategic locations to redirect flow coming through cracks and other defects in the wall, or to seal the entire exterior surface of the

manhole, shall be in accordance with the grout manufacturer's recommendations. Injection holes shall be in staggered rows and near observed defects and pipe seals.

3. Grout typically shall be injected through the lowest holes first and shall proceed higher up the manhole until it is externally sealed with grout. Additional holes may be required to verify that the grout has encompassed the entire exterior of the manhole.
4. The injection holes shall be cleaned and patched as recommended by the manufacturer.

F. Field Records

1. The Contractor shall keep field records for each sewer line section prior to, during, and after completion of the chemical grouting operation. Records shall include information such as accurate locations, gel times, grout volumes, grout pressures, air temperatures, and joints not sealed due to close proximity to building service connections and sanitary sewer manholes.

3.05 TESTING FOR ACCEPTANCE/WARRANTY

- A. Prior to and during the joint testing phases of the work, the Contractor shall perform control, intermediate, and final testing in accordance with ASTM F2304, ASTM F2414, and ASTM F2454.

B. Testing Sewer Joints:

1. Joint testing pressure shall be equal to 5 psi. Test pressure shall not exceed 10 psi without prior approval by the Engineer.
2. Joints in laterals which are directly connected to manholes shall be tested to 18 inches.
3. Each sewer pipe joint shall be tested at the previously-specified pressure in accordance with the following air test procedure:
 - a. The packer shall be positioned within the pipe so it straddles the joint to be tested.
 - b. The packer ends shall be expanded so the joint is isolated from the remainder of the pipe and a void area is created between the packer and the pipe joint. The ends of the testing device shall be expanded against the pipe per the manufacturer's recommendations. If all attempts to isolate the joint fail, grout shall be pumped to seal the leak around the packer end elements. The Contractor shall be paid at the unit price for grout to seal the packer unless the Engineer determines that the sewer was inadequately cleaned or the packer is not properly working.
 - c. Air shall then be slowly introduced into the void area until a pressure equal to or greater than the required test pressure, but in no cases greater than 2 psi above the required test pressure, is observed on the pressure monitoring equipment. When the desired pressure is reached, the air flow shall be stopped. If the void pressure decreases by more than 1.0 psi within the next 15 seconds, the joint will have failed the test and shall be sealed.
 - d. Upon completing the testing of each individual joint, the packer shall be deflated with the pressure meter continuing to display void pressure. If the void pressure reading does not drop to 0.0 plus or minus 0.5 psi, the test equipment shall be cleaned of residual grout material or repaired as needed to result in an accurate void pressure

reading.

C. Testing Lateral Connections:

1. Lateral connection testing pressure shall be equal to 5 psi. Test pressure shall not exceed 10 psi without prior approval by the Engineer.
2. Each lateral connection shall be tested at the previously-specified pressure in accordance with the following air test procedure:
 - a. The area to be tested shall be isolated using the lateral connection packer and by applying positive pressure into the isolated void area. For laterals directly connected to the main line sewer, a pan and tilt camera shall be used to position the lateral packer.
 - b. The lateral bladder shall be inverted from the main line assembly into the lateral pipe and inflated. The main line elements shall then be inflated to isolate the lateral connection and the portion of the lateral to be tested.
 - c. A sensing unit shall monitor the pressure of the packer void and shall accurately transmit a continuous readout of the void pressure to the control panel at the grouting truck or to a pressure gauge on the packer recorded by the CCTV camera.
 - d. Air shall then be slowly introduced into the void area until a pressure equal to or greater than the required test pressure, but in no cases greater than 2 psi above the required test pressure, is observed on the pressure monitoring equipment. When the desired pressure is reached, the air flow shall be stopped. If the void pressure decreases by more than 2.0 psi within the next 15 seconds, the lateral will have failed the test and shall be grouted and retested.
 - e. Upon completing the testing of each individual lateral, the lateral packer shall be deflated with the pressure meter continuing to display void pressure. If the void pressure reading does not drop to 0.0 plus or minus 0.5 psi, the test equipment shall be cleaned of residual grout material or repaired as needed to result in an accurate void pressure reading.

D. Manholes:

1. All manholes shall be visually inspected to ensure that the inflow and infiltration into the manhole has been eliminated.

E. Field Testing for Final Acceptance

1. No sooner than nine (9) months but no later than Twelve (12) months after the completion of all chemical grouting work, the Contractor shall conduct testing in an initial retest area consisting of specific sewer line sections selected by the Engineer. Sewer line segments to be retested will be randomly selected by the Engineer throughout the project area and shall be representative of a majority of sealing work performed. The initial retest area shall consist of 10% of the sewer segment lineal footage contained in the Work.
2. Within the initial retest area, Contractor shall retest designated defects previously grouted. Grouted defects which were sealed previously and fail the retest shall be resealed at no additional cost to the Owner.

3. If the failure rate of these retested defects is less than 5% of defects retested, work shall be considered satisfactory and no further retesting will be required
4. If failure rate of retested defects exceeds 5% of defects retested, an additional retest area of equivalent size shall be selected, and all grouted defects shall be retested. Additional testing and sealing, if necessary, will continue until a failure rate of less than 5% of the total retested grouted defects is met. Any additional cleaning and testing beyond the initial test area that is required due to a failure rate greater than 5% shall be at no cost to the Owner
5. Should as much as 25% of Work be retested and fail to meet the 5% requirement, the Contractor shall provide the same number of crews as utilized in the original project so that retesting will proceed at a rapid rate.
6. If 25% of the original number of joints or defects grouted fail the retest and must be re-grouted, the Contractor shall again provide a one year warranty and perform a one year retest the following year for those joints and defects re-grouted during the first one year retest.

3.06 SITE RESTORATION

- A. After the grouting has been completed and accepted by the Owner, the Contractor shall restore the entire Project area and shall return the ground cover to its original or better condition. All excess material and debris not incorporated into the permanent installation shall be disposed of by the Contractor.
- B. A container shall be furnished for the collection of solvents used in the cleaning of the grouting equipment. Contractor shall use an approved solvent recovery process to dispose of the collected solvents. Disposal of cleaning solvents into the sewer system or into natural watercourses is strictly prohibited.

[END OF SECTION]

SECTION 02762

SEWER SERVICE LATERAL CIPP LINING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required to install cured-in-place pipe (CIPP) lining to rehabilitate existing active service laterals as shown on the Drawings or as directed by the Engineer. Service laterals shall be lined from the connection with the main sewer to the property line or easement edge, unless otherwise noted or approved by the Engineer. A full-wrap style lining shall be used to address the connection between the main sewer and the service lateral.
- B. Furnish all labor, materials, equipment, and incidentals required to conduct air testing, post-rehabilitation CCTV inspections, and other requirements described herein for final service lateral lining acceptance.
- C. This specification shall also apply to installing CIPP lining for laterals discharging directly into manholes, if the pipe diameter is 6-inch or less.
- D. Service laterals may be a combination of tees, wyes, or break-in taps of varying sizes (4-inch to 8-inch) with angles generally ranging up to 90 degrees. In most cases, a cleanout will be installed at the property line or easement edge.
- E. If any active service laterals are identified as defective and the Contractor is unable to line the lateral from the main sewer to the cleanout, the Contractor shall inform the Engineer about the lateral's condition and shall propose a rehabilitation method that maximizes the lateral's rehabilitated length while minimizing the extent of surface disruption. The Engineer will direct the Contractor as to the acceptable approach for rehabilitating or replacing the service lateral in question.

1.02 SUBMITTALS

- A. Submit the following in accordance with Section 01300 - Submittals:
 - 1. Shop drawings and schedules for all service lateral lining and appurtenances required
 - 2. Design data and specification data sheets listing all parameters used in the lining design
 - 3. Thickness calculations based on ASTM F1216-09, for fully deteriorated pipe
 - a. All service lateral lining design calculations shall be sealed and signed by a Florida registered professional Engineer.
 - 4. Detailed procedure for installing the service lateral lining
 - 5. The service lateral lining manufacturer's name and the facility location where the service lateral lining will be manufactured
 - 6. Contractor's Qualifications. Submit copy of manufacturer's licenses certificate. A qualified bidder for installing a mainline/lateral connection and lateral repair system shall use a manufactured system with a minimum 5-year history of satisfactory performance.

The manufactured system must have a minimum of 10,000 documented successful installations in the state of Florida. A licensed and certified trainer and representative from the lining system manufacturer shall be on-site to assist in the work for a minimum of 2 weeks. This trainer shall have a minimum of 5 years' experience installing this system with 2,000 minimum installations. As an alternate requirement, the superintendent must have the same minimum installations and experience. Submit list with 10 similar jobs within the past 3 years that used this manufacturer's product. Provide project information such as project name, number of service connection laterals, date completed, and project references.

7. The following information shall be submitted for review and approval:
 - a. The Contractor's years of experience in performing service lateral lining projects
 - b. The name for the service lateral lining manufacturer and supplier for this work and previous work listed below. The Contractor shall be an approved installer as certified and/or licensed by the lining manufacturer.
 - c. A list with municipal clients for whom the Contractor has performed this type without defects or performance problems
 - (i) The list shall contain names, email addresses, and telephone numbers for persons to be contacted to verify previous satisfactory performance.
 - (ii) A full description for the actual work performed
 - (iii) The number of service laterals lined over the past 3 years
8. Material Certifications. Written certification is required from the manufacturer stating all materials used in the work were manufactured and tested in accordance with ASTM F1216 and is being used or installed in conformance with the manufacturer's recommendations.
9. Customer Notifications. Submit a copy of the initial customer notification as described below under Public Notification.
10. Storage and Delivery Procedures. Provide the lining manufacturer's recommended storage and delivery procedures. This shall include storage and delivery temperatures, maximum time from wet-out to installation, and other pertinent information.
11. Material Safety Data Sheets. Submit Material Safety Data Sheets (MSDS) for each component of the service lateral lining system.
12. Test Results. Prior to using any materials, furnish the proposed material's test results from an independent laboratory in conformance with these specifications. All submitted test data shall have been performed on field installed samples within the last 12 months. Testing by an independent laboratory shall verify the products to be used meet all minimum strength standards as set forth in ASTM F1216, Table 1. Testing shall also verify any product to be used on the project meets the minimum chemical resistance requirements as established in ASTM F1743, Table 2, where the testing is in accordance with Section 7.2.1 of ASTM F1743.
13. Pipe Cleaning Narrative. Submit a narrative describing in sufficient detail the proposed methods for root cutting and cleaning the existing laterals. Prepare such narrative to

include the degree of cleaning as recommended by the lining manufacturer. Such narrative shall indicate the lining manufacturer's technical representative's approval for the proposed cleaning methods.

14. Lining Thickness Calculations. Perform lining thickness calculations for each set of laterals for each manhole-to-manhole section, and furnish them to the Engineer with supporting assumptions. Calculations shall be done after cleaning, televising, and other field inspections have been accomplished. Design parameters shall be used in calculations.
15. Curing Cycle and Cooling Rate. If the lateral lining is heat-cured, submit the resin manufacturer's recommended curing cycle and the recommended cooling rate. Submit a copy of the cure logs for each lateral installation.
16. Post-lining inspection data. Submit the final television inspection in a Granite XP compatible database that shows the rehabilitated lateral.

1.03 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
 1. ASTM D790 – Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
 2. ASTM F1216 – Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin Impregnated Tube
 3. ASTM F2561 – Standard Practice for Rehabilitation of a Sewer Service Lateral and its Connection to the Main Using a One Piece Main and Lateral Cured-in-Place Liner
 4. ASTM F1743 – Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP)
 5. ASTM D2990 – Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics
- B. Where reference is made to one of the above standards, the revision in effect at the time of the bid opening shall apply.

1.04 QUALITY ASSURANCE

- A. The Contractor performing the service lateral lining work shall be fully qualified, experienced, and equipped to complete this work expeditiously and in a satisfactory manner. See above for description under Submittals of Contractor qualifications.
- B. Be able to provide crews as needed to complete the work without undue delay and within the contract time allotted.
- C. The service lateral lining shall be provided by a single manufacturer. The supplier shall be responsible for providing all test requirements specified herein as applicable.
- D. The Engineer may inspect the service lateral lining after delivery. The service lateral lining shall be subject to rejection at any time if it fails to meet any requirements specified, even though sample lining may have been accepted as satisfactory at the manufacturer. Lining

rejected after delivery shall be marked for identification and removed from the job site at once.

- E. Final Installed Lining Thickness. The final installed lining thickness shall not be less than or more than 10 percent greater than the required thickness. The final installed lining thickness measurement shall be determined from lining sample coupons retrieved from the sewer, plate samples or as deemed necessary by the Engineer. It shall be the Contractor's responsibility to consider site conditions and their installation process to determine the proper lining thickness to install.
- F. Non-Compliance. If the flat plate samples do not meet the required 4,500 psi flexural strength and 250,000 psi flexural elasticity modulus as outlined, actual installed samples must be taken. The installed samples shall be taken as directed by the Engineer and in accordance with all applicable ASTM requirements. From these samples, the installed thickness shall be determined by taking an average of at least 10 thickness measurements. Installed samples shall then be prepared for re-testing in accordance with these specifications.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Care shall be taken in shipping, handling, and storing to avoid damaging the service lateral lining. Extra care shall be taken during cold weather construction. Any lining damaged in shipment shall be replaced as directed by the Engineer.
- B. Any lining showing a split or tear, or which has received a blow that may have caused damage, even though damage may not be visible, shall be marked as rejected and removed at once from the job site.
- C. At all times, the lining materials, including the wet-out lining, shall be maintained at a proper temperature, such as in refrigerated facilities, to prevent premature curing prior to installation. The lining shall be protected from UV light prior to installation. Any lining showing evidence of premature curing will be rejected for use and will be removed from the site immediately.

1.06 PUBLIC NOTIFICATION

- A. Notify the owners and residents of any homes or businesses whose service lateral will be affected by the lining work. Also deliver written notification to each such resident or business 3 days prior to such lining work, further advising of the work. Include in the notifications any restrictions on using the sewage system facilities. Describe exact days and hours when the sewer system cannot be used. CONTACT ANY HOME OR BUSINESS THAT CANNOT BE RECONNECTED WITHIN TIME STATED IN THE WRITTEN NOTICE.
- B. THE MAXIMUM TIME ANY HOME OR BUSINESS SHALL BE WITHOUT SANITARY SEWER SERVICE IS 10 HOURS, AND NOT BETWEEN 6:00 PM AND 8:00 A.M. ANY SERVICE OUT LONGER THAN 10 HOURS WILL HAVE SERVICE RESTORED AT CONTRACTOR'S EXPENSE OR TEMPORARY MEASURES TAKEN.

1.07 GUARANTEE

- A. The manufacturer shall warrant the pipe liner to be free from defects in raw materials for one (1) year from the date of delivery. The Contractor shall warrant the pipe liner installation for a period of two (2) years from the date of acceptance. During the Contractor warranty period, any defect, which materially affects the integrity or strength of the pipe liner, shall be repaired at the Contractor's expense in a manner mutually agreed to by the Owner and the Contractor.

- B. If a liner fails to reform, the Contractor shall be required to remove the failed liner at no additional cost to the Owner. This shall include, but not be limited to, all material, excavation, backfilling, cutting concrete, pipe, shoring, temporary pavement, permanent pavement, permits, and other incidental work required to remove the liner from the host pipe. If removal is not feasible, or if removal will cause more harm than acceptable to the host pipe, alternatives may be proposed by the Contractor to the Engineer for review and approval. The integrity of the existing pipe, where the liner was removed, shall be rehabilitated by installing another new pipe section. There shall be no direct payment for this work.

1.08 WATER

- A. The Contractor shall arrange for its water supply through Pinellas County Utilities. Usage shall be in accordance with Pinellas County backflow and metering policies. Pinellas County water usage costs shall be compensated at no markup from the water usage item established in the Contract Documents.

PART 2 PRODUCTS

2.01 MATERIALS

- A. The service lateral lining shall be a seamless, corrosion-resistant, cured-in-place pipe lining product that seals the service lateral pipe and the junction between the service lateral pipe and main sewer. The portion of the lateral lining system that connects to the main/lateral interface shall be either a full-wrap or brim-seal connection type.
- B. The service lateral lining shall be a resin-impregnated, flexible polyester felt, non-woven textile tube, needle punched felt, circular knit or circular braid, glass fiber reinforced plastic or equivalent material tube which is cured -in-place by an acceptable curing method. The tube shall be able to conform to bends, offset joints, bells, and disfigured pipe sections.
- C. The service lateral shall provide a 50-year service life and shall have the minimum structural properties listed below:

<u>Physical Properties</u>	<u>Minimum Standard</u>
Flexural Strength (ASTM D790)	4,500 psi
Flexural Modulus of Elasticity (ASTM D790)	250,000 psi

- D. The service lateral shall be designed, fabricated, and installed for the actual conditions encountered for this application including the host pipe material, in accordance with the applicable ASTM F1216, ASTM D2990 provisions, and shall meet the following minimum design conditions:
1. AASHTO H-20 live load with two trucks passing
 2. Soil Weight 120 pounds per cubic foot
 3. Friction coefficient $Ku' = 0.130$
 4. Estimated maximum groundwater level at ground surface
 5. Fully deteriorated pipe with 2 percent (min.) ovality. If existing pipe's ovality is found to be worse, use actual percent up to 5 percent (max.).

6. Soil Modulus 1,000 psi
 7. Safety factor = 2
 8. Soil Depth: The cover depth will be determined by field measurements.
- E. The finished lining shall have a 3 mm minimum thickness for 4-inch laterals and 4.5 mm for 6-inch laterals.
 - F. The service lateral lining shall have sufficient wall thickness to withstand all anticipated external pressures and loads that may be imposed after installation. The design shall be performed and certified by a Florida registered professional Engineer.
 - G. The service lateral lining shall be manufactured and installed by T-Liner by LMK, SCS+L by BLD Services, LLC, or approved equal.
 - H. When cured, the service lateral lining shall extend from the mainline into the lateral connection in a continuous tight fitting, watertight pipe-within-a-pipe to eliminate any visible groundwater leakage and future root growth at the lateral to mainline connection and along the lateral. The service lateral product system shall be compatible with the mainline and/or lateral pipe or lining. The lining portion within the mainline pipe may be a full-wrap or brim-seal connection or style.
 - I. When cured, the finished service lateral product shall be chemically resistant to domestic sewage over the rehabilitated pipe's expected lifetime. The lining material and resin shall be completely compatible.
 - J. The connection between the service lateral and the main sewer shall be lined so a continuous overlap between the service lateral lining and the main sewer extends 3-inches minimum from the lateral along the entire circumference.
 - K. A leak-free seal must be created to form a sealing bond between the service lateral product and the host lateral and mainline pipe walls. The Contractor should use either a hydrophilic material or an epoxy-sealing component at each lining tube end to provide a leak-free seal.
 - L. When cured, the lining shall form a hard, impermeable lining which is chemically resistant to chemicals found in domestic sewage.

2.02 RESIN

- A. The resin system shall meet the requirements of ASTM F1216, Section 5.2. The resin installed service lateral lining system shall produce a service lateral that will comply with the structural requirements specified herein, and shall provide chemical resistance for the flow media in the gravity pipe. The resin shall be compatible with the rehabilitation process, shall be able to cure in water's presence or absence, and shall have an initiation temperature for cure as recommended by the resin manufacturer. Unless otherwise specified, provide a general purpose or enhanced strength unsaturated, thermosetting, polyester, vinyl ester, epoxy or silicate resin and a catalyst system compatible with the installation process. The resin shall be vacuum impregnated into the lining.
- B. Submit documentation from the resin manufacturer specifically describing the resin system's chemical characteristics including allowable mixing, impregnation, and handling time, transportation, and storage time, and recommended curing cycle including temperatures, pressures, and times. The resin manufacturer's documentation must also include maximum

allowable time for handling the impregnated tube prior to insertion and the maximum allowable elapsed time from insertion to exotherm. If remedial measures are available to extend either of the maximum allowable times indicated above, without affecting the resin's physical properties, the resin manufacturer should describe these measures and the time limits beyond which even these measures will not prevent altering the resin's physical properties.

PART 3 EXECUTION

3.01 PRE-INSTALLATION

- A. In accordance with Section – 02731, Television Inspection, a pre-rehabilitation digital CCTV video inspection must be done on the mainline pipe with a pan and tilt camera and the service lateral to confirm the proposed repair falls within the limitation parameters set by the manufacturer on the following aspects:
1. The location and clock reference of the lateral junctions to be lined
 2. Any offsets, any intrusions from the lateral into the main
 3. Angle at which the connection comes in
 4. Any changes in the lateral's approach angle for the repair length
 5. Potential flows coming throughout the lateral pipe
 6. Potential flows going through the main pipe
 7. Diametric connection size for the lining length
 8. Main pipe's size at the service lateral point
 9. Service lateral's condition including the presence of debris, turns, bends, changes in diameter, or other observations
 10. Active infiltration present within the work area vicinity
 11. Any defects noted in the mainline pipe or lateral should be documented using NASSCO PACP/LACP Standards.
- B. Inform the Engineer about service laterals in which a service lateral lining cannot be installed from the main sewer to the cleanout established at the property line or easement line. The Contractor shall identify these service laterals and provide the Engineer with documentation about the conditions encountered including the CCTV inspection. If a full length lateral lining cannot be installed or a point repair on the service cannot be performed, the Engineer may direct the Contractor to install a short lateral lining with no cleanout required extending up the lateral from the main. The length is to be field determined to the maximum length possible, but should extend 3 feet minimum up the lateral from the main
- C. Inform the Engineer about service laterals in which a short length service lateral product cannot be installed. The Contractor shall identify, document, and video record these services, and inform the Engineer about the conditions encountered. If a short length lateral lining cannot be installed, the service connection will be "cut and buffed" to restore a 95% minimum service opening.

3.02 LINE PREPARATION

- A. Prior to installing the service lateral product, the area around the lateral sealing surface in the main and lateral shall be inspected. Waste product build-up, hard scale, roots, lateral cutting debris, or resin slugs must be removed using high pressure water jetting or in-line cutters. All laterals to be lined shall be cleaned as required prior to lining. The term "cleaned" shall mean removing all sand, dirt, roots, grease, and other solids or semisolid materials from the interior face of the sewer mainlines and the service laterals.
- B. Built-up deposits on the main and lateral pipe walls shall be removed. The removal shall reach at least 1 foot beyond the scheduled service lateral installation length to allow the bladder to inflate tightly against the pipe walls ensuring a smooth transition from service lateral product to the existing pipe wall.
- C. Televiser the lateral to provide a detailed record of existing conditions and lateral connections. Have a copy of the pre-lining inspections in the field. Immediately prior to lining insertion, the camera shall traverse the lateral to inspect for debris which may have entered the line after the existing condition inspection.
- D. Where active infiltration is present and when it is recommended by the service lateral lining manufacturer, the infiltration must be stopped in advance by grouting.
- E. Additional precautions need to be taken when applying the sleeve to a main pipe lined with a CIPP lining with a polyolefin coating. The coating is to be lightly scarified, scraping off the coating in the main CIPP in the service lateral lining's vicinity and verified by the Engineer. This scuffing is mandated for service lateral linings required to adhere to the pipe wall. Service lateral linings with hydrophilic material are not required to have the existing lining scarified.
- F. The Contractor shall be responsible, if needed, for bypassing sewage while installing the service lateral lining product. In cases where the temporary sewage backup is accepted as a replacement for bypassing, the Contractor shall be responsible for all damage caused by sewage backing up into properties or sanitary sewer overflows.

3.03 INSTALLATION

- A. CIPP lining of the service lateral shall be from the main sewer to the existing cleanout at the property line. If a cleanout does not exist, the Contractor shall install a cleanout at the property line at a location designated by the Engineer and terminate the rehabilitation or replacement pipe at this new cleanout.
- B. The service lateral lining shall be vacuum-impregnated with resin (wet-out) under controlled conditions. The resin volume used shall be sufficient to fill all voids in the textile lining material at nominal thickness and diameter. The volume shall be adjusted by adding 5% to 10% excess resin for the change in resin volume due to polymerization and to allow for any resin migration into the cracks and joints in the original pipe. All resin shall be contained within the translucent bladder during vacuum impregnations. No dry or unsaturated area in the lateral tube shall be acceptable upon visual inspection.
- C. The service lateral product shall be loaded on the applicator apparatus, attached to a robotic manipulator device, and positioned at the cleanout or pipe opening of the service connection that is to be rehabilitated. For service lateral full-wrap style linings with compression gaskets, the mainline lining and bladder shall be wrapped around the "T" launching device and held firmly by placing 4 hydrophilic material bands around the main lining. For service lateral full-

wrap linings that do not use hydrophilic material, a 300 ml volume adhesive sealant, shall be applied to the main/lateral interface, and shall be applied as a 2-inch wide band on the main lining.

- D. The pressure apparatus shall include a bladder with sufficient length in the main and lateral lines so the inflated bladder extends beyond the ends of the service lateral product's lateral tube and main line tube, pressing the end edges flat against the internal pipe wall, thus forming a smooth transition from service lateral product to pipe diameters without a step, ridge, or gap between the service lateral product and the lateral and mainline pipes' inner diameters.
- E. For service lateral linings with hydrophilic materials, the main bladder shall be inflated causing the main sheet to unwrap and expand, embedding the hydrophilic material between the main lining and the main pipe as the main lining is pressed tight against the main pipe.
- F. After insertion is completed, recommended pressure must be maintained on the impregnated service lateral product according to ASTM F1216-09, Sections 7.4.2 and 7.4.3, pressing the lining firmly against the inner pipe wall during the entire curing process. The lining shall be cured at ambient temperatures or by a suitable heat source. In no instance will sewage be used to invert or cure linings or calibration tubes.
- G. The finished service lateral lining shall be free from dry spots, lifts, and delamination. The installed service lateral lining should not inhibit the CCTV post installation video inspection for the mainline and service lateral pipes or future pipe cleaning operations. For service lateral linings with compression gaskets, the CIPP shall taper at each end providing a smooth transition to accommodate video equipment and maintain proper flow in the mainline. In all cases, the finished product must provide an airtight/watertight verifiable non-leaking connection between the main sewer and sewer service lateral. During the warranty period, any defects with the service lateral that affect the lateral connection's performance, cleaning, or watertightness shall be repaired at the Contractor's expense in a manner acceptable to Owner.
- H. Following the lining installation, provide the Engineer with an electronic picture and recorded data identifying the location and showing the completed work and restored condition for all the rehabilitated service laterals from the sewer main to the service reconnection point. The Contractor shall televise the rehabilitated lateral to provide a detailed record of finished conditions using NASCCO PACP/LACP guidelines. When complete, the Contractor shall submit the rehabilitated lateral inspections in a Granite XP-compatible database and the accompanying logs on DVDs or an external USB hard drive.

3.04 FIELD TESTING AND ACCEPTANCE

- A. The lining's field acceptance shall be based on the Engineer's evaluation of the installation including post-lined digital CCTV inspection and reviewing certified test data for the installed pipe samples. The CCTV inspection for each lateral shall extend 10 feet minimum past the end of the rehabilitation work on the service lateral. For laterals where a cleanout was installed, the CCTV inspection shall include the cleanout and the connection to the existing, undisturbed service lateral.
- B. The lining shall have zero groundwater infiltration, and each lateral must pass a 2-minute 4 psi air test conducted by the Contractor.
- C. A flat plate sample shall be collected for every 50 lateral installations, and the sample shall be submitted to a third party testing laboratory to confirm strength properties (flexural

strength and flexural modulus) in accordance with ASTM F1216. The test results must meet or exceed the strengths in the design, or the Contractor must provide a 10% credit for up to 50 laterals the sample represents.

- D. All service connections shall be open, clear, and watertight.
- E. The lining shall have no evidence of splits, cracks, breaks, lifts, kinks, delaminations, or crazing.
- F. If any defective lining is discovered after it has been installed, it shall be removed and replaced by the Contractor with a new lining, a new pipe, or other measures with the Engineer's approval at no additional cost to Owner. Any lining installation not meeting specified strengths or thickness shall provide other acceptable remediation measures or credit as approved by the Engineer. The re-inspection requirements as listed above shall apply to this re-installed section of line.

3.05 CLEAN-UP

- A. After the installation work and testing have been accepted, restore the project area affected by the operations to a condition at least equal to what existed prior to the work.

[END OF SECTION]

SECTION 02934

SODDING

PART 1 – GENERAL

1.01 SCOPE

- A. Provide all labor, materials, and equipment necessary for preparation of subsoil, placing topsoil, fertilizing, sod installation, and maintenance as required to complete Work as shown on the Drawings and specified in this Section.
- B. This shall include, but not be limited to:
 - 1. Testing of topsoil.
 - 2. Raking and leveling topsoil as required for sodding.
 - 3. Liming and fertilizing of topsoil.
 - 4. Laying and rolling of sod.
 - 5. Maintaining sod.

1.02 REFERENCES

- A. ASPA (American Sod Producers Association) – Guideline Specifications to Sodding.
- B. FS O-F-241 – Fertilizers, Mixed, Commercial.

1.03 QUALITY ASSURANCE

- A. Sod Producer: Company specializing in sod production and harvesting with minimum five years of experience and certified by the State of Florida.
- B. Installer: Company approved by the sod producer.
- C. Sod: Minimum age of 18 months, with root development that will support its own weight, without tearing, when suspended vertically by holding the upper two corners.
- D. Submit sod certification for grass species and location of sod source.

1.04 REGULATORY REQUIREMENTS

- A. Comply with regulatory agencies for fertilizer and herbicide composition.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Sod shall be machine cut and delivered to the Site on pallets. Protect exposed roots from dehydration.
- B. Do not deliver more sod than can be laid within 24 hours of delivery.

1.06 MAINTENANCE SERVICE

- A. Maintain installed sod until Owner has accepted Work.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Fertilizer

1. Fertilizer shall be commercial fertilizer, as manufactured by International Chemical Company or approved equal.
2. Fertilizer shall have a 10 20 6 N.P.K. content and contain a minimum of 60% of organic material.
3. It shall be delivered at the site in the original sealed containers.
4. Fertilizer content and application rate shall comply with Pinellas County Code of Ordinances, Chapter 58, Article XIII.

B. Sod

1. The sod shall be as grown by a certified nursery grace, cultivated grass sod with fibrous root system, free of stones and burned or bare spots.
2. Sod shall be furnished and installed in rectangular sod strips measuring 12 to 16 inches in width of standard lengths of not less than 2 feet. The area of each section of sod shall not exceed one square yard with minimum ½-inch topsoil base.
3. After the preparation of the areas to be sodded has been approved sod all disturbed areas where no permanent construction exists. Supply and install sod to match existing sod. For areas scheduled to receive new sod that do not have an existing sod to match, provide the following sods, unless otherwise directed, for stabilization of final grade:
 - a. Irrigated and non-irrigated areas: Sod composed of grasses grown from a Bahia Seed mixture.

C. Accessories

1. Wood Pegs: Softwood; sufficient size and length to ensure anchorage of sod on slope.
2. Wire Mesh: Interwoven hexagonal metal wire mesh of 2 size.

PART 3 – EXECUTION

3.01 INSPECTION

- A. Verify that prepared soil base is ready to receive the work of this Section.
- B. Beginning of installation means acceptance of existing site conditions.

3.02 PREPARATION OF SUBSOIL

- A. Prepare subsoil to eliminate uneven areas and low spots. Maintain lines, levels, profiles, and contours. Make changes in grade gradual. Blend slopes into level areas.
- B. Remove foreign materials and undesirable plants and their roots. Do not bury foreign material beneath areas to be sodded. Remove contaminated subsoil.
- C. Scarify subsoil to a depth of 4 inches where topsoil is to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted subsoil.

3.03 PLACING TOPSOIL

- A. Fine grade to achieve the finished subgrade after compaction which shall be obtained by rolling, dragging or by an approved method which obtains an equivalent compaction to that produced by a hand roller weighing from 75 to 100 pounds per foot of width. All depressions caused by settlement or rolling shall be filled with additional existing or furnished topsoil and regraded and prepared as specified above until it presents a reasonably smooth and even finish at the required sod sub grade.
- B. Spread topsoil to a minimum depth of 2 inches over area to be sodded.
- C. Place topsoil during dry weather and on dry subgrade.
- D. Remove vegetable matter and foreign non-organic material while spreading.
- E. Grade to eliminate rough, low, or soft areas, and to ensure positive drainage.

3.04 FERTILIZING

- A. Apply fertilizer in accordance with manufacturer's instructions.
- B. Apply fertilizer in accordance with Pinellas County Code of Ordinances, Chapter 58, Article XIII.
 - 1. No applicator shall apply fertilizers containing nitrogen and/or phosphorous to turf and/or landscape plants during the restricted season from June 1 through September 30.
 - 2. No applicator shall apply fertilizers containing nitrogen and/or phosphorus to turf and/or landscape plants during a period for which the National Weather Service has issued any of the following advisories for any portion of Pinellas County: a severe thunderstorm warning or watch, flood warning or watch, tropical storm warning or watch, hurricane warning or watch, or if rain greater than or equal to two inches in a 24-hour period is forecasted.
- C. Apply after smooth raking of topsoil and prior to installation of sod.
- D. Apply fertilizer no more than 48 hours before laying sod.
- E. Mix thoroughly into upper 2 inches of topsoil.
- F. Lightly water to aid the dissipation of fertilizer.

3.05 INSTALLATION

- A. All sod furnished shall be living sod containing at least 70% of thickly matter grasses as specified and free from noxious weeds.
- B. No broken pads or torn or uneven ends will be accepted. Standard size sections of sod shall be strong enough to support own weight and retain their size and shape when suspended vertically with a firm grasp on the upper 10% of the section. Sod shall not be harvested when its moisture content (excessively wet or dry) may adversely affect its survival.
- C. Sod shall be harvested, delivered, and installed within a period of 24 hours. Sod not installed within this time period shall be subject to inspection and rejection by Engineer, and shall be removed from the site and a fresh sod supply shall be furnished at no extra cost to Owner.
- D. The topsoil shall not be moist at time of installation; however, it shall contain sufficient moisture so as not be powdery or dusty, both as determined by the supplier's representative.
- E. The overlapping of existing lawn with new sod along limit of work lines will not be permitted. Sod shall be laid in strips, edge to edge, with the lateral joints staggered. All minor or unavoidable openings in the sod shall be closed with sod plugs or with topsoil, as directed by Engineer. However, sod laid with joints determined to be too large shall be lifted and reinstalled as specified herein at no extra cost to Owner. Lay sod tight with no open joints visible, and no overlapping; stagger end joints 12 inches minimum. Do not stretch or overlap sod pieces.
- F. Immediately after the sod is laid, the sod shall be watered thoroughly by hand or mechanical sprinkling until the sod and at least 4 inch of the topsoil bed have been thoroughly moistened.
- G. Contractor shall be responsible to furnish his own supply of water to the site at no extra cost. If possible, Owner shall furnish Contractor, upon request, with a source and supply of water. Contractor shall apply for temporary meter and pay Owner for water used at current utility billing rates. However, if Owner water supply is not available or not functioning, Contractor shall be responsible to furnish adequate supplies at his own cost. All work damaged due to the lack of, or the use of too much water, shall be Contractor's responsibility to correct.
- H. Lay smooth. Align with adjoining grass areas. Place top elevation of sod 1/2 inch below adjoining paving or curbs.
- I. On slopes 6 inches per foot and steeper, lay sod perpendicular to slope and secure every row with wooden pegs at maximum 2 feet on center. Drive pegs flush with soil portion of sod.
- J. Prior to placing sod on slopes exceeding 8 inches per foot or where indicated, place wire mesh over topsoil. Securely anchor sod in place over wire mesh and topsoil with wood pegs sunk firmly into the ground.
- K. After sod and soil have dried, roll sodded areas to ensure good bond between sod and soil and to remove minor depressions and irregularities. Roll sodded areas with roller not exceeding 150 lbs. per foot of roller width.

3.06 MAINTENANCE

- A. Maintain the entire sodded areas until final acceptance at the completion of the Contract. Maintenance shall include watering as specified, weeding and removal of stones which may appear. All bare or dead spots which become apparent shall be properly prepared, limed and fertilized, and resodded at Contractor's expense as many times as necessary to secure a good

growth. In the event that the sod installation is not accepted by Engineer, the entire area shall be maintained and cut by Contractor until final acceptance of the sod installation.

- B. Take whatever measures are necessary to protect the sod while it is developing. These measures shall include furnishing or warning signs, barriers, or any other necessary measures of protection.
- C. Mow grass at regular intervals to maintain at a maximum height of 2½ inches.
- D. Neatly trim edges and hand clip where necessary.
- E. Immediately remove clippings after mowing and trimming.
- F. Water to prevent grass and soil from drying out.
- G. Roll surface to remove minor depressions or irregularities.
- H. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.

[END OF SECTION]

SECTION 02944

SEEDING

PART 1 – GENERAL

1.01 WORK INCLUDED

- A. Preparation of subgrade to receive topsoil.
- B. Seeding and fertilizing.
- C. Seed protection on slopes.
- D. Hydroseeding.
- E. Maintaining seeded areas until acceptance.

1.02 RELATED WORK

- A. Section 01410, Testing Laboratory Services.
- B. Section 02550, Finish Grading.

1.03 QUALITY ASSURANCE

- A. Test topsoil in accordance with Section 01410, Testing Laboratory Services.
- B. Supply written analysis stating N, P, and K requirements, application rates, organic matter content, and pH value of soil.
- C. Prior to seeding, the Contractor shall submit a proposed seed and seeding schedule, including the source of seed and contents by percent weight. No seed shall be purchased, nor work shall be performed until the seed mixes and schedule are approved.
- D. Prior to seeding, Contractor shall perform compaction testing and forward results to Engineer for approval.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver grass seed in original containers showing analysis of seed moisture, percentage of pure seed, year of production, net weight, date of packaging and location of packaging. Damaged packages are not acceptable.
- B. Deliver fertilizer in new, unopened waterproof bags showing weight, chemical analysis, and name of manufacturer.

1.05 EXISTING CONDITIONS

- A. Beginning work means acceptance of existing conditions.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Seed

1. Grass seed shall be a mixture of equal parts of Bermuda seed and Pensacola Bahia, except that during the winter months, if so directed by the Engineer, rye grass seed or other approved winter cover crop seed may be substituted for the Bermuda seed. The two types of seed used shall be thoroughly dry mixed immediately before sowing. Seed which has become wet or moldy shall not be used.
2. The Bermuda seed shall be hulled seed. The Pensacola Bahia seed shall be scarified seed, having a minimum active germination of 40 percent and a total germination of 85 percent. All seed shall meet the requirements of the Florida State Department of Agriculture and all applicable State laws, and shall be approved by the Engineer before being sown.

B. Mulch

1. Mulch shall not be used as ground cover or soil amendment and may only be used for plantings with Owner approval.

C. Commercial Fertilizer

1. Commercial fertilizers shall comply with the State fertilizer laws.
2. The numeral designations for fertilizer indicate the minimum percentages (respective) of: (1) total nitrogen, (2) available phosphoric acid, and (3) water soluble potash, contained in the fertilizer.
3. The chemical designation shall be 8-8-8. Other designations may be approved specifically for a particular project; and if liquid fertilizer other than that of chemical designation 8-8-8 is used, the total nitrogen content shall not exceed 12 percent.
4. Either dry or liquid fertilizer may be used.
5. Fertilizer content and application rate shall comply with Pinellas County Code of Ordinances, Chapter 58, Article XIII.

D. Water for Grassing

1. The water used in the grassing operations may be obtained from any approved spring, pond, lake, stream, or municipal water system. The water shall be free of excess and harmful chemicals, acids, alkalis, or any substance which might be harmful to plant growth or obnoxious to traffic. Salt water shall not be used. Municipal water shall be metered. Contractor shall apply for temporary meter and pay current utility billing rates.

2.02 EQUIPMENT

- A. Fertilizer Spreader: The device for spreading dry fertilizer or for spraying liquid fertilizer shall meet the approval of the Engineer.
- B. Seed Spreader: The seed spreader shall be an approved mechanical hand spreader or other approved type of spreader and may be integral with the cultipacker rolling equipment specified

below.

- C. Rollers: A cultipacker, traffic roller, or other roller approved by the Engineer, will be required for rolling the grassed areas.
- D. Water Metering Devices: The vehicle used for applying the water to the grassed areas shall be equipped with an approved metering device installed at such point on the vehicle as to measure the water at the time of its being applied to the grassed areas.

PART 3 – EXECUTION

3.01 INSTALLATION

A. General

1. Fertilizing and seeding operations will not be permitted when wind velocities exceed 15 miles per hour. Seed shall be sown only when the soil is moist and in proper condition to induce growth.
2. All soil manipulation shall be done at right angles to the direction of slope.
3. The soil shall be maintained in a moist condition for a period of at least two weeks after the planting.

B. Applying and Mixing Fertilizer

1. At the Contractor's option either dry or liquid commercial grade fertilizer may be used.
2. The fertilizer content and rate of application shall comply with Pinellas County Code of Ordinances, Chapter 58, Article XIII.
3. The fertilizer shall be spread or sprayed uniformly over the area to be grassed by use of the approved distributing device, except that on steep slopes or other areas where machine spreading may not be practicable, spreading may be done by hand or by hose if the Engineer so directs. Immediately after dry fertilizer is spread it shall be harrowed in and mixed with the soil to a depth of approximately four inches. When liquid fertilizer is used, the Soil, if dry, shall be moistened by sprinkling before the liquid fertilizer is applied. Liquid fertilizer shall be applied no later than seven days after the seed is in place.
4. Apply fertilizer in accordance with Pinellas County Code of Ordinances, Chapter 58, Article XIII.
 - a. No applicator shall apply fertilizers containing nitrogen and/or phosphorous during the restricted season from June 1 through September 30.
 - b. No applicator shall apply fertilizers containing nitrogen and/or phosphorus during a period for which the National Weather Service has issued any of the following advisories for any portion of Pinellas County: a severe thunderstorm warning or watch, flood warning or watch, tropical storm warning or watch, hurricane warning or watch, or if rain greater than or equal to two inches in a 24-hour period is forecasted.

C. Seeding:

1. While the soil is still loose and moist, the seed shall be scattered uniformly over the grassing area.
 2. The rate of spread for the seed shall be as follows:
 - a. Rate shall be 60 pounds per acre. In the period from March 15th to October 15th the seed mixture shall be 30 pounds of bahia and 30 pounds of Bermuda. In the remainder of the year the mixture shall be 20 pounds each of bahia, Bermuda, and rye seed.
 3. Seeding may be done in conjunction with rolling if the equipment used is designed for that purpose.
- D. Rolling: Immediately after completion of the seeding, the entire grassed area shall be rolled thoroughly with the equipment specified. At least two trips over the entire area will be required.
- E. Seed Protection on Slopes
1. Cover seeded slopes where grade is 3:1 or greater with jute matting. Roll matting down over slopes without stretching or pulling.
 2. Lay matting smoothly on soil surface, burying top end of each section in a narrow six inch deep trench. Leave 12-inch overlap from top roll over bottom roll. Leave four-inch overlap over adjacent section.
 3. Staple outside edges and overlaps at 36-inch intervals.
 4. Lightly dress slopes with topsoil to ensure close contact between matting and soil.
 5. In ditches, unroll matting in direction of flow. Overlap ends of strips by six inches with upstream section on top.

3.02 MAINTENANCE PERIOD

- A. Maintenance period shall be until final acceptance.

3.03 MAINTENANCE

- A. Maintain surfaces and supply additional topsoil where necessary, including areas affected by erosion.
- B. Water to ensure uniform seed germination and to keep surface of soil damp.
- C. Apply water slowly so that surface of soil will not puddle and crust.
- D. Cut grass first time when it reaches height of 2 1/2 inches and maintain to minimum height of two inches. Do not cut more than 1/3 of blade at any one mowing. Remove clippings.
- E. After first mowing, water grass sufficiently to moisten soil from three to five inches deep.
- F. Apply weed killer when weeds start developing, during calm weather when air temperature is above 50 degrees F.

- G. Replant damaged grass areas showing root growth failure, deterioration, bare or thin spots, and eroded areas.

3.04 RESTORATION

- A. Restore pavement, concrete, grassed areas, planted areas, and structures damaged during execution of work of this section.

3.05 ACCEPTANCE

- A. Seeded areas will be accepted at end of maintenance period when seeded areas are properly established and otherwise acceptable.

[END OF SECTION]

SECTION 03400

PRECAST CONCRETE

PART 1 GENERAL

1.01 SCOPE

- A. Furnish all labor, materials, equipment, engineering design, fabrication, incidentals, transportation, erection, forming, shoring, and supervision and perform all operations necessary to complete all pre-cast concrete and related work called for by the Drawings and/or Specifications, or reasonably inferable from either or both, including but not limited to the following:
- B. Pre-cast keystone joints, corbels, and all required shoring and leveling, all designed/produced/furnished/installed by the approved fabricator.
- C. Shop Drawings: Sealed by the Firm's Professional Engineer registered in Florida.
- D. Design Calculations: Sealed by the Firm's Professional Engineer registered in Florida.
- E. Reinforcing: All types including all additional shear, moment and temperature bars required by the Drawings.
- F. Finishing and curing of prefabricated units: In Situ concrete placing and finishing shall also comply to Section 03300 "Cast In Place Concrete".
- G. In addition to the Shop Drawing requirements of the General Conditions, the shop and erection drawings shall include a large scale detail of connections and joints in the structure involving pre-cast units. Every unit shall bear an erection mark on the Shop Drawing.

1.02 CONDITIONS AND REQUIREMENTS

- A. All Work in this section shall be accomplished by a recognized pre-cast concrete composite framing system fabrication firm whose design, fabrication and erection operations are supervised and controlled by a Florida Registered Professional Engineer who is an officer or full time employee of the firm. The firm shall have had a minimum of 10 years in this specific business and shall have a fabrication plant in Florida capable of producing the required units on schedule. Items delivered to the site for use in the Work shall be available for inspection.

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of other requirements of these Specifications, all work specified herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the end of the Bid.
 - 1. Florida Building Code
 - 2. ACI 318-19 Building Code Requirements for Structural Concrete
 - 3. PCI Standard MNL-116 - Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products

4. PCI Design Handbook

1.04 DESIGN, MANUFACTURE, AND PRODUCTION

- A. General: Design, materials, fabrication and installation shall conform to ACI 318 77 and to additional requirements of the Standard Building Code. Units shall be designed by manufacturer's Registered Engineer.
- B. Design: Units shall be of sizes, shapes and dimensions indicated on Plans and designed to safely support the indicated minimum superimposed live loads, not including weight of concrete slabs, curbs, walls or other permanently supported dead load. Maximum deflection under live load $1/360$ th of span, considered at mid span. Maximum camber at mid span under dead load shall not exceed $3/8$ inch.
- C. Workmanship: Units shall be plant fabricated, transported and erected by methods prescribed in PCI Standards. Units damaged in any way will be rejected. Units with visible cracks will not be permitted and if installed will be rejected and ordered removed and replaced at Contractor's expense.
- D. Finish: Manufacturer shall be solely responsible for true, smooth surfaces free of pock marks and/or honeycombs. Smooth forms and proper vibration for the correct lengths of time during manufacture are mandatory.

1.05 SUBMITTALS

- A. Submit samples and/or Shop Drawings in accordance with Section 01300 - Submittals.
- B. Submittals shall include, but not be limited to:
 - 1. Shop drawings for all precast concrete items showing all dimensions, locations, and type of lifting inserts, and details of reinforcement and joints.
 - 2. A list of the design criteria used by the manufacturer for all manufactured, precast items.
 - 3. Certified reports for all lifting inserts, indicating allowable design loads.
 - 4. Information on lifting and erection procedures.
 - 5. Complete layout and installation Drawings and schedules with clearly marked dimensions.
 - 6. Material certificates on all piping materials.
 - 7. Structural design calculations sealed by a P.E. registered in the State of Florida. Design calculations for precast manholes and vaults shall include confirmation structures adequately resist flotation when they are totally empty and subjected to groundwater full height of structure.
 - 8. Results of leakage test.

1.06 QUALITY ASSURANCE

- A. All manufactured precast concrete units shall be produced by an experienced manufacturer regularly engaged in the production of such items. All manufactured precast concrete and

site-cast units shall be free of defects, spalls, and cracks. Care shall be taken in the mixing of materials, casting, curing and shipping to avoid any of the above. The Engineer may elect to examine the units at the casting yard or upon arrival of the same at the site. The Engineer shall have the option of rejecting any or all of the precast work if it does not meet with the requirements specified herein or on the Drawings. All rejected work shall be replaced at no additional cost to the Owner.

B. Manufacturer Qualifications

The precast concrete manufacturing plant shall be certified by the Prestressed Concrete Institute, Plant Certification Program, prior to the start of production. Certification is only required for plants providing prestressed structural members such as hollow core planks, double-T members, etc.

C. Plant production and engineering must be under direct supervision and control of an Engineer who possesses a minimum of five years experience in precast concrete work.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cement: ASTM C 150, Domestic Portland, Type II.

B. Concrete

1. For prestressed concrete items, minimum compressive strength of concrete at 28 days shall be 5,000 psi unless otherwise specified. Minimum compressive strength of concrete at transfer of prestressing force shall be 3,500 psi unless otherwise specified.
2. For non-prestressed concrete items, minimum compressive strength of concrete at 28 days shall be 4000 psi unless otherwise specified.

C. Grout

1. Minimum compressive strength of grout at 7 days shall be 3,000 psi.

D. Prestressing Strands

1. Prestressing strands shall be 7-wire, stress-relieved, high-strength strands Grade 250K or 270K

E. Steel Inserts

1. All steel inserts protruding from or occurring at the surface of precast units shall be galvanized

F. Bearing Pads

1. Plastic bearing pads shall be multi-monomer plastic strips which are non-leaching and support construction loads with no visible overall expansion, manufactured specifically for the purpose of bearing precast concrete.

G. Aggregate: Comply with Section 03300.

H. Water: Potable

I. Reinforcing for joists:

1. Deformed Bars: Domestic, new, made from Billet Steel conforming to ASTM A615, Grade 60.

PART 3 EXECUTION

3.01 FABRICATION AND CASTING

- A. All precast members shall be fabricated and cast to the shapes, dimensions and lengths shown on the Drawings and in compliance with PCI MNL-116. Precast members shall be straight, true and free from dimensional distortions, except for camber and tolerances permitted later in this clause. All integral appurtenances, reinforcing, openings, etc., shall be accurately located and secured in position with the form work system. Form materials shall be steel and the systems free from leakage during the casting operation.
- B. All cover of reinforcing shall be the same as detailed on the Drawings.
- C. Because of the critical nature of the bond development length in prestressed concrete panel construction, if the transfer of stress is by burning of the fully tensioned strands at the ends of the member, each strand shall first be burned at the ends of the bed and then at each end of each member before proceeding to the next strand in the burning pattern.
- D. The Contractor shall coordinate the communication of all necessary information concerning openings, sleeves, or inserts to the manufacturer of the precast members.
- E. Grout all recesses due to cut tendons which will not otherwise be grouted during erection.
- F. Use of a membrane curing compound will not be allowed.
- G. The manufacturer shall provide lifting inserts or other approved means of lifting members.

3.02 HANDLING, TRANSPORTING AND STORING

- A. Precast members shall not be transported away from the casting yard until the concrete has reached the minimum required 28 day compressive strength and a period of at least 5 days has elapsed since casting, unless otherwise permitted by the Engineer.
- B. No precast member shall be transported from the plant to the job site prior to approval of that member by the plant inspector. This approval will be stamped on the member by the plant inspector.
- C. During handling, transporting, and storing, precast concrete members shall be lifted and supported only at the lifting or supporting points as indicated on the shop drawings.
- D. All precast members shall be stored on solid, unyielding, storage blocks in a manner to prevent torsion, objectionable bending, and contact with the ground.
- E. Precast concrete members shall not be used as storage areas for other materials or equipment.
- F. Precast members damaged while being handled or transported will be rejected or shall be

repaired in a manner approved by the Engineer.

3.03 INSTALLATION/ERECTION

- A. Erection/installation by manufacturer of units and performed by experienced and competent mechanics regularly employed in this type of work under supervision of Firm's Registered Engineer. Adequate handling and lifting equipment must be used. Include all leveling, special anchorages and special cutting for finish fitting.
- B. All units shall be carefully lifted, transported and erected in such manner that they will suffer no damage. Provide soft wood shims for temporary support during transport and erection.
- C. Erectors shall inspect all bearing surfaces for level, smoothness and uniform bearing. Notify Engineer if for any reason there are defects detrimental to installation of units. Erection of units shall signify acceptance of surface.
- D. Clean all bearing surfaces prior to erection.
- E. Powder actuated fasteners not permitted in pre-cast unit.
- F. Drilling of hole in units at job site not permitted unless done under the supervision of fabrication firm's Registered Engineer.
- G. Grouting between adjacent precast members and along the edges of the assembled precast members shall be accomplished as indicated on the drawings, care being taken to solidly pack such spaces and to prevent leakage or droppings of grout through the assembled precast members. Any grout which seeps through the precast members shall be removed before it hardens.
- H. In no case shall concentrated construction loads, or construction loads exceeding the design loads, be placed on the precast members. In no case shall loads be placed on the precast members prior to the welding operations associated with erection, and prior to placing of topping (if required).
- I. No Contractor, Subcontractor or any of his employees shall arbitrarily cut, drill, punch or otherwise tamper with the precast members.
- J. Precast members damaged while being erected will be rejected or shall be repaired in a manner approved by the Engineer.

[END OF SECTION]

SECTION 07900
JOINT FILLERS, SEALANTS AND CAULKING

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Furnish labor, materials, equipment and appliances required for the complete execution of Work shown on the Drawings and specified herein.

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. ASTM C-920 – Elastomeric Joint Sealants
 - 2. ASTM D-1056 – Flexible Cellular Materials – Sponge or Expanded Rubber
 - 3. SWRI – Sealant and Caulking Guide Specification

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the Contract Documents, submit the following:
 - 1. Manufacturers literature and installation instructions. Label each product submitted with Type as indicated in paragraph 2.01 A.
 - 2. Color samples of each type of sealant.

1.04 QUALITY ASSURANCE

- A. Applicator shall be a company specializing in the installation of sealants with a minimum of five years of experience.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in unopened labeled packages.
- B. Store materials in location protected from freezing or damages.
- C. Reject and remove from the site materials within broken or damaged packaging.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Sealants

1. Type 1: Multi-component, non-sag, low-modulus polyurethane rubber sealant meeting ASTM C-920, Type M, Grade NS, Class 25, use NT, M, A, and O. Capable of withstanding 50% in extension or compression such as Sikaflex-2C NS/SL, Sika Corporation, or Sonolastic NP-2, Sonneborn, or DynaTrol II by Pecora Corporation.
2. Type 2: Single component polyurethane sealant meeting ASTM C-920, Type S, Grade NS, Class 25, Use NT, M, A, and O. Capable of withstanding 25% in extension or compression such as Sikaflex 1A by Sika Corporation, DynaTrol 1-XL by Pecora Corporation, or Sonolastic NP-1 by Master Builders Solutions.
3. Type 3: Single component, low-modulus moisture curing silicone meeting ASTM C-920, Type S, Grade NS, Class 25, Use NT, M, G, and A. Capable of withstanding 50% extension and compression. Pecora 890 by Pecora Corporation, Sonolastic Omni Seal by Master Builders Solutions.
4. Type 4: Single component, mildew resistant, moisture-curing silicone meeting ASTM C-920, Type S, Grade NS, Class 25, Use NT, M, G, and A. Pecora 898 by Pecora Corporation, Sonolastic Omni Plus by Master Builders Solutions.
5. Type 5: Single component, acrylic latex meeting ASTM C-834. AC-20+ Silicone by Pecora Corporation, Sonneborn Sonolac by Master Builders Solutions.
6. Type 6: High grade butyl sealant meeting Federal Specification TT-S-00-1657. BC-158 by Pecora Corporation or equal.
7. Type 7: Multi-component chemical resistant polysulfide sealant conforming to ASTM C-920, Type M, Grade NS, Class 25 such as Deck-O-Seal by W.R. Meadows, Tammsflex by DuraJoint Concrete Accessories, or Synthacalk GC2+ by Pecora Corporation.
8. Type 8: Nonsag, Multi Component, traffic grade polyurethane sealant meeting ASTM C920, Type 19, Grade NS, Class 25, use T, M, A, and O. DynaTread by Pecora Corporation, Sonolastic Ultra by Master Builders Solutions.

B. Primer: Non-staining primer recommended by sealant manufacturer for the substrates on this project.

C. Backer Rod: Closed cell foam, nonreactive with caulking materials, non-oily, and approved by the sealant manufacturer. Minimum density shall be 2.00 pounds per cubic foot. Use no asphalt or bitumen-impregnated fiber with sealants.

- D. Joint Cleaner: Recommended by sealant or caulking compound manufacturer.
- E. Bond breaker: Either polyethylene film or plastic tape as recommended by the sealant manufacturer.
- F. Color: Where manufacturer's standard colors do not closely match materials being sealed, provide a custom color.

PART 3 – EXECUTION

3.01 QUALITY CONTROL

- A. Coordinate work with details shown on approved shop drawings prepared by other trades.
- B. Verify conditions in the field.
- C. Schedule work to follow closely the installation of other trades.
- D. Apply sealants and related items in temperatures and dry conditions recommended by the manufacturers.
- E. Do not paint sealant, unless recommended by sealant and paint manufacturer.

3.02 PREPARATION

- A. Protect finished surfaces adjoining by using masking tape or other suitable materials.
- B. Clean and prime joints before starting any caulking or sealing work.
- C. Thoroughly clean joints and spaces of mortar and other foreign materials. Cleaning agent shall be Xylol or similar non-contaminating solvent to remove any film from metal surfaces. Masonry or concrete surfaces shall be brushed or air jet cleaned.
- D. Joint Requirements
 - 1. All joints and spaces to be sealed in exterior work shall be less than 1/2-inch deep and not less than 1/4 inch wide. If joints in masonry are less than that specified herein, the mortar shall be cut out to the required width and depth. All joints and spaces to receive sealant shall be completely prepared and thoroughly dry before installation of sealant.
 - 2. Unless otherwise specified, joints and spaces which are open to a depth of 1/2 inch or greater shall be solidly filled with back-up material to within 1/4 inch of the surface. Back-up material shall be packed tightly and made continuous throughout the length of the joints. Bond breaker shall be applied as required. If joints are less than 1/4-inch deep, the back-up material may be omitted, a bond breaker

substituted and the joint completely filled with sealant. The back-up material shall not project beyond the ¼-inch depth of the open space in any joint. The following width-to-depth ratio table shall be adhered to, unless otherwise recommended by manufacturer.

Joint Width	Sealant Depth	
	Minimum	Maximum
¼ inch	1/4 inch	1/4 inch
Over 1/4 inch to 1/2 inch	1/4 inch	Equal to width
Over 1/2 inch to 1 inch	1/2 inch	Equal to width
Over 1 inch to 2 inches	1/2 inch	1/2 of width

3.03 APPLICATION

- A. Exercise care before, during, and after installation so as not to damage any material by tearing or puncturing. All finished work shall be approved before covering with any other material or construction.
- B. Apply sealant by an approved type of gun except where the use of a gun is not practicable, suitable hand tools shall be used. Avoid applying the compound to any surface outside of the joints or spaces to be sealed. Mask areas where required to prevent overlapping of sealant.
- C. All joints shall be waterproof and weathertight.
- D. Point sealed joints to make a slightly concave joint, the edges of which are flush with the surrounding surfaces. Exposed joints in the interior side of the door and other frames shall be neatly pointed flush or to match adjacent jointing work.
- E. Adjacent materials which have been soiled shall be cleaned immediately and the work left in neat and clean condition.
- F. Comply with sealant manufacturer's written instructions except where more stringent requirements are shown or specified and except where manufacturer's technical representative directs otherwise.

3.04 ADJUSTMENT AND CLEANING

- A. Remove misplaced sealant compounds promptly using methods and materials recommended by the manufacturer, as the work progresses.
- B. Allow sealants to cure and remove protective edging, of doors, louvers, saddles windows etc. as directed by the Engineer.

3.05 SCHEDULE

Schedule of Sealants

Application	Sealant	Color
Vertical and horizontal expansion and construction joints in concrete structures unless noted otherwise herein or on Drawings.	Type 1	To closely match adjacent surfaces or mortar and as selected by the Owner.
Vertical and horizontal joints bordered on both sides by masonry, precast concrete, natural stone or other porous building material, unless noted otherwise herein or on Drawings.	Type 2	To closely match adjacent surfaces or mortar and as selected by the Owner.
Vertical and horizontal joints bordered on both sides by painted metals, anodized aluminum, mill finished aluminum, PVC, glass or other non-porous building material.	Type 3	To closely match adjacent surfaces and as selected by the Owner.
Masonry expansion and control joints less than 1¼" wide.	Type 2	To closely match adjacent surfaces and as selected by the Owner.
Masonry expansion and control joints equal or greater than 1¼ inches wide and not to exceed 2".	Type 1	To closely match adjacent surfaces and as selected by the Owner.
Interior – wood trim and finish joints.	Type 5	Color to be selected by Owner
Sanitary areas, joints in ceramic tile, around plumbing fixtures, countertops, and back splashes. ¹	Type 4	To closely match adjacent surfaces and as selected by the Owner.
Perimeter sealing of doors, windows, louvers, piping, ducts, and electrical conduit. ²	Type 2 or Type 3	To closely match adjacent surfaces and as selected by the Owner.
Below thresholds.	Type 6	Manufacturer's standard
Submerged in liquids. ⁴	Type 1	Manufacturer's standard
Submerged in liquids with high concentration of chlorine (> 2 ppm) or wastewater.	Type 7	Manufacturer's standard
Horizontal Joints exposed to vehicular or pedestrian traffic.	Type 8	To closely match adjacent surfaces.
Other joints indicated on the drawings or customarily sealed but not listed.	Type recommended by manufacturer	To closely match adjacent surfaces and as selected by the Owner.

¹ Sealant for Laboratory Countertop shall be as recommended by countertop manufacturer.

² Provide UL approved sealants for penetrations thru fire-rated walls.

³ Sealants which will come in contact with potable water shall meet the requirements of NSF 61.

⁴ Where sealant will be immersed in liquid chemicals verify compatibility prior to installation of sealant.

[END OF SECTION]

SECTION 09900

PAINTING

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Furnish labor, materials, equipment and appliances required for complete execution of Work shown on Drawings and Specified herein.
- B. Section Includes:
 - 1. Paint Materials
 - 2. Shop Painting
 - 3. Field Painting
 - a. Surface Preparation
 - b. Piping and Equipment Identification
 - c. Schedule of Colors
 - d. Work in Confined Spaces
 - e. OSHA Safety Colors

1.02 RELATED SECTIONS

- A. Section 07900 – Joint Fillers, Sealants, and Caulking
- B. Section 15030 – Piping and Equipment Identification Systems

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of these specifications, the Work shall conform to the applicable requirements of the following documents:
 - 1. SSPC – The Society for Protective Coatings Standards
 - a. SSPC-Vis 1 – Pictorial Surface Preparation Standards for Painting Steel Structures
 - b. SSPC-SP2 – Hand Tool Cleaning
 - c. SSPC-SP3 – Power Tool Cleaning

- d. SSPC-SP5/NACE 1 – White Metal Blast Cleaning
 - e. SSPC-SP6/NACE 3 – Commercial Blast Cleaning
 - f. SSPC-SP7/NACE 4 – Brush-off Blast Cleaning
 - g. SSPC-SP10/NACE 2 – Near-White Metal Blast
 - h. SSPC-SP11 – Power Tool Cleaning to Bare Metal
 - i. SSPC-SP13/NACE6 – Surface Preparation of Concrete
- 2. ICRI – International Concrete Repair Institute
 - 3. NACE – National Association of Corrosion Engineers
 - 4. NAFP – The National Association of Pipe Fabricators
 - 5. ASTM D1737 – Test Method for Elongation of Attached Organic Coatings with Cylindrical Mandrel Apparatus
 - 6. ASTM B117 – Method of Salt Spray (Fog) Testing
 - 7. ASTM D4060 – Test Method for Abrasion Resistance of Organic Coating by the Taber Abraser
 - 8. ASTM D3359 – Method for Measuring Adhesion by Tape Test

1.04 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the Contract Documents, submit the following:
 - 1. Manufacturer's literature and Material Safety Data Sheets for each product.
 - 2. Samples of each finish and color. Submitted samples of each finish and color shall be prepared in a step-down format so that the area of each sample indicates the appearance of the various coats. For example, where a three-coat system is specified, the sample shall be divided into three areas indicating one coat only, two coats and all three coats. The Engineer will provide written authorization constituting a standard, as to color and finish only, for each coating system
 - 3. Painting schedule identifying surface preparation and paint systems proposed. Cross reference with Tables 1 and 2. Provide the name of the paint manufacturer, and name, address, and telephone number of manufacturer's representative who will inspect the work. Submit schedule for approval as soon as possible following the Award of Contract, so approved schedule may be used to identify colors and

specify shop paint systems for fabricated items. Manufacturer shall substitute paint system with equal performance where required for VOC compliance.

4. Contractor shall submit Q.C. Inspection plan describing all tests and inspections task to be performed. Include copy of daily log showing environmental conditions measurements and frequency. Copy of completed log shall be provided at completion of work.
5. Name and detailed qualifications of the protective coating applicator or subcontractor. Qualifications shall include, but not be limited to, five (5) project references which show that the painting applicator or subcontractor has previous successful experience with the specified or comparable coating systems, a list of installations that are currently in service and documentation that applicator or subcontractor is currently a qualified applicator of the proposed coatings by the manufacturer. Include the name, address and telephone number of the owner of each installation for which the coating applicator provided the coating.
6. Certifications: The coating manufacturer shall submit the following certifications:
 - a. A letter from the coating manufacturer stating that the specified material is suitable for the application.
 - b. Inspection reports of coating manufacturer certifying that all inspections by the manufacturer showed satisfactory performance of the work by the coating applicator.
 - c. A letter from the coating manufacturer certifying that the surface preparation has been properly completed.
 - d. A letter from the coating manufacturer certifying that the coating system has been properly applied and acknowledging that their warranty is in effect.
 - e. A sample copy of the warranty to be issued after completion of the work.
7. Test reports of all testing and inspections during the work.

1.05 SYSTEM DESCRIPTION

- A. Work shall include surface preparation, paint application, inspection of painted surfaces and corrective action required, protection of adjacent surfaces, cleanup and appurtenant work required for the proper painting of all surfaces to be painted. Surfaces to be painted are designated within the Painting Schedule and may include new and existing piping, miscellaneous metals, equipment, buildings, exterior fiberglass, exposed electrical conduit and appurtenances.
- B. Perform Work in strict accordance with manufacturer's published recommendations and instructions, unless the Engineer stipulates that deviations will be for the benefit of the project.

- C. Paint surfaces which are customarily painted, whether indicated to be painted or not, with painting system applied to similar surfaces, areas and environments, and as approved by Engineer.
- D. Piping and equipment shall receive color coding and identification. Equipment shall be the same color as the piping system.

1.06 QUALITY ASSURANCE

- A. The Applicator must have a minimum NACE Level 1 certified inspector on staff.
- B. Painting operations shall be accomplished by skilled craftsman and licensed by the state/commonwealth to perform painting work.
- C. Provide a letter indicating that the painting applicator has five years of experience, and 5 references which show previously successful application of the specified or comparable painting systems. Include the name, address, and the telephone number for the Owner of each installation for which the painting applicator provided services.
- D. Contractor shall coordinate Q.C. Inspections.
- E. Notify Owner and Engineer at completion of surface preparation, priming application and final cure to allow inspection by Owner and Engineer or their Third-Party Inspector.

1.07 STORAGE AND DELIVERY

- A. Bring materials to the job site in the original sealed and labeled containers.
- B. Container label to include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Store paint materials at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.08 SAFETY AND HEALTH REQUIREMENTS

- A. Require that personnel perform work in strict accordance with the latest requirements of OSHA Safety and Health Standards for construction. Meet or exceed requirements of regulatory agencies having jurisdiction and the manufacturer's published instructions and recommendations. Maintain a copy of all Material Safety Data Sheets at the job site of each product being used prior to commencement of work. Provide and require that personnel use protective and safety equipment in or about the project site. Provide respiratory devices, eye and face protection, ventilation, ear protection, illumination and other safety devices required to provide a safe work environment.

- B. Respirators shall be worn by persons engaged or assisting in spray painting. The Contractor shall provide ventilating equipment and all necessary safety equipment for the protection of the workmen and the work.
- C. All paint shall comply with all requirements of the Air Pollution Regulatory Acts concerning the application and formulation of paints and coatings for an area in which the paints are applied. Specifically, paints shall be reformulated as required to meet the local, State and Federal requirements.

1.09 SERVICES OF MANUFACTURER'S REPRESENTATIVE

- A. The Contractor shall purchase paint from an acceptable manufacturer. The manufacturer shall assign a representative to inspect the application of his product both in the shop and field. The Contractor, through the manufacturer's representative, shall submit his report to the Engineer at the completion of his Work identifying the products used and verifying that said products were properly applied and that the paint systems were proper for the exposure and service.
- B. Services shall also include, but not be limited to, inspecting prior coatings of paint, determination of best means of surface preparation, inspection of complete work, and re-inspection of painted work to be performed six months after the job is completed.

1.10 MANUFACTURER'S INSTRUCTIONS

- A. The manufacturer's published instructions for use as a guide in specifying and applying the manufacturers proposed paint shall be submitted to the Engineer. Paint shall not be delivered to the job before acceptance of the manufacturer's instructions is given by the Engineer.
- B. A manufacturer's paint will not be considered for use unless that manufacturer's published instructions meets the following requirements:
- C. The instructions must have been written and published by the manufacturer for the purpose and with the intent of giving complete instruction for the use and application of the proposed paint in the locality and for the conditions for which the paint is specified or shown to be applied under this Contract.
- D. All limitations, precautions, and requirements that may adversely affect the paint; that may cause unsatisfactory results after the painting application; or that may cause the paint not to serve the purpose for which it was intended; that is, to protect the covered material from corrosion, shall be clearly and completely stated in the instructions. These limitations and requirements shall, if they exist, include, but not be limited to the following:
 - 1. Methods of application
 - 2. Number of coats

3. Thickness of each coat
 4. Total thickness
 5. Drying time of each coat, including primer
 6. Primer required to be used
 7. Primers not permitted
 8. Use of a primer
 9. Thinner and use of thinner
 10. Temperature and relative humidity limitations during application and after application
 11. Time allowed between coats
 12. Protection from sun
 13. Physical properties of paint including solids content and ingredient analysis
 14. Surface preparation
 15. Touch up requirements and limitations
- E. Concrete surfaces specified by the paint manufacturer to be acid etched shall be etched in accordance with the manufacturer's instructions. The surface shall then be thoroughly scrubbed with clean water, rinsed, and allowed to dry. The surface shall be tested with a moisture meter to determine when dry before coating. The surface shall also be tested for pH to determine the acid has been properly neutralized.

1.11 SURFACES NOT TO BE COATED

- A. The following items shall not be coated unless otherwise noted:
1. Encased piping or conduit.
 2. Stainless steel work.
 3. Clear PVC secondary containment piping.
 4. Galvanized checkered plate.
 5. Aluminum handrails, walkways, windows, louvers, grating and checkered plate.
 6. Flexible couplings, lubricated bearing surfaces and insulation.

7. Packing glands and other adjustable parts of mechanical equipment.
8. Finish hardware.
9. Steel encased in concrete or masonry
10. Plastic switch plates and receptacle plates.
11. Signs and nameplates.
12. Any code-required labels, such as Underwriters' Laboratories and Factory Mutual, or any equipment identification, performance rating, name or nomenclature plates.
13. Any moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sensing devices, motor and fan shafts, unless otherwise indicated

1.12 QUALITY WORKMANSHIP

- A. The Contractor shall be responsible for the cleanliness of his painting operations and shall use covers and masking tape to protect work whenever such covering is necessary, or if so requested by the Owner. Any unwanted paint shall be carefully removed without damage to any finished paint or surface. If damage occurs, the entire surface, adjacent to and including the damaged area, shall be repainted without visible lapmarks and without additional cost to the Owner.
- B. Painting found defective shall be scraped or sandblasted off and repainted as the Owner may direct. Before final acceptance of the work, damaged surfaces of paint shall be cleaned and repainted as directed by the Owner.

1.13 ADDITIONAL PAINT

- A. At the end of the project, the Contractor shall turn over to the Owner a one gallon can (single component material) or small kit (multi component material – minimum of one gallon yield) of each type and color of paint, primer, thinner or other coating used in the field painting. The material shall be delivered in unopened, labeled cans as it comes from the factory. The manufacturer's literature describing the materials and giving directions for their use shall be furnished in three bound copies. A type-written inventory list shall be furnished at the time of delivery.

1.14 WARRANTY

- A. The coating manufacturer shall provide a standard material product warranty for a period of 5 years from the date of Substantial Completion.

PART 2 – MATERIALS

2.01 GENERAL INFORMATION

- A. The term "paint" is defined as both paints and coatings including emulsions, enamels, stains, varnishes, sealers, and other coatings whether organic or inorganic and whether used as prime, intermediate, or finish coats.
- B. Purchase paint from an approved manufacturer. Manufacturer shall assign a representative to inspect application of their product both in the shop and field. The manufacturer's representative shall submit a report to the Engineer at the completion the Work identifying products used and verifying that surfaces were properly prepared, products were properly applied, and the paint systems were proper for the exposure and service.
- C. Provide primers and intermediate coats produced by same manufacturer as finish coat. Use only thinners approved by paint manufacturer, and only within manufacturer's recommended limits.
- D. Ensure compatibility of total paint system for each substrate. Test shop primed equipment delivered to the site for compatibility with final paint system. Provide an acceptable barrier coat or totally remove shop applied paint system when incompatible with system specified, and repaint with specified paint system.
- E. Use painting materials suitable for the intended use and recommended by paint manufacturer for the intended use.
- F. Require that personnel perform work in strict accordance with the latest requirements of OSHA Safety and Health Standards for construction. Meet or exceed requirements of regulatory agencies having jurisdiction and the manufacturer's published instructions and recommendations. Maintain a copy of all Material Safety Data Sheets at the job site of each product being used prior to commencement of work. Provide and require that personnel use protective and safety equipment in or about the project site. Provide respiratory devices, eye and face protection, ventilation, ear protection, illumination and other safety devices required to provide a safe work environment.
- G. All building, facilities, structures, and appurtenances, as indicated on the Drawings and as specified herein, shall be painted with not less than one shop coat and two field coats, or one prime coat and two finish coats of the appropriate paint. Items to be painted include, but are not limited to, exterior and interior concrete, structural steel, miscellaneous metals, steel and aluminum doors and frames, concrete block, ductwork, sluice gates, operators, pipe fittings, valves, mechanical equipment, motors, conduit, and all other work which is obviously required to be painted unless otherwise specified.
- H. Baked-on enamel finishes and items with standard shop finishes such as graphic panels, electrical equipment, toilet partitions, lockers, instrumentation, etc., shall not be field painted unless the finish is damaged during shipment or installation. Aluminum,

stainless steel, fiberglass and bronze work shall not be painted unless color coding and marking is required or otherwise specified.

2.02 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Specifications, provide products from one of the following manufacturers:
 - 1. Tnemec Company Inc.
 - 2. CARBOLINE.
 - 3. Sherwin-Williams.
 - 4. Or approved equal.

PART 3 – EXECUTION

3.01 SHOP PAINTING

- A. Shop prime fabricated steel and equipment with at least one shop coat of prime paint compatible with finish paint system specified. Prepare surface to be shop painted in strict accordance with paint manufacturer's recommendations and as specified. Finish coats may be shop applied, if approved by the Engineer. Package, store and protect shop painted items until they are incorporated into Work. Repair painted surfaces damaged during handling, transporting, storage, or installation to provide a painting system equal to the original painting received at the shop.
- B. Identify surface preparation and shop paints on Shop Drawings. Verify compatibility with field applied paints.
- C. Coordinate shop painting and field coating to ensure item is delivered and field coating occurs within recoat window of shop painted system requirements.
- D. Shop finish coats may be the standard finish as ordinarily applied by the manufacturer if it can be demonstrated to the Engineer that the paint system is equal to and compatible with the paint system specified. However, all pumps, motors and other equipment shall receive at least one field applied finish coat after installation.

3.02 SURFACE PREPARATION

- A. General
 - 1. Surfaces to be painted shall be clean and dry, and free of dust, rust, scale, and foreign matter. No solvent cleaning, power or hand tool cleaning shall be permitted unless approved by the Engineer.

2. Protect or remove, during painting operations, hardware, accessories, machined surfaces, nameplates, lighting fixtures, and similar items not intended to be painted prior to cleaning and painting. Reposition items removed upon completion of painting operations.
3. Examine surfaces to be coated to determine that surfaces are suitable for specified surface preparation and painting. Report to Engineer surfaces found to be unsuitable in writing. Do not start surface preparation until unsuitable surfaces have been corrected. Starting surface preparation precludes subsequent claim that such surfaces were unsuitable for the specified surface preparation or painting.
4. Surface preparation shall be in accordance with specifications and manufacturer's recommendations. Provide additional surface preparation, and fill coats where manufacturer recommends additional surface preparation, in addition to requirements of specification.
5. Touch-up shop or field applied coatings damaged by surface preparation or any other activity, with the same shop or field applied coating; even to the extent of applying an entire coat when required to correct damage prior to application of the next coating. Touchup coats are in addition to the specified applied systems, and not considered a field coat.
6. Protect motors and other equipment during blasting operation to ensure blasting material is not blown into motors or other equipment. Inspect motors and other equipment after blasting operations and certify that no damage occurred, or where damage occurred, the proper remedial action was taken.
7. Field paint shop painted equipment in compliance with Color Coding and as approved by Engineer.

B. Metal Surface Preparation

1. Prepare all welds to a minimum NACE weld preparation level "C" per NACE Standard SP0178. Provide additional weld preparation where required by the coating manufacturer. Contractor shall provide NACE SP0178 weld mold visual aids on site for evaluation of all weld preparation.
2. Conform to current The Society for Protective Coatings Standards (SSPC) Specifications for metal surface preparation. Use SSPC-Vis-1 pictorial standards or NACE visual standards TM-01-70 or TM-01-75 to determine cleanliness of abrasive blast cleaned steel.
3. Perform blast cleaning operations for metal when following conditions exist:
 - a. Moisture is not present on the surface.

- b. Ambient and surface temperatures are 5°F or greater than the dew point temperature.
 - c. Painting or drying of paint is not being performed in the area.
 - d. Equipment is in good operating condition.
 - e. Proper ventilation, illumination, and other safety procedures and equipment are being provided and followed.
- 4. Abrasive blast ferrous metals to be shop primed, or component mechanical equipment in accordance with SSPC-SP10, Near-White Metal Blast.
 - 5. Abrasive blast field prepared ferrous metals in accordance with SSPC-SP10, Near White Metal Blast, where metal is to be submerged, in a corrosive environment, or in severe service. Provide a 3.0 mil minimum angular anchor profile unless recommended otherwise by the coating manufacturer in writing.
 - 6. Abrasive blast field prepared ferrous metals in accordance with SSPC-SP6 Commercial Blast, where metal is to be used in mild or moderate service, or non-corrosive environment or weathering exposure. Provide a 1.5 mil minimum angular anchor profile unless recommended otherwise by the coating manufacturer in writing.
 - 7. Clean nonferrous metals, copper, or galvanized metal surfaces in accordance to SSPC-SP1, Solvent Cleaning, or give one coat of metal passivator or metal conditioner compatible with the complete paint system. Galvanized metal shall be prepared in accordance with SSPC SP-16. Abrasive blast clean to increase mechanical adhesion in accordance with ASTM D6386, Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting when required by coating manufacturer. Provide a 1.5 mil minimum angular anchor profile unless recommended otherwise by the coating manufacturer in writing. All nonferrous metals are to be coated as soon as possible on the same day of surface preparation.
 - 8. Abrasive blast clean internal and external ductile iron pipe surfaces prior to coating in accordance with NAPF 500-03-04, Surface Preparations Standard for Abrasive Blast Cleaning of Ductile Iron Pipe. Abrasive blast clean internal and external cast ductile iron and cast-iron fitting surfaces in accordance with NAPF-03-05.
 - 9. Prime cleaned metals immediately after cleaning to prevent rusting.
 - 10. Clean rusted metals down to bright metal by abrasive blasting and immediately field primed.

C. Concrete Surface Preparation

1. Cure concrete a minimum of 28 days at 75° F before surface preparation, and painting begins. Allow more time at lower temperatures if specified by paint manufacturer.
2. Test concrete for pH and salts using test methods recommended by the paint manufacturer. A minimum of one test per 1000 square feet of area to be coated shall be performed unless approved otherwise by Engineer. All concrete that was previously exposed to acidic environments must be confirmed to have a minimum pH of 9. Do not begin painting until acceptable to manufacturer and Engineer.
3. Floor Coatings: Moisture content of concrete and masonry surfaces shall conform to manufacturer's recommended limits, and as listed in SSPC-SP13/NACE 6 Section 6 Acceptance Criteria Table 1. Floor surfaces to be coated shall be tested in accordance with ASTM F1869 – Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride or as required by the coating manufacturer. For epoxy coating systems, moisture vapor transmission shall not exceed ten pounds per 1,000 square feet in a 24-hour period or less if specified by Coating Manufacturer. Vertical and horizontal floor surfaces shall be tested in accordance with ASTM F2170 – Standard Test Method for Determining Relative Humidity in Concrete using in situ Probes (relative humidity shall not exceed 80% or as required by the coating manufacturer) or with ASTM D4263 – Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Test Method (test results shall be no moisture present). Engineer or Coating Manufacturer Representative shall specify all test locations. A minimum of one test per 1000 square feet of area to be coated shall be performed unless approved otherwise by Engineer.
4. Prepare concrete surfaces to receive coatings in accordance with NACE 6/SSPC-13 – Joint Surface Preparation Standards and ICRI Technical Guidelines. Remove contaminants, open bugholes, surface voids, air pockets, and other subsurface irregularities using abrasive blasting, shot blasting, water jetting or mechanical abrading. Use dry, oil-free air for blasting operations. Surface texture after blasting shall achieve profile as required by manufacturer or where not defined by manufacturer, profile shall be a minimum ICRI-CSP 5 surface profile. Remove residual abrasives, dust, and loose particles by vacuuming or other approved method.
5. Surface defects, such as hollow areas, bugholes, honeycombs, and voids shall be filled with polymeric or waterborne epoxy cementitious filler compatible with painting system. Complete fill coats may be used in addition to specified painting system and as approved by the Engineer. Fins, form marks, and all protrusions or rough edges shall be removed.
6. Repair existing concrete surfaces which are deteriorated to the point that surface preparation exposes aggregate with fill coats or patching mortar as recommended by paint manufacturer and as directed by the Engineer.

7. Clean concrete of all dust, form oils, curing compounds, oil, tar, laitance, efflorescence, loose mortar, and other foreign materials before paints are applied.
8. To ease coating around outside corners, provide $\frac{3}{4}$ -inch chamfered edges on all new concrete outside corners and grind existing concrete outside corners to a minimum radius of $\frac{3}{4}$ -inch.
9. Unless recommended otherwise by the coating manufacturer, provide $\frac{1}{4}$ " deep by $\frac{1}{4}$ " wide tool cut terminations at 1-inch maximum from all coating edges for anchorage. Provide terminations around all equipment, piping, openings, gates, top and bottom of walls, stop locations of each day's work and overlap onto previously completed work. Transition coating 3-inches onto interior lining of piping except where coating compatibility concerns are noted by coating manufacturer.
10. Apply epoxy or polymeric filler compatible with painting system to all inside corners of areas to be coated with a margin trowel to form a continuous 45-degree cant cove across corners with a minimum dimension of 1.5-inch. Roughen or prepare cured filler as recommended by coating manufacturer for proper coating adhesion.
11. All equipment grouting shall be installed and cured prior to starting coating work. Coating shall be applied over grout up to the edges of all equipment, gates and uninterrupted piping unless specifically noted otherwise.

D. Wood

1. Clean wood surfaces free of all foreign matter, with cracks and nail holes and other defects properly filled and smoothed. Remove sap and resin by scraping and wipe clean with rags dampened with mineral spirits.
2. Saturate end grain, cut wood, knots, and pitch pockets with an appropriate sealer before priming.
3. Prime and backprime wood trim before setting in place.
4. After prime coat has dried, fill nailholes, cracks, open joints, and other small holes with approved spackling putty. Lightly sand wood trim prior to applying second coat of paint.

E. Castings

1. Prepare castings for painting by applying a brush or a knife-applied filler. Fillers are not to be used to conceal cracks, gasholes, or excessive porosity.
2. Apply one coat of primer with a minimum thickness of 1.2 mils in addition to coats specified. Allow sufficient drying time before further handling.

F. Exposed Pipe, Valves and Pumps

1. Bituminous coated pipe shall not be used in exposed locations. Pipe which shall be exposed after project completion shall be primed in accordance with the requirements herein. Any bituminous coated ferrous pipe which is inadvertently installed in exposed locations shall be sandblasted to SSPC-SP-10 Near-white Metal before priming and painting.
2. After installation and prior to finish painting, all exterior, exposed flanged joints shall have the gap between adjoining flanges and gaps between the pipe wall and threaded-on flanges sealed with a single component Thiokol caulking to prevent rust stains.

G. Masonry

1. Cure for a minimum of 30 days prior to paint application.
2. Clean masonry surfaces free from all dust, dirt, oil, grease, loose mortar, chalky deposits, efflorescence, and other foreign materials.
3. Test masonry for moisture content. Use test method recommended by paint manufacturer. Do not begin painting until moisture content is acceptable to manufacturer.

H. Gypsum Drywall

1. Sand joint compound with sandpaper to provide a smooth flat surface. Avoid sanding of adjacent drywall paper.
2. Remove dust, dirt, and other contaminants.

I. PVC Pipe Surfaces

1. All pipe surfaces shall be cleaned and lightly sanded before painting.

J. Previously-Painted Surfaces

1. Totally remove existing paint when: surface is to be submerged in a severe environment, paint is less than 75% intact, brittle, eroded or has underfilm rusting.
2. Surfaces which are greater than 75% intact require removal of failed paints and then spot primed. Spot priming is in addition to coats specified.
3. Remove surface contamination such as oil, grease, loose paint, mill scale, dirt, foreign matter, rust, mold, mildew, mortar, efflorescence, and sealers.
4. Clean and dull glossy surfaces prior to painting in accordance with the manufacturer's recommendations.

5. Check existing paints for compatibility with new paint system. If incompatible, totally remove existing paint system or apply a barrier coat recommended by the paint manufacturer. Remove existing paints of undetermined origin. Prepare a test patch of approximately 3 square feet over existing paint. Allow test patch to dry thoroughly and test for adhesion. If proper adhesion is not achieved remove existing paint and repaint.

3.03 APPLICATION OF PAINT

- A. Apply paint by experienced painters with brushes or other applicators approved by the Engineer, and paint manufacturer.
- B. Apply paint without runs, sags, thin spots, or unacceptable marks.
- C. Apply at rate specified by the manufacturer to achieve at least the minimum dry mil thickness specified. Apply additional coats, if necessary, to obtain thickness.
- D. Special attention shall be given to nuts, bolts, edges, angles, flanges, welds, etc., where insufficient film thicknesses are likely. Stripe paint outside corners and edges in accordance with SSPC PA Guide 11. Stripe painting shall be in addition to coats specified.
- E. Perform thinning in strict accordance with the manufacturer's instructions, and with the full knowledge and approval of the Engineer and paint manufacturer.
- F. Allow paint to dry a minimum of twenty-four hours between application of any two coats of paint on a particular surface, unless shorter time periods are a requirement by the manufacturer. Longer drying times may be required for abnormal conditions as defined by the Engineer and paint manufacturer. Do not exceed manufacturer's recommended drying time between coats.
- G. Suspend painting when any of the following conditions exist:
 1. Rainy or excessively damp weather.
 2. General air temperature cannot be maintained at 50°F or above through the drying period, except on approval by the Engineer and paint manufacturer.
 3. Unsuitable environmental conditions are expected within 1 hour of the listed "Dry to Touch" time for the coating.
 4. Surface temperature of item is within 5 degrees of dewpoint.
 5. Dew or moisture condensation are anticipated.
 6. Surface temperature exceeds the manufacturer's recommendations.

- H. Where application of coating across concrete control joints or expansion joints has the potential to crack, turn coating into joints and caulk joints with a sealant compatible with coating rated for the intended service per Section 07900 – Joint Fillers, Sealants, Caulking.
- I. All surfaces which are to be installed against concrete, masonry etc., and will not be accessible for field priming and/or painting shall be back primed and painted as specified herein, before erection. Anchor bolts shall be painted before the erection of equipment and then the accessible surfaces repainted when the equipment is painted.
- J. Painting found defective shall be scraped or sandblasted off and repainted as the Engineer may direct. Before final acceptance of the Work, damaged surfaces of paint shall be cleaned and repainted as directed by the Engineer.

3.04 INSPECTION

- A. Each field coat of paint will be inspected and approved by the Engineer or his authorized representative before succeeding coat is applied. Tint successive coats so that no two coats for a given surface are exactly the same color. Tick-mark surfaces to receive black paint in white between coats.
- B. Use magnetic dry film thickness gauges and wet film thickness gauges for quality control. Furnish magnetic dry film thickness gauge for use by the Engineer.
- C. Coatings shall pass a holiday detector test.
- D. Determination of Film Thickness: Randomly selected areas, each of at least 107.5 contiguous square feet, totaling at least 5% of the entire control area shall be tested. Within this area, at least 5 squares, each of 7.75 square inches, shall be randomly selected. Three readings shall be taken in each square, from which the mean film thickness shall be calculated. No more than 20 percent of the mean film thickness measurements shall be below the specified thickness. No single measurement shall be below 80 percent of the specified film thickness. Total dry film thickness greater than twice the specified film thickness shall not be acceptable. Areas where the measured dry film thickness exceeds twice that specified shall be completely redone unless otherwise approved by the Engineer. When measured dry film thickness is less than that specified additional coats shall be applied as required.
- E. Holiday Testing: Holiday test painted ferrous metal surfaces which will be submerged in water or other liquids, or surfaces which are enclosed in a vapor space in such structures. Holiday testing shall be in accordance with (NACE SP 0188). Mark areas which contain holidays. Repair or repaint in accordance with paint manufacturer's printed instructions and retest.
 - 1. Dry Film Thickness Exceeding 20 Mils: For surfaces having a total dry film thickness exceeding 20 mils: Pulse-type holiday detector such as Tinker & Rasor Model AP-W, D.E. Stearns Co. Model 14/20, shall be used. The unit shall be

adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the specified coating thickness.

2. Dry Film Thickness of 20 Mils or Less: For surfaces having a total dry film thickness of 20 mils or less: Tinker & Rasor Model M1 non-destructive type holiday detector, K-D Bird Dog, shall be used. The unit shall operate at less than 75-volts. For thicknesses between 10 and 20 mils, a non-sudsing type wetting agent, such as Kodak Photo-Flow, shall be added to the water prior to wetting the detector sponge.
- F. Paint manufacturer's NACE certified representative shall provide their services as required by the Engineer. Services shall include, but not be limited to, inspecting existing paint, determination of best means of surface preparation, inspection of completed work, and final inspection of painted work 11 months after the job is completed.

3.05 PROTECTION OF ADJACENT PAINT AND FINISHED SURFACES

- A. Use covers, masking tape, other method when protection is necessary, or requested by Owner or Engineer. Remove unwanted paint carefully without damage to finished paint or surface. If damage does occur, repair the entire surface adjacent to and including the damaged area without visible lapmarks and without additional cost to the Owner.
- B. Take all necessary precautions to contain dispersion of abrasive blasting debris and paint to the limits of the work. Take into account the effect of wind and other factors which may cause dispersion of the abrasive blasting debris and paint. Suspend painting operations when abrasive blasting debris or paint cannot be properly confined. Assume all responsibilities and cost associated with damage to adjacent structures, vehicles, or surfaces caused by the surface preparation and painting operations.

3.06 PIPING AND EQUIPMENT IDENTIFICATION

- A. Piping and equipment identification shall be in accordance with Section 15030 – Piping and Equipment Identification Systems.

3.07 SCHEDULE OF COLORS

- A. Match colors indicated. Piping and equipment colors are indicated in Section 15030 – Piping and Equipment Identification Systems. Colors which are not indicated shall be selected from the manufacturer's full range of colors by the Engineer. No variation shall be made in colors without the Engineer's approval. Color names and numbers shall be identified according to the appropriate color chart issued by the manufacturer of the particular product in question.

3.08 WORK IN CONFINED SPACES

- A. Provide and maintain safe working conditions for all employees. Supply fresh air continuously to confined spaces through the combined use of existing openings, forced

draft fans and temporary ducts to the outside, or direct air supply to individual workers. Exhaust paint fumes to the outside from the lowest level in the contained space. Provide explosionproof electrical fans, if in contact with fumes. No smoking or open fires will be permitted in, or near, confined spaces where painting is being done. Follow OSHA, state/commonwealth, and local regulations at all times.

3.09 OSHA SAFETY COLORS

- A. Paint wall around wall-mounted breathing or fire apparatus with the appropriate safety red color; area not to exceed 2 feet wide by 3 feet high, unless apparatus covers the area. Fire apparatus include fire hoses, extinguisher, and hydrants.
- B. Paint hazardous areas and objects in accordance with OSHA regulations.

3.10 VOC REGULATIONS

- A. Provide paint systems in accordance with local, state, and federal regulations. Where paint systems shown in schedule do not comply substitute equal products with VOC limits which comply with local, state, and federal regulations.

Table 1: Painting Schedule

Surface	Application	Painting System and No. of Coats	Product Reference (Table 2)	Total Min. Dry Film Thickness (Mils)
Concrete and Masonry				
Interior masonry and concrete walls and ceilings	All new structures	1 coat sealer 2 coats acrylic epoxy	101 116	75-85 sq.ft./gal. 4-6/coat
Interior masonry and concrete walls in chemical rooms		1 coat sealer 2 coats epoxy polyamide	117 102	60-80 sq.ft./gal. 4-6/coat
Exterior masonry cavity walls on cavity face of inner wythe	All new structures	Dampproofing	Refer to Individual Specifications	
Exterior below grade if interior is dry	Accessible areas (e.g. pipe galleries, pump rooms, basements)	Waterproofing	Refer to Individual Specifications	
Submerged water	Water retaining side of new wall surfaces where opposite side of wall is interior and dry and where indicated "epoxy waterproofing" on drawing	1 coat resurfacer at a minimum 1/16" on vertical surfaces and as needed to bring surfaces to level	121	1/16"
		2 coats NSF-600 approved epoxy polyamide	105	6-10/coat
Submerged wastewater (aerobic)		1 coat resurfacer at a minimum 1/16" on vertical surfaces and as needed to bring surfaces to level	121	1/16"
		2 coats high solids epoxy	119	5-10/coat
		1 coat urethane above the waterline, extending down 1' below the waterline.	115	2-5
Submerged wastewater (anaerobic)		1 coat resurfacer at a minimum 1/16" on vertical surfaces and as needed to bring surfaces to level	121	1/16"
		1 coat epoxy primer	128	6-10
		1 coat specialty high build epoxy	130	125
Containment Liner ¹	Interior and exterior secondary containment floors, tank supports and walls	1 coat resurfacer at a minimum 1/16" on vertical surfaces and as needed to bring surfaces to level	121	1/16"
		1 coat primer	122	6-10
		1 coat mortar with embedded fiberglass mat	123/124	60-80
		1 coat saturant coat	125	10-12
		1 coat topcoat	126	6-10

Surface	Application	Painting System and No. of Coats	Product Reference (Table 2)	Total Min. Dry Film Thickness (Mils)
Metals				
Interior and exterior nonsubmerged (gloss)	All new blowers, pumps, motors and mechanical equipment, piping, etc.	1 coat epoxy polyamide primer	104	3-6
		1 coat epoxy polyamide	104	3-6
		1 coat aliphatic polyurethane	115	3-5
Interior insulated		1 coat acrylic	103	2-3
Submerged water	All metal piping, and mechanical equipment, etc.	1 coat MIO/Zinc primer	127	2.5-3.5
		2 coats NSF-600 approved epoxy	105	6-10/coat
Submerged Wastewater (Aerobic)		1 coat MIO/Zinc primer	127	2.5-3.5
		2 coats high solids epoxy	119	6-10/coat
		1 coat urethane above the waterline, extending down 1' below the waterline.	115	3-5
Submerged Wastewater (Anaerobic)		1 coat epoxy primer	128	5-10
		1 or 2 coats specialty high build epoxy	129	25-40
Steel doors, windows and door frames, steel stairs, monorails, structural steel, misc. metals (steel), galvanized lintels,		1 tie coat	113	1-2
		2 coats aliphatic polyurethane	115	2-5/coat
Aluminum surfaces in contact with concrete		2 coats coal tar	107	26
Shop Primed Structural Steel	Pre-Engineered Buildings	1 tie coat	113	1-2
		1 coat epoxy	114	3-4
		1 coat epoxy	102	3-4
Other				
Interior: Gypsum Wallboard	All new structures	1 coat acrylic primer/sealer	131	2-3/coat
		2 coats acrylic	103	
PVC Piping		1 coat epoxy polyamine	104	2-6
		1 coat aliphatic polyurethane	115	3-5

1 Painting manufacturer shall verify compatibility of containment liner and chemical to be contained. Where incompatible substitute a compatible coating system.

Ref.	System	Purpose	Product		
			Tnemec Series	CARBOLINE	Sherwin-Williams
101	Acrylic filler	Primer-sealer	130	Sanitile 100	Cement-Plex 875
102	Epoxy polyamine	Finish coat semi-gloss or gloss	N69	Carboguard 60	Macropoxy 646
103	Acrylic	Acrylic finish	1026 or 1028 or 1029	Carbocrylic 3359DTM	DTM Acrylic Primer/Finish
104	Epoxy polyamide	Primer/intermediate/finish	66	Carboguard 60	Macropoxy 646
105	Epoxy	Primer/Finish	21	Carboguard 61/891VOC	Macropoxy 646 PW
107	Coal tar	Sealer	46H-413	Bitumastic 300M	Hi-Mil Sher Tar Epoxy
113	Urethane	Barrier coat	530	Rustbond	-
114	Polyamine Epoxy	Intermediate coat	27	Carboguard 60	Copoxxy Primer
115	Aliphatic Polyurethane	Finish coat	1094 or 1095	Carbothane 134HG	Acrolon 218HS
116	Acrylic epoxy	Finish coat	113 or 114	Sanitile 255	Water-Based Catalyzed Epoxy
117	Epoxy block filler	Sealer	1254	Sanitile 500	Kem Cati-Coat HS Epoxy Filler
119	High solids epoxy	Finish coat	104	Carboguard 890	Dura-Plate 235
121	Cementitious Epoxy	Resurfacer	218	-	-
122	Secondary Containment	Primer	201	-	-
123	Secondary Containment	Novolac Epoxy Mortar Bedcoat	239SC-MCK	-	-
124	Secondary Containment	Fiberglass Reinforcement	211-0215 or 211-0216	-	-
125	Secondary Containment	Novolac Epoxy Saturant Coat	239SC-RCK	-	-
126	Secondary Containment	Novolac Epoxy Topcoat	282	-	-
127	Submerged Metals	MIO/Zinc Urethane Primer	1	-	-
128	Severe Wastewater Finish - Metal	High Build Epoxy	435	-	-

Ref.	System	Purpose	Product		
			Tnemec Series	CARBOLINE	Sherwin-Williams
129	Severe Wastewater Finish - Metal	High Build Epoxy	435	-	-
130	Severe Wastewater Finish – Concrete	High Build Epoxy	436	-	-
131	Drywall primer/sealer	Vinyl Acrylic	51	-	-

Table 2: Product Listing

[END OF SECTION]

SECTION 11000
EQUIPMENT - GENERAL

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, test, and place in acceptable operation all mechanical equipment and all accessories as specified herein, as shown on the Drawings, and as required for a complete and operable system.
- B. The mechanical equipment shall be provided complete with all accessories, special tools, spare parts, mountings, shims, sheaves, couplings, and other appurtenances as specified, and as may be required for a complete and operating installation.
- C. The Contractor shall provide the Owner complete and operational equipment/systems. To this end, it is the responsibility of the Contractor to coordinate all interfaces with related mechanical, structural, electrical, instrumentation, and control work and to provide necessary ancillary items such as controls, wiring, etc., to make each piece of equipment operational as shown and specified.
- D. The complete installation shall be free from excessive vibration, cavitation, noise, and oil or water leaks.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. All equipment, materials, and installations shall conform to the requirements of the most recent editions with latest revisions, supplements, and amendments of the specifications, codes, and standards listed in the individual specifications.

1.03 ACTION/INFORMATIONAL SUBMITTALS

- A. Product Data: Comply with Contract Documents submittal requirements.
- B. Shop Drawings shall be submitted to the Engineer for all equipment and shall include the following additional information:
 - 1. Equipment name, identification number and specification number.
 - 2. Performance characteristics and descriptive data.
 - 3. Detailed equipment dimensional drawings and setting plans.
 - 4. Drive and motor data as required by individual specifications. Where pump and motor speeds are to be regulated by variable speed drives, the Contractor shall coordinate, furnish and exchange all necessary requirements with the respective

equipment manufacturers to ensure compatibility and shall submit pump, motor and variable speed drive shop drawings together as a complete system.

5. Information on bearing types and bearing life.
6. Gear box design and performance criteria and AGMA service factor.
7. Piping schematics.
8. Equipment protective device details and connection diagrams.
9. Panel layout drawings, schematic wiring diagrams, and component product data sheets for control panels.
10. A list of spare parts and special tools to be provided.
11. Any additional information required to demonstrate conformance with the equipment specifications.
12. Warranty documentation including statement of duration of warranty period and contact phone numbers and addresses for warranty issues.
13. Shipment, delivery, handling, and storage instructions.

1.04 CLOESOUT SUBMITTALS

- A. Submit warranty documentation.
- B. Submit Operation and Maintenance (O&M) manuals.

1.05 MAINTENANCE MATERIALS SUBMITTALS

- A. Operation and Maintenance (O&M) manuals shall be submitted in accordance with:
 1. Section 01730 – Operation and Maintenance Data.
- B. Spare parts and extra materials shall be provided in accordance with the individual specifications:
 1. For spare parts, extra stock materials, and tools, submit quantity of items specified in associated Specification Section.

1.06 QUALITY ASSURANCE SUBMITTALS

- A. Factory testing plan.
- B. Factory Test Results shall be submitted and approved prior to shipment of equipment.
- C. Field testing plan.

- D. Preliminary field test data.
- E. Final field test data.

1.07 GENERAL INFORMATION AND DESCRIPTION

- A. All parts of the equipment furnished shall, be designed and constructed for the maximum stresses occurring during fabrication, transportation, installation, testing, and all conditions of operation. All materials shall be new and shall conform to all applicable Sections of these Specifications.
- B. All parts of duplicate equipment shall be interchangeable without modification. Manufacturer's design shall accommodate all the requirements of these Specifications.
- C. Equipment and appurtenances shall be designed in conformity with specifications, codes and reference standards.
- D. All bearings and moving parts shall be protected by bushings or other Engineer approved means against wear, and provision shall be made for accessible lubrication by extending lubrication lines and fittings to approximately 30 inches above finished floor elevation.
- E. Details shall be designed for appearance as well as utility. Protruding members, joints, corners, gear covers, etc., shall be finished in appearance. All exposed welds on machinery shall be ground smooth and the corners of structural shapes shall be rounded or chamfered.
- F. Machinery parts shall conform within allowable tolerances to the dimensions shown on the working drawings.
- G. All machinery and equipment shall be safeguarded in accordance with the specifications, codes, and reference standards.
- H. All rotating shafts, couplings, or other moving pieces of equipment shall be provided with protective guards of sheet metal or wire mesh, neatly and rigidly supported. Guards shall be removable as required to provide access for repairs.
- I. All equipment greater than 100 pounds shall have lifting lugs, eyebolts, etc., for ease of lifting, without damage or undue stress exerted on its components.
- J. All manufactured items provided under this Section shall be of current manufacture and shall be the products of manufacturers specializing in the manufacture of such products.

1.08 EQUIPMENT WARRANTIES

- A. Warranty requirements shall be as specified in the individual equipment specifications.

PART 2 – PRODUCTS

2.01 ANCHORS AND SUPPORTS

- A. The Contractor shall furnish, install, and protect all necessary guides, bearing plates, anchor and attachment bolts, and all other appurtenances required for the installation of the devices included in the equipment specified. Working Drawings for installation shall be furnished by the equipment manufacturer, and suitable templates shall be used by the Contractor when required in the detailed equipment Specifications.
- B. Anchor bolts and fasteners shall be furnished in accordance with the individual equipment Specifications. All anchor bolts, guard bolts, washers, clips, clamps, and fasteners of any type shall be constructed of 316 stainless steel, unless otherwise specified the individual equipment Specifications.
- C. The Contractor shall provide all concrete pads or pedestals required for equipment furnished. All concrete equipment pads shall be a minimum of 6" high, unless otherwise shown on the Drawings and shall be doweled.
- D. Pipe sleeves or other means of adjusting anchor bolts shall be provided where indicated or required. Equipment shall be leveled by first using sitting nuts on the anchor bolts, and then filling the space between the equipment base and concrete pedestal with non-shrink grout, unless alternate methods are recommended by the manufacturer and are acceptable to the Engineer (such as shim leveling pumps, or chemical grout).
- E. Equipment anchors shall be in accordance with the manufacturer's recommendations with respect to diameter, length, spacing, quantity, and depth of embedment.

2.02 STRUCTURAL STEEL

- A. All materials shall conform to applicable provisions of the AISC Specifications for the design and fabrication of structural steel, and to pertinent ASTM Standard Specifications.

2.03 DISSIMILAR METALS

- A. All dissimilar metals shall be isolated to the satisfaction of the Engineer.

2.04 GALVANIZING

- A. Where required by the equipment specifications, galvanizing shall be performed.

2.05 STANDARDIZATION OF GREASE FITTINGS

- A. The grease fittings on all mechanical equipment shall be such that they can be serviced with a single type of grease gun. Fittings shall be "Zerk" type.

2.06 ELECTRICAL REQUIREMENTS

- A. All electrical equipment and appurtenances, including but not limited to motors, panels, conduit, and wiring, etc., specified in the equipment specifications shall comply with the applicable requirements of the individual electrical specifications and the latest National Electric Code.
- B. In the individual equipment specifications, specified motor horsepower is intended to be the minimum size motor to be provided. If a larger motor is required to meet the specified operating conditions and performance requirements, the Contractor shall furnish the larger sized motor and shall upgrade the electrical service (conduit, wires, starters, etc.) at no additional cost to the Owner.
- C. Where variable frequency drives (VFDs) are specified, the Contractor shall be responsible for coordinating between equipment supplier and VFD supplier to ensure a complete and operational system.

2.07 ACCESSORIES, SPARE PARTS, AND SPECIAL TOOLS

- A. Accessories, spare parts, and special tools shall be provided in accordance with the individual equipment specifications.

2.08 EQUIPMENT IDENTIFICATION

- A. All mechanical equipment shall be provided with a substantial stainless-steel nameplate, mechanically fastened with stainless steel hardware in a conspicuous place, and clearly inscribed with the manufacturer's name, year of manufacture, serial number, and principal rating data.
- B. Each pump and other piece of mechanical equipment shall also be identified as to name and number by a suitable laminated plastic or stainless-steel nameplate mechanically fastened with stainless steel hardware; for example, "Raw Water Pump #1". Coordinate name and number with same on remotely located controls, control panel, and other related equipment.
- C. Nameplates shall not be painted over.

PART 3 – EXECUTION

3.01 SHOP TESTING

- A. All equipment shall be tested in the shop of the manufacturer in a manner which shall conclusively prove that its characteristics comply fully with the requirements of the Contract Documents and that it will operate in the manner specified or implied.

- B. No equipment shall be shipped to the project until the Engineer has been furnished a certified copy of test results and has notified the Contractor, in writing, that the results of such tests are acceptable.
- C. A certified copy of the manufacturer's actual test data and interpreted results thereof shall be forwarded to the Engineer for review.
- D. If required by the individual equipment Specifications, arrangements shall be made for the Owner/Engineer to witness performance tests in the manufacturer's shop. The Engineer shall be notified ten working days before shop testing commences. Expenses are to be paid by Contractor.

3.02 SHIPMENT, DELIVERY, HANDLING AND STORAGE

- A. Shipment, delivery, and handling of equipment and materials shall be in accordance with individual equipment specifications and manufacturer's written instructions.
- B. Storage of equipment and materials shall be in accordance with individual equipment specifications and manufacturer's written instructions.

3.03 MANUFACTURER'S FIELD SERVICES

- A. Manufacturer's field services shall be in accordance with individual equipment specifications.
- B. The Contractor shall arrange for a qualified factory trained Technical Representative from each manufacturer or supplier of equipment who is regularly involved in the inspection, installation, start-up, troubleshooting, testing, maintenance, and operation of the specified equipment. Qualification of the Technical Representative shall be appropriate to the type of equipment furnished and subject to the approval of the Engineer and the Owner. Where equipment furnished has significant process complexity, furnish the services of engineering personnel knowledgeable in the process involved and the function of the equipment. When necessary, the Contractor shall schedule multiple Technical Representatives to be present at the same time for the purpose of coordinating the operation of multiple pieces of related equipment.
- C. Services of the Technical Representative will require a minimum of two (2) site visits, one for installation and testing and one for startup and training, and will be for the minimum number of days recommended by the manufacturer and approved by the Engineer but will not be less than the number of days specified in individual equipment sections. Additional site visits may be required as described below and in the equipment specifications.
- D. For each site visit, the Technical Representative shall submit jointly to the Owner, the Engineer, and the Contractor a complete signed report of the results of his inspection, operation, adjustments, and testing. The report shall include detailed descriptions of the

points inspected, tests and adjustments made, quantitative results obtained if such are specified.

E. The manufacturer's Technical Representative shall provide the following services.

1. Installation: The Technical Representative shall inspect the installed equipment to verify that installation is in accordance with the manufacturer's requirements. Where required by individual equipment specifications, the Technical Representative shall also supervise the installation of the equipment.
2. Testing: After installation of the equipment has been completed and the equipment is presumably ready for operation, but before it is operated by others, the Technical Representative shall inspect, operate, test, and adjust the equipment as required to prove that the equipment is in proper condition for satisfactory operation under the conditions specified. Unless otherwise noted in the signed site visit report, the report shall constitute a certification that the equipment conforms to the requirements of the Contract and is ready for startup and that nothing in the installation will render the manufacturer's warranty null and void. The report shall include date of final acceptance field test, as well as a listing of all persons present during tests.
3. Startup: The Technical Representative shall start up the equipment for actual service with the help of the Contractor. If equipment or installation problems are experienced, the Contractor and the representative shall provide the necessary services until the equipment is operating satisfactorily and performing according to the specifications at no additional cost to the Owner. Unless otherwise noted in the signed site visit report, the report shall constitute a certification that the equipment conforms to the requirements of the Contract and is ready for permanent operation and that nothing in the installation will render the manufacturer's warranty null and void.
4. Training: Training shall be provided in accordance with individual equipment specifications.
5. Services after Startup: Where required by the individual equipment specifications, the Technical Representative shall return to the project site thirty (30) days after the startup date to review the equipment performance, correct any equipment problems, and conduct operation and maintenance classes as required by the Owner. This follow-up trip is required in addition to the specified services of Technical Representative prior to and during equipment startup. At this time, if there are no equipment problems, each manufacturer shall certify to the Owner in writing that his equipment is fully operational and capable of meeting operating requirements. If the equipment is operating incorrectly, the Technical Representative will make no certification to the Owner until the problems are corrected and the equipment demonstrates a successful thirty (30) days operating period.

- F. The Contract amount shall include the cost of furnishing the Technical Representative for the minimum number of days specified, and any additional time required to achieve successful installation and operation. The times specified for services by the Technical Representative in the equipment Specifications are exclusive of travel time to and from the facility and shall not be construed as to relieve the manufacturer of any additional visits to provide sufficient service to place the equipment in satisfactory operation.
- G. The Contractor shall notify the Engineer at least 14 days in advance of each equipment test or Owner training session.
- H. The Technical Representative shall sign in and out at the office of the Engineer's Resident Project Representative on each day the Technical Representative is at the project.

3.04 INSTALLATION

- A. The Contractor shall obtain written installation manuals from the equipment manufacturer prior to installation. Equipment shall be installed strictly in accordance with recommendations of the manufacturer. A copy of all installation instructions shall be furnished the Engineer's field representative one week prior to installation.
- B. The Contractor shall have on hand sufficient personnel, proper construction equipment, and machinery of ample capacity to facilitate the work and to handle all emergencies normally encountered in work of this character. To minimize field erection problems, mechanical units shall be factory-assembled insofar as practical.
- C. Equipment shall be erected in a neat and workmanlike manner on the foundations at the locations and elevations shown on the Drawings.
- D. All equipment sections and loose items shall be match-marked prior to shipping.
- E. For equipment that requires field alignment and connections, the Contractor shall provide the services of the manufacturer's qualified mechanic, millwright, or machinist, to align the equipment and motor prior to making piping connections or anchoring the equipment base. Alignment shall be as specified herein.
- F. The Contractor shall furnish oil and grease for initial operation and testing. The manufacturer and grades of oil and grease shall be in accordance with the recommendations of the equipment manufacturer.

3.05 ALIGNMENT

- A. Set equipment to dimensions shown on drawings. Dimensions shall be accurate to +/- 1/16 inch unless otherwise noted on the drawings. Wedges shall not be used for leveling, aligning, or supporting equipment.
- B. General Equipment Leveling: Non-rotating equipment shall be set level to +/- 1/16 inch per 10-foot length (.005 inch per foot) unless otherwise noted on the drawings. Shims

shall be used unless equipment is furnished with leveling feet. Set shims flush with equipment baseplate edges. When grouting is required, equipment shall be shimmed to allow a minimum of one-inch grout thickness. Grout shall cover shims at least 3 inches. Final level check shall be held for inspection and approval by Engineer before proceeding.

C. Grouting

1. Fill anchor bolt holes or sleeves with grout, after bolt alignment is proven, and prior to placing grout under equipment bases.
2. Surface Preparation. Roughen surface by chipping, removing laitance, and unsound concrete. Clean area of all foreign material such as oil, grease, and scale. Saturate area with water at least 4 hours prior to grouting, removing excess water ponds.
3. Application. Place grout after the equipment base has been set and its alignment and level have been approved. Form around the base, mix grout, and place in accordance with the grout manufacturers published instructions. Eliminate all air or water pockets beneath the base using a drag chain or rope.
4. Finishing. Point the edges of the grout to form a smooth 45-degree slope.
5. After grout has cured (not before 3 days after placement) paint exposed surfaces of grout with shellac.
6. Level Verification. After grout has cured, and immediately prior to drive alignment, recheck equipment for level and plumb. Re-level and square as necessary. Hold final checks for inspection and approval by Engineer.

D. Inspect for and remove all machining burrs or thread pulls in female holes on mating surfaces of mounting frame and machine feet.

E. Inspect and clean equipment mounting base pads, feet, and frames to remove all grease, rust, paint, and dirt.

F. Assembled equipment shafts shall be set level to .0015 inches per foot of shaft length (+/- .0005 inches) up to a maximum of 0.015 inches for any length shaft unless the manufacturers requirements are more stringent or unless otherwise noted in the equipment specifications. Use the machined surfaces on which the equipment sets for the base/mounting frame leveling plane. Use the machined shaft surface for equipment leveling plane.

G. Sprocket and Sheave Alignment. Check shaft mounted components for face runout and eccentricity (outside diameter) runout by magnetically mounting a dial indicator on a stationary base and indicating over 360 degrees on a continuous machined surface at

the outside diameter of the component. Maximum allowable total indicated face runout and eccentricity for sprockets and sheaves will be per ANSI Standard B29.1-1975.

- H. Belt tensioning. Set drive belt tension to manufacturer's specification for the belt type. Recheck alignment after drive tensioning.
- I. Thermal/Mechanical Growth. Thermal/mechanical growth corrections for driver and driven machines will be used in vertical and horizontal alignment where applicable. The equipment manufacturer will determine thermal/mechanical growth applicability for any machine and provide the correction offsets to be used.
- J. Rotating Shaft Alignment
 - 1. Fixtures will be set up on the driver and driven machine, machines shaft surfaces. Machined coupling hubs may be used only if there is no clearance to mount fixtures directly on the shafts.
 - 2. Primary alignment method for direct drive machines is when coupled. Uncoupled alignment will be used only when approved by the Engineer.
 - 3. Account for possible coupling flex by always rotating coupled machines in the same direction during alignment.
 - 4. Uncoupled machines must be connected so that both shafts turn together without relative motion during alignment.
 - 5. Indicator bar sag will be measured and included for each reverse indicator alignment setup.
 - 6. Reverse Dial Indicator. The final maximum allowable misalignment: vertical and horizontal from the desired targets of .000 inches (for a non-thermal growth machine) or from the given target readings (for a thermal growth machine) must meet both of the following conditions simultaneously: 1/2 the final total indicator reading at each indicator will be no more than shown in the table below and the final remaining correction at each machine foot be no more than .001 inches of required movement.

Machine Speed (RPM)	Total Misalignment* (inches)
Up to 1800	.002
1800 and greater	.001

* 1/2 indicator reading

3.06 FIELD TESTING

- A. Field testing shall be in accordance with the individual equipment specifications.
- B. All equipment shall be set, aligned, and assembled in conformance with the manufacturer's drawings and instructions. Provide all necessary calibrated instruments to execute performance tests. Submit report certified by the pump manufacturer's representative.
- C. Preliminary Field Tests, Yellow Tag
 - 1. As soon as conditions permit, after the equipment has been secured in its permanent position, the Contractor shall:
 - a. Verify that the equipment is free from defects.
 - b. Check for alignment as specified herein.
 - c. Check for direction of rotation.
 - d. Check motor for no load current draw.
 - 2. Contractor shall flush all bearings, gear housings, etc., in accordance with the manufacturer's recommendations, to remove any foreign matter accumulated during shipment, storage or erection. Lubricants shall be added as required by the manufacturer's instructions.
 - 3. When the Contractor has demonstrated to the Engineer that the equipment is ready for operation, a yellow tag will be issued. The tag will be signed by the Engineer, or his assigned representative and attached to the equipment. The tag shall not be removed.
 - 4. Preliminary field tests, yellow tag, must be completed before equipment is subjected to final field tests, blue tag.
- D. Final Field Tests, Blue Tag
 - 1. Upon completion of the above, and at a time approved by the Engineer, the equipment will be tested by operating it as a unit with all related piping, ducting, electrical and controls, and other ancillary facilities.
 - 2. The equipment will be placed in continuous operation as prescribed or required and witnessed by the Engineer or his assigned representative and the Owner or his assigned representative.
 - 3. The tests shall prove that the equipment and appurtenances are properly installed, meet their operating cycles and are free from defects such as overheating,

overloading, and undue vibration and noise. Operating field tests shall consist of the following:

- a. Check equipment for excessive vibration and noise as specified herein.
 - b. Check motor current draw under load conditions. The rated motor nameplate current shall not be exceeded.
 - c. Recheck alignment with dial indicators where applicable, after unit has run under load for a minimum of 24 hours.
- E. Additional field testing recommended by the manufacturer shall be performed at no cost to Owner.
- F. Until final field tests are acceptable to the Engineer, the Contractor shall make all necessary changes, readjustments, and replacements at no additional cost to the Owner.
- G. Upon acceptance of the field tests, a blue tag will be issued. The tag will be signed by the Engineer and attached to the unit. The tag shall not be removed, and no further construction work will be performed on the unit, except as required during start-up operations and directed by the Engineer.
- H. Defects which cannot be corrected by installation adjustments will be sufficient grounds for rejection of any equipment.
- I. All costs in connection with field testing of equipment such as lubricants, temporary instruments, labor, equipment, etc., shall be borne by the Contractor. Power, fuel, chemicals, water, etc. normally consumed by specific equipment shall be supplied by the Owner unless otherwise specified in the individual equipment specifications.
- J. The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the Owner formally takes over the operation thereof.
- K. Field testing of electric motors shall be in accordance with individual electrical and equipment specifications.

3.07 VIBRATION TESTING

- A. Vibration testing shall be in accordance with individual equipment specifications.

3.08 FAILURE OF EQUIPMENT TO PERFORM

- A. Any defects in the equipment, or failure to meet the guarantees or performance requirements of the Specifications shall be promptly corrected by the Contractor by replacements or otherwise.

- B. If the Contractor fails to make these corrections, or if the improved equipment shall fail again to meet the guarantees or specified requirements, the Owner, notwithstanding his having made partial payment for work and materials which have entered into the manufacture of said equipment, may reject said equipment and order the Contractor to remove it from the premises at the Contractor's expense.
- C. The Contractor shall then obtain specified equipment to meet the contract requirements or upon mutual agreement with the Owner, adjust the contract price to reflect not supplying the specific equipment item.
- D. In case the Owner rejects said equipment, then the Contractor hereby agrees to repay to the Owner all sums of money paid to him for said rejected equipment on progress certificates or otherwise on account of the lump sum prices herein specified.
- E. Upon receipt of said sums of money, the Owner will execute and deliver to the Contractor a bill of sale of all his rights, title, and interest in and to said rejected equipment; provided, however, that said equipment shall not be removed from the premises until the Owner obtains from other sources other equipment to take the place of that rejected.
- F. Said bill of sale shall not abrogate Owner's right to recover damages for delays, losses, or other conditions arising out of the basic contract.

3.09 PAINTING

- A. All surface preparation, shop painting, field repairs, finish painting, and other pertinent detailed painting specifications shall conform to applicable paragraphs of Section 09900 – Painting.
- B. All shop coatings shall be compatible with proposed field coatings.
- C. All inaccessible surfaces of the equipment, which normally require painting, shall be finished painted by the manufacturer. The equipment and motor shall be painted with a high-quality epoxy polyamide semi-gloss coating specifically resistant to chemical, solvent, moisture, and acid environmental conditions, unless otherwise specified.
- D. Gears, bearing surfaces, and other unpainted surfaces shall be protected prior to shipment by a heavy covering of rust-preventive compound sprayed or hand applied which shall be maintained until the equipment is placed in operation. This coating shall be easily removable by a solvent.

3.10 WELDING

- A. The Equipment Manufacturer's shop welding procedures, welders, and welding operators shall be qualified and certified in accordance with the requirement of AWS D1.1 "Structural Welding Code - Steel" or AWS D1.2 "Structural Welding Code - Aluminum" of the American Welding Society, as applicable.

- B. The Contractor's welding procedures, welders, and welding operators shall be qualified and certified in accordance with the requirements of AWS D1.1 "Structural Welding Code - Steel" or AWS D1.2 "Structural Welding Code - Aluminum" of the American Welding Society, as applicable.
- C. The Contractor shall perform all field welding in conformance with the information shown on the Equipment Manufacturer's drawings regarding location, type, size, and length of all welds in accordance with "Standard Welding Symbols" AWS A2.0 of the American Welding Society, and special conditions, as shown by notes and details.

[END OF SECTION]

SECTION 11100
PUMPS – GENERAL

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Comply with the requirements of Section 11000, Equipment - General.
- B. The pumps shall be provided complete with all accessories, special tools, spare parts, mountings, shims, sheaves, couplings, and other appurtenances as specified, and as may be required for a complete and operating installation.
- C. The provisions of this section shall apply to all pumps and pumping equipment specified except where specifically noted otherwise in the Contract Documents.
- D. All pumps provided under an individual specification section shall be by the same manufacturer unless otherwise indicated in the specification.
- E. All equipment for the pumps, including motors, cans and bases, shall be provided as a complete unit by the pump Manufacturer.
- F. The pump supplier shall have unit responsibility for coordinating the proper pump mounting system with the Contractor to ensure stable pump operation free from abnormal vibration.
- G. The pump supplier shall include, in his bid, time, labor, materials and tools required for installation assistance, testing and start-up with the Contractor.

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. All equipment, materials, and installations shall conform to the requirements of the most recent editions with latest revisions, supplements, and amendments of the specifications, codes, and standards listed in the individual specifications.
- B. Pumping system equipment, installation and testing shall be in accordance with the following applicable codes and standards. All standards shall be the latest version as of the date of project bidding.

1. Hydraulic Institute

- a. ANSI/HI 3.1-3.5 Rotary Pumps for Nomenclature, Definitions, Application and Operation
- b. ANSI/HI 3.6 Rotary Pump Test
- c. ANSI/HI 9.6.1 Rotodynamic Pumps – Guideline for NPSH Margin

- d. ANSI/HI 9.6.2 Rotodynamic Pumps for Assessment of Applied Nozzle Loads
 - e. ANSI/HI 9.6.3 Rotodynamic Pumps – Guideline for Operating Regions
 - f. ANSI/HI 9.6.4 Rotodynamic Pumps for Vibration Measurements and Allowable Values
 - g. ANSI/HI 9.6.5 Rotodynamic Pumps Guideline for Condition Monitoring
 - h. ANSI/HI 9.6.6 Rotodynamic Pumps for Pump Piping
 - i. ANSI/HI 9.6.8 Rotodynamic Pumps -Guideline for Dynamics of Pumping Machinery
 - j. ANSI/HI 9.8 Rotodynamic Pumps for Pump Intake Design
 - k. ANSI/HI 11.6 Rotodynamic Submersible Pumps for Hydraulic Performance, Hydrostatic Pressure, Mechanical and Electrical Tests
 - l. ANSI/HI 12.1-12.6 Rotodynamic Slurry Pump for Nomenclature, Definitions, Applications and Operation
 - m. ANSI/HI 14.1-14.2 Rotodynamic Pumps for Nomenclature and Definitions
 - n. ANSI/HI 14.3 Rotodynamic Pumps for Design and Application
 - o. ANSI/HI 14.6 Rotodynamic Pumps for Hydraulic Performance Acceptance Tests
- 2. American Society of Mechanical Engineers
 - a. ANSI/ASME B73.1 Specifications for Horizontal End Suction Centrifugal Pumps for Chemical Process
- 3. American Petroleum Institute
 - a. ANSI/API Standard 610 Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries
- 4. American Water Works Association
 - a. ANSI/AWWA E103 Standard for Horizontal and Vertical Line-Shaft Pumps
- 5. American Society for Testing and Materials
 - a. A36 Specification for Structural Steel
 - b. A48 Specification for Gray Iron Castings

- c. A53 Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - d. A148 Specification for Steel Castings, High Strength, for Structural Purposes
 - e. A193 Specification for Alloy Steel and Stainless Steel Bolting Materials for High Temperature Service
 - f. A276 Specification for Stainless Steel Hot/Cold-Finished Bars
 - g. A322 Specification for Steel Bars, Alloy, Standard Grades
 - h. A514 Specification for High Yield Strength, Quenched and Tempered alloy Steel Plate, Suitable for Welding
 - i. A532 Specification for Abrasion-Resistant Cast Irons
 - j. A536 Specification for Ductile Iron Castings
 - k. A565 Specification for Martensitic Stainless Steel Bars
 - l. A582 Specification for Free-Machining Stainless and Heat-Resisting Steel Bar, Hot-Rolled and Cold-Rolled
 - m. A743 Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel and Nickel-Base, Corrosion-Resistant for General Application
 - n. B148 Specification for Aluminum-Bronze Sand Castings
 - o. B584 Specification for Copper Alloy Sand Castings for General Application
- 6. American National Standards Institute
 - a. B16.1 Standard for Cast Iron Pipe Flanges and Flanged Fittings
 - b. B16.5 Standard for Pipe Flanges and Flanged Fittings
 - 7. ANSI/NFPA 70 National Electric Code
 - 8. Society of Automotive Engineers SAE J404 Chemical Compositions of SAE Alloy Steels
 - 9. Standard, ISO 1940 – Mechanical Vibration – Balance quality requirements for rotors balance quality grade for rotors in a constant rigid state.

1.03 ACTION/INFORMATIONAL SUBMITTALS

- A. Provide submittals identified in Specification Section 11000, Equipment General Provisions in addition to the submittals identified herein and in addition to the submittals identified in the individual pumping specification sections.
- B. Shop Drawings shall include the following information in addition to the requirements specified elsewhere in the Contract Documents and shall include the following information:
 - 1. Pump name, identification number, and specification number.
 - 2. Performance characteristics and descriptive data, including but not limited to pump performance curves at rated speed and reduced speeds (if reduced speeds are specified). Curves shall indicate flow, head, impeller diameter, efficiency, brake horsepower, and NPSH required. Curves shall identify minimum continuous stable flow (minimum flow to avoid suction recirculation), preferred operating region (POR) and allowable operating region (AOR) per the latest version of ANSI/HI 9.6.3. Performance curves submitted shall be for the entire pump assembly, including efficiency corrections and losses. Pump performance curves shall be submitted both in the form of performance data cut sheets and in tabular format. Tabular data shall include the following:
 - a. Flow
 - b. Pump Head
 - c. NPSH required
 - d. Pump Efficiency
 - e. A minimum of 10 data points shall define rotodynamic pump performance curves listed above. Performance curve data points shall include the following:
 - 1) best efficiency point
 - 2) all specified operating points
 - 3) preferred operating range minimum and maximum
 - 4) allowable operating range minimum and maximum
 - 5) shutoff condition
 - 6) runout.

- 7) The remainder of the points shall be distributed evenly to clearly define the shape of each of the curves.
 - 8) Each data point shall be reported to a minimum of three (3) significant figures.
 - 9) The curve data shall align with the HI acceptance grade (1B, 2B, 1U, etc.) as specified in the individual pump specification and shall explicitly state the applicable tolerance band, as defined by the Hydraulic Institute Standards, associated with each value.
3. Minimum submergence requirements shall be provided for vertically suspended pumps and submersible pumps.
4. Detailed dimensional drawings and setting plans including but not limited to:
 - a. General cutaway sections
 - b. Materials
 - c. Dimension of shaft projections
 - d. Shaft and keyway dimensions
 - e. Shaft diameter
 - f. Shaft-impeller connection details
 - g. Dimension between bearings
 - h. General dimensions of pump
 - i. Suction head bolt orientation
 - j. Anchor bolt locations
 - k. Forces.
 - l. Assembly views
 - m. Provide weight of entire pump assembly, including motor and base weight of individual major subassemblies. Indicate the weight of each component, and total static and dynamic loads imparted by the equipment to the supporting structure.
 - n. Impeller
 - o. Drawings shall identify each component by tag number to which the catalog data and detail sheets pertain.

5. Complete motor data shall include but not be limited to size, make, type and characteristics along with wiring diagrams. Where pump and motor speeds are to be regulated by variable speed drives, the Contractor shall coordinate, furnish, and exchange all necessary requirements with the respective equipment manufacturers to ensure compatibility and shall submit pump, motor, and variable speed drive shop drawings together as a complete system.
 6. Information on bearing types and bearing life.
 7. Gear box design and performance criteria and AGMA service factor.
 8. Equipment protective device details and connection diagrams.
 9. Details of shaft sealing system including seal/packing type, seal water control devices, and seal water piping schematic.
 10. Information on pump appurtenances including couplings, shaft guards, v-belt drive systems, etc.
 11. Submersible pump submittals shall also include:
 - a. Product data sheets for power and control cables, length of cables and cable support system.
 - b. Details on pump guide rail system and mounting requirements.
 - c. Minimum allowable pump submergence
 - d. Details on submersible pump's retrieval system.
 12. Any additional information required to demonstrate compliance with the specifications.
- C. Results of structural, lateral, and torsional dynamic analyses as required herein and in the individual specification sections.
- D. Shipment, Delivery, Handling and Storage instructions.
- E. Installation instructions.
- F. Manufacturer's literature and brochures
- G. Lubrication Information: Complete lubrication instructions and lubricant schedule, including manufacturer's recommended lubricant. All lubricants shall be food grade, NSF 61 approved. Schedule shall include frequency of lubricant application, type of lubricant, and instructions regarding lubricant application

- H. Materials of construction and associated specifications (such as AISI, ASTM, SAE, etc.), including grade and type.
- I. Coatings: Coating system data and description of coating system, surface preparation and shop painting, including certification that the shop paint is compatible with the finish paint.

1.04 CLOSEOUT SUBMITTALS

- A. Submit warranty documentation in accordance with the Contract Documents.
- B. Operation and Maintenance (O&M) manuals shall be submitted in accordance with:
 - 1. Section 01730 – Operation and Maintenance Data.
 - 2. Section 11000 – Equipment - General.

1.05 QUALITY ASSURANCE SUBMITTALS

- A. Factory testing plan.
- B. Factory Test Results shall be submitted and approved prior to shipment of equipment.
- C. Field testing plan.
- D. Preliminary field test data.
- E. System field quality control testing.
- F. Final field test data.
- G. Certified test reports.
- H. Startup report including data substantiation of successful completion of 30-day operational demonstration of performance.

1.06 GENERAL INFORMATION AND DESCRIPTION

- A. Comply with Section 11000, Equipment – General.

1.07 WARRANTY

- A. Warranty requirements shall be as specified in the individual equipment specifications.
- B. Comply with the Equipment Warranties requirements specified in Section 11000, Equipment.

1.08 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS:

- A. When operating at the maximum output speed each pump shall have a characteristic performance curve which meets the conditions listed in the pump schedule. The pumps and drive motors shall be capable of operating satisfactorily under the full-range of speed, flow and pressure conditions as defined by the pump schedule. Pump efficiency as defined herein shall include all mechanical losses from bearings and shaft seals.
- B. Each pumping unit and its driving equipment shall be designed and constructed to withstand the maximum turbine run-away speed of the unit due to backflow through the pump with the primary TDH specified available at the pump discharge flange. Maximum reverse run-away speed shall not exceed 130 percent of the design operating speed.
- C. Pump manufacture shall certify a Minimum Continuous Stable Flow (MCSF) rating at maximum speed that is lower than the specified minimum operating flow. Where a reduced speed operating condition is specified, the manufacturer shall also certify MCSF at the pump speed required to meet this condition.
- D. Factory test acceptance grade for rating point shall be as specified herein, except where superseded via specification and/or scheduled values in the individual pump specifications, however power required shall not exceed the rated motor horsepower.
- E. Pump Operating Conditions: Refer to respective individual pump specifications for specific performance requirements.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Performance Curves: All centrifugal pumps shall have a continuously rising curve. In no case shall the required horsepower at any point on the performance curve exceed the rated horsepower of the motor or drive. Safety factors will not be considered in determining compliance with this requirement.
- B. Suction and discharge flanges shall conform to ASME B16.1 or B16.5 dimensions.
- C. For pumps in raw sewage service and as required by individual pump specifications, handholes shall be provided on the pump suction nozzle and the pump volute and shall be shaped to follow the contours of the casing or adjoining piping to avoid any obstructions in the water passage.
- D. The minimum ABMA L10 bearing life for all pump, motor and drive bearings shall be 60,000 hours unless otherwise specified in the individual pump specification sections.

2.02 ANCHORS AND SUPPORTS

- A. Comply with the following Specification Sections:

1. Specification Section 11000, Equipment - General.
 2. Comply with individual pump specifications.
- B. Comply with ACI 351.3R-04 – Foundations for Dynamic Equipment.

2.03 DEFAULT MATERIALS

- A. Pumps shall be constructed out of the materials specified in respective individual pumping specification sections. Material not specifically called for shall be high-grade, standard commercial quality, free from all defects and imperfection that might affect the serviceability of the product for the purpose for which it is intended, and shall conform to the following requirements unless otherwise specified in individual pumping equipment Specifications:

Component	Material
Casings and Bowls	Close-grained gray cast iron, conforming to ASTM A 48, or equal
Impellers	ASTM B 148, aluminum bronze
Shafts, wetted	Type 400 series stainless steel
Shafts, non-wetted	AISI 4140 steel
Miscellaneous stainless steel parts	Type 316 series stainless steel
Anchor Bolts and Fasteners	Type 316 stainless steel

2.04 COMPONENTS:

- A. Refer to individual specification sections for specific requirements.
- B. Pump Shaft:
1. The shaft shall be heat treated, turned, ground, and polished over its entire length and shall be provided with keyways on both ends.
 2. Shall be sufficiently large in diameter to safely transmit the maximum torque developed by the drive unit and provide a rigid support for the impeller to prevent excessive vibration.
- C. Bearings:
1. Bearings shall be designed for continuous heavy duty loads and for both axial and radial thrust loads.
 2. The specified AFBMA B-10 life for bearings shall be under worst possible operating conditions.

3. Bearings shall support the shaft and the complete rotating elements.

2.05 STRUCTURAL STEEL

- A. Structural steel used for fabricating equipment supports, etc. shall conform to applicable provisions of the AISC Specifications for the design and fabrication of structural steel, and to pertinent ASTM Standard Specifications

2.06 DISSIMILAR METALS

- A. All dissimilar metals shall be isolated to the satisfaction of the Engineer.

2.07 GALVANIZING

- A. Where required by the equipment specifications, galvanizing shall be performed.

2.08 STANDARDIZATION OF GREASE FITTINGS

- A. Grease Fittings: Comply with Section 11000, Equipment - General.

2.09 APPURTENANCES

- A. Seals:

1. Mechanical seals shall be furnished as specified in individual pumping equipment sections.
2. If the pump manufacturer recommends a better seal or alternate flushing arrangement for a specific application, the substitution may be submitted to the Engineer for approval in accordance with the Contract Documents.

- B. Pressure Gauges:

1. Contractor shall supply all pressure gauges for all pumps by one manufacturer.
2. Gauges shall be provided through the instrumentation subcontractor to match other gauges on the project.
3. All gauges shall be provided with diaphragm seals or isolating ring seals.
4. The Contractor shall furnish and install pressure gauges as shown on the Drawings, but the following gauges shall be provided as a minimum:
 - a. On the suction and discharge of each pump, except wet-pit submersible pumps and vertical turbine pumps.
 - b. On the discharge piping of each wet-pit submersible pump and vertical turbine pump in the locations shown on the Drawings or as directed by the Engineer.

5. Gauge ranges shall be coordinated with the pump manufacturer and shall meet the following requirements, except where otherwise specified:

Location	Type	Graduation	Suction Range	Discharge Range
Suction	Single Scale, Compound	FT H20	-34-FT	+34-FT
Discharge	Single Scale	FT H20	0-FT	Greatest of the following: - Shutoff + 5-FT - 130% of Maximum

C. Shaft Couplings:

1. Except as otherwise specified in individual pump specification sections, flexible couplings for direct driven pumps shall be as manufactured by Falk, Dodge, Woods Corp., or equal and shall be furnished with guards in accordance with OSHA Rules and Regulations.
2. Spacer couplings shall be provided where necessary to allow removal of the pump rotating element without disturbing the driver.
3. Comply with protective guard requirements of Section 11000, Equipment - General.

D. Equipment Guards: Provide guards in accordance with OSHA requirements for all rotating assemblies that would otherwise be exposed at the operating deck level.

E. Provide access to:

1. Couplings
2. Oil drains

2.10 ELECTRICAL REQUIREMENTS

- A. All electrical equipment and appurtenances, including but not limited to motors, panels, conduit and wiring, etc., specified in the equipment specifications shall comply with the applicable requirements of the individual electrical specifications and the latest National Electric Code.
- B. All pumps shall be furnished with motors such that the motor shall not be overloaded throughout the full range of the pump operation. The use of service factor will not be allowed in determining overloaded condition.
- C. In the individual pump specifications, specified motor horsepower is intended to be the minimum size motor to be provided. If a larger motor is required to meet the specified operating conditions and performance requirements, the Contractor shall furnish the

larger sized motor and shall upgrade the electrical service (conduit, wires, starters, etc.) at no additional cost to the Owner.

- D. Where variable frequency drives (VFDs) are specified, the Contractor shall be responsible for coordinating between pump supplier and VFD supplier to ensure a complete and operational system.

2.11 SPARE PARTS AND SPECIAL TOOLS

- A. Accessories, spare parts, and special tools shall be provided in accordance with the individual equipment specifications.
- B. Spare parts for equipment shall be furnished where indicated in the equipment Specifications and/or where recommended by the equipment manufacturer.
- C. Spare parts shall be identical and interchangeable with original parts.
- D. The Contractor shall furnish a one-year supply of all recommended lubricating oils and greases.

2.12 EQUIPMENT IDENTIFICATION

- A. Comply with the requirements of Section 11000, Equipment - General.
- B. All pumps shall be provided with a substantial stainless steel nameplate, mechanically fastened with stainless steel hardware in a conspicuous place, and clearly inscribed with:
 - 1. the manufacturer's name
 - 2. year of manufacture
 - 3. model number
 - 4. serial number
 - 5. and principal rating data including the following at the primary design point:
 - a. Capacity in gallons per minute
 - b. rated total dynamic head
 - c. speed in rotations per minute
 - d. efficiency at the primary design point.
- C. Each pump shall also be identified as to name and number by a suitable laminated plastic or stainless steel nameplate mechanically fastened with stainless steel hardware;

for example, "Raw Water Pump – 1 (RWP-1)". Coordinate name and number with same on remotely located controls, control panel, and other related equipment.

- D. Nameplates shall not be painted over.

PART 3 – EXECUTION

3.01 SHOP TESTING

- A. The terms Shop Testing and Factory Testing shall be considered to be interchangeable.
- B. Perform Shop Testing in conformance with Section 11000, Equipment - General.
- C. The Contractor shall be responsible for the coordination of factory testing of each pump, variable speed drive, and motor. Pump tests shall utilize the actual motors and pump motor bases and couplings to be furnished with the pumping equipment. Where required as indicated by the individual pump specification sections, variable speed pumps shall be tested with the actual variable speed controllers supplied for the project. Use of the pump manufacturers standard test motors and test stand is not acceptable.
- D. Factory testing shall be conducted in accordance with the latest version of Hydraulic Institute Standard 14.6, Hydraulic Performance Acceptance Tests. For submersible pumps, testing shall be conducted in accordance with the latest version of ANSI/HI 11.6.
- E. Hydraulic Performance Acceptance Tests
 1. The testing procedure shall be submitted to the Engineer for review and approval before scheduling the testing. The Owner/Engineer shall be given at least 2 weeks advanced notice of the scheduled testing date.
 2. Notification and payment of expenses for witness testing shall be as described in Section 11000, Equipment - General wherever individual pump specifications call for witness testing.
 3. Pump rating point shall be within the tolerances specified for Acceptance Grade 1U unless otherwise specified in the individual pump specifications.
 4. Factory performance test shall include a minimum of seven test points between shutoff and runout.
 5. Where required by the individual equipment specification sections, NPSH tests shall be conducted to demonstrate compliance with the specified NSPH requirements. Where full curve NPSH testing is required, a minimum of four points shall be tested.
 6. Certified test curves shall be provided for all centrifugal pumps unless otherwise specified in the individual pump specifications.

- a. Certified tests will not be required for submersible sump pumps with motors less than 5 hp.
 - b. Certified curves shall identify minimum continuous stable flow (minimum flow to avoid suction recirculation) and preferred operating region (POR) and allowable operating region (AOR) per the latest version of ANSI/HI 9.6.3.
- 7. Where required by the individual pump specification sections, factory vibration testing shall be performed to demonstrate compliance with HI 9.6.4.
- 8. For wet pit submersible pumps and vertical turbine pumps, all tests shall be run at minimum pump submergence specified in the individual pump specifications.
- 9. All instruments shall be calibrated as required by ANSI/HI 14.6 or 11.6 as applicable.
- F. Where required in the individual pump specifications, a certified hydrostatic test shall be completed on each pumping unit in accordance with ANSI/HI 14.6 or 11.6 as applicable. Test pressure shall be 1.5 times maximum operating head or 1.25 times shutoff head, whichever is greater.
- G. Where required in the individual pump specifications, each individual casting shall be Brinnell tested in a minimum of two places, in an area of representative casting thickness to ASTM Method E-10. Results shall be certified by a registered professional ENGINEER.
- H. Shop testing of electric motors shall conform to:
 - 1. Section 11000, Equipment - General.

3.02 SHIPMENT, DELIVERY, HANDLING AND STORAGE

- A. Shipment, delivery and handling of equipment and materials shall be in accordance with individual specifications and manufacturer's written instructions.
- B. Storage of equipment shall be in accordance with individual specifications and manufacturer's written instructions.
- C. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.
- D. Machined surfaces of all exposed pump openings or other exposed unpainted surfaces shall be protected by wooden blanks or Cosmoline, as appropriate, strongly built and securely bolted thereto.
- E. After hydrostatic or other tests, all entrapped water shall be drained prior to shipment, and proper care shall be taken to protect parts from the entrance of water during shipment, storage and handling.

3.03 MANUFACTURER'S FIELD SERVICES

- A. Manufacturer's field services shall be in accordance with individual equipment specifications.
- B. Unless otherwise referenced in the individual pump specification section, as a minimum the services of the manufacturer's representative shall be provided for as stated in the following schedule:

Service	Number of Trips	Number of Days/Trip
Installation and Testing	1	2
Startup and Training	1	2
Services after Startup	1	1

- C. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor.

3.04 INSTALLATION

- A. Pumping equipment shall be installed in accordance with Section 11000, Equipment General, the manufacturer's recommendations, accepted procedures submitted with the shop drawings and as indicated on the Drawings, unless otherwise accepted by the Engineer.
- B. Level pump and motor and grout feet or baseplate with non-shrink grout. Ensure minimum grout depth is obtained as recommended by the pump and grout manufacturers.
- C. Drains: All gland seals, air valves, and drains shall be piped to the nearest floor drain or trench drain with stainless steel pipe or copper tube (as appropriate for the environment), properly supported with brackets.
- D. Contractor shall have unit responsibility for the proper coordination, sizing, and installation of the pump foundation/mounting requirements based on the manufacturer's recommendations, subject to Engineer's review and comment.

3.05 ALIGNMENT

- A. Pumping equipment shall be aligned in accordance with Section 11000, Equipment - General, the manufacturer's recommendations, accepted procedures submitted with the shop drawings and as indicated on the Drawings.

- B. Equipment shall be aligned and free from binding, scraping, excessive vibration, shaft runout, or other defects. Pump drive shafts shall be measured just prior to assembly to ensure correct alignment without forcing.
- C. As a minimum, comply with International Standard, ISO 1940 – Mechanical Vibration – Balance quality requirements for rotors balance quality grade for rotors in a constant rigid state.

3.06 FIELD TESTING

- A. Comply with Section 11000, Equipment - General for applicable preliminary and final field testing requirements supplementary to those described in this specification.
- B. All pumping units shall be field tested after installation, in accordance with the Contract Documents, to demonstrate satisfactory operation over the full operating speed range, without excessive noise, vibration, cavitation, and overheating of the bearings. The field testing shall be performed in the presence of an experienced field representative of the manufacturer of each major item of equipment, who shall supervise the following tasks and shall certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation:
 - 1. Pumps shall be tested for vibration over the full specified speed range. Unless otherwise required by individual specification sections, vibration shall be within the limits identified in the latest version of ANSI/HI 9.6.4 (or ANSI/HI 11.6 for submersible pumps), or manufacturer's limits if more stringent. If vibration is greater than 80% of the limits identified in ANSI/HI 9.6.4, follow-up vibration testing shall be completed after a 90-day break-in period to ensure that vibration remains within ANSI/HI 9.6.4 allowable limits. If vibration exceeds the allowable limits during the follow up testing, modifications shall be made as a warranty repair.
 - 2. Bearing temperatures shall be determined. A running time of at least 20 minutes shall be maintained for this test, unless liquid volume available is insufficient for a complete test.
 - 3. Where specified in the individual pump specifications, the natural frequencies of each installed pump shall be determined using the "bump test" method. Natural frequency testing shall demonstrate a minimum of 10% separation from the 1x running speed, 2x running speed and vane pass frequencies.
 - 4. Pump performance shall be documented by obtaining concurrent readings, showing motor voltage, amperage, motor power, flow, pump suction head, and pump discharge head, for at least five (5) pumping conditions at full speed. One of the points shall be within -5% and 0%, and one being within 0% and +5% of the guarantee point flow rate; the remaining three points shall be spaced over the allowable operating range of the pump performance curve with points taken at or near the maximum allowable (shutoff) head region and at or near the maximum allowable flow (runout). Additional reduced speed testing shall be performed to

demonstrate that pumps can achieve performance at turndown conditions where specified in individual pump specification sections. Each power lead to the motor shall be checked for proper current balance. Flow shall be measured to the extent possible by permanently installed instrumentation or drawdown measurement. The rated motor nameplate current shall not be exceeded at any point. Pumps with drive motors rated at less than five horsepower shall only be tested for overcurrent when overheating or other malfunction becomes evident in general testing. Field performance testing shall meet HI 14.6 pump acceptance test grade and tolerance band grade specified herein, unless individual equipment specifications indicate otherwise.

- C. The field testing shall be witnessed by the Owner or its representative. The Contractor shall submit to the Engineer a written notification of all pump field tests a minimum of one (1) week prior to testing. In the event of failure of any pump to meet any of the above requirements, the Contractor shall make all necessary modifications, repairs, or replacements to conform to the requirements of the Contract Documents and the pump shall be re-tested at no additional compensation, until found satisfactory. The Contractor shall then certify in writing that the equipment has been satisfactorily tested, and that all final adjustments thereto have been made. Certification shall include date of final acceptance test, as well as a listing of all persons present during tests, and resulting test data. The costs of all Work performed in this Paragraph by factory-trained representatives shall be borne by the Contractor.

3.07 FAILURE OF EQUIPMENT TO PERFORM

- A. Comply with Section 11000, Equipment - General.

3.08 PAINTING

- A. Comply with Section 11000, Equipment - General.
- B. Comply with Section 09900, Painting.

[END OF SECTION]

SECTION 11115
HORIZONTAL CENTRIFUGAL SELF-PRIMING PUMPS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish horizontal centrifugal self-priming pumps at the locations shown on the Drawings and as specified herein. All pumps shall be supplied by the same manufacturer.
- B. Equipment shall be provided in accordance with the requirements of Section 11000, Equipment - General and Section 11100, Pumps – General.

1.02 DEFINITIONS

- A. The following definitions are used to clarify restart requirements.
 - 1. Priming shall refer to the start-up at any time when the pump casing is full of water or sewage.
 - 2. Repriming shall refer to start-up when, for whatever reason, a portion of liquid is lost from the pump casing with the resultant loss of suction head in the suction leg.
 - 3. Static Suction Lift shall be the vertical distance, measured in feet, from the centerline of pump suction to the water surface elevation.

1.03 SUBMITTALS

- A. Provide submittals identified in Section 11000, Equipment - General and Section 11100, Pumps - General in addition to the submittals identified herein.
- B. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Fabrication, assembly, installation, and wiring diagrams.
 - b. Product Data:
 - 1) Manufacturer's literature, illustrations, specifications, paint certification (if required) and engineering data including; dimensions, materials, size, weight of pumping assembly with and without motor, and part lists for all components in sufficient detail to allow an item-by-item comparison with the Contract Documents.

- 2) Pump performance data and curves showing overall pump efficiencies, required net positive suction head (NPSH), allowable suction lift, flow rate, head, brake horsepower, motor horsepower, speed, and shut-off head. Curves shall range from minimum flow to shut-off head at full speed and for all speed curves specified. Curves shall indicate Preferred Operating Region (POR) and Allowable Operating Region (AOR), as defined in ANSI/HI 9.6.3.
- c. Motor Data: Furnish certified motor data sheet for previously tested, electrically duplicate motor to that specified, including the following:
 - 1) Speed-torque relationship.
 - 2) Efficiency at 1/2, 3/4, and full load.
 - 3) Power factor at 1/2, 3/4, and full load.
 - 4) Slip at full load.
 - 5) Running light, full load and locked rotor current.
 - 6) Temperature rises and results of dielectric tests.
 - 7) Bearing type and lubrication medium
 - 8) Insulation class and temperature ratings.
 - d. Testing Plans, Procedures, and Testing Limitations:
 - 1) Provide pump Supplier's proposed shop testing plan, including complete list of testing facility limitations.
 - 2) Provide proposed field-testing plan.

C. Informational Submittals:

1. Manufacturer Instructions:
 - a. Provide Supplier's instructions for handling and installing products.
 - b. Setting drawings, templates, and directions for installing anchor bolts and other anchorages.
2. Source Quality Control Submittals:
 - a. Results of shop testing for complete pump and motor unit.
 - b. Location of nearest permanent service headquarters of pump manufacturer to the Site.

3. Field Quality Control Submittals:
 - a. Results of field testing.
 - b. Submit a written report of the results of each visit to Site by pump manufacturer's service representative, including purpose and time of visit, tasks performed, and results obtained.

1.04 CLOSEOUT SUBMITTALS

- A. Submit warranty documentation in compliance with the Contract Documents.
- B. Submit complete installation, operation, and maintenance manuals, including shop and field test reports, maintenance data and schedules, description of operation, and spare parts information. Operation and Maintenance (O&M) manuals shall be submitted in accordance with:
 1. Section 01730, Operation and Maintenance Data.
 2. Section 11000, Equipment - General.
 3. Section 11100, Pumps - General.

1.05 WARRANTY

- A. Warranty shall be as specified in Section 11000, Equipment - General with the exception that the warranty period shall be extended to cover two (2) years.

1.06 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

- A. Design criteria and performance requirements shall be as shown on the Drawings or specified elsewhere in the Contract Documents.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Comply with Section 11100, Pumps - General, except where superseded in this specification section.
- B. Pump Type: Horizontal, non-clog, self-priming, centrifugal.
- C. All equipment for the pumps, including motors and bases, shall be provided as a complete unit by the pump manufacturer.
- D. All pumps for same pumping application shall be provided by one manufacturer.

- E. Each pump shall be designed to retain adequate liquid in the pump casing to insure unattended, automatic repriming of the pump at its rated speed.

2.02 MANUFACTURERS

A. Pump Manufacturer:

1. Model Super T Series as manufactured by Gorman-Rupp Pumps.
2. Or approved equal.

2.03 ANCHORAGE

- A. Contractor shall provide anchorage in accordance with Section 11000, Equipment - General and Section 11100, Pumps - General. Anchor quantity, spacing, size, length, and depth of embedment shall be according to manufacturer's recommendations.

2.04 MATERIALS OF CONSTRUCTION

Materials of Construction Schedule

Component	Materials of Construction
Pump Casing and Castings (Cover Plates and Seal Plate)	Cast Iron, ASTM A48, CL30
Shaft	ANSI 17-4PH stainless steel
Shaft Sleeve	Alloy Steel 4130
Wear Plate	Carbon Steel 1015, Carbon Steel 1026, or Cast Iron CL30
Flap Valve	Neoprene
Bearing Housing	Cast Iron, ASTM A48, CL30
Impeller	High chromium hard iron
Fasteners, Anchorage, and Hardware	Zinc plated steel
O-Rings and Gaskets	Nitrile (NBR) or Viton
Mechanical Seal Stationary and Rotating Members	Tungsten-Titanium Carbide Alloy

2.05 COMPONENTS

A. Casing

1. The openings and passages of the pump shall be large enough to permit the passage of a sphere of the specified diameter including any trash or stringy material.

2. The pump must be equipped with a removable suction inlet cover, allowing access to pump interior to permit the clearing of stoppages and to provide easy access for service and repairs without disturbing the suction or discharge piping.
3. Each pump shall incorporate a molded one-piece suction flap check valve that can be removed or installed through the removable cover plate opening, without disturbing the suction piping.
4. The pump casing and volute and all areas exposed to sewage shall contain no openings of a lesser diameter than the sphere size specified.
5. Screens or any internal devices that interfere with priming and performance of the pump will not be permitted.
6. An easily accessible tapped drain plug, minimum of 1 inch, shall be provided in the bottom of the casing to facilitate draining the pumps for maintenance purposes. The bearing cavity and the seal cavity shall have individual oil level sight gauges to monitor the level and condition of cavity oil.

B. Impeller

1. The impellers and wear plates shall have a minimum Brinell hardness of 360. Foundry certificates and results of Brinell hardness testing shall be submitted. Each individual impeller and wear plate casting shall be Brinell Tested to ASTM method E-10, reflecting a minimum 360 Brinell hardness.
2. Each casting shall be checked in a minimum of two places, in an area that is representative of casting thickness. Results of the Brinell test shall be certified by a Registered Professional Engineer and submitted for approval before final shipment.

C. The impeller shall be two-vaned, semi-open, non-clog, with integral pump out vanes on the back shroud.

D. The impeller shall thread onto the pump shaft and be secured with a sockethead self-locking capscrew and conical washer.

E. Means shall be provided for external adjustment of the clearance between the impeller and wear plate without requiring disassembly of the pump. Clearances shall be maintained by a four-point external shimless cover plate adjustment system, which utilizes a four collar and four adjusting screw design allowing for incremental adjustment of clearances by hand as required.

2.06 WEAR PLATE

A. The pump shall be fitted with a replaceable wear plate. Replacement of the wear plate, impeller, and seal shall be accomplished through the removable suction inlet cover without disturbing the pump volute or piping.

- B. The entire rotating assembly, which includes bearings, shaft, seal, and impeller, shall be removable as a unit from the pump casing without disturbing the pump volute or piping. Openings into pump shall provide a line of sight for the adjustment of clearance for the wear plate and impeller.
- C. The impeller shall be removable from both the front and rear of the pump casing without disturbing the pump volute or casing.

2.07 SHAFT AND BEARINGS

- A. Pump shaft connections to drives shall be connected through a flexible coupling.
- B. The shaft shall be contained within a bearing pedestal of ample size to contain roller-type radial and thrust ball bearings.
- C. The bearings shall be oil lubricated. The bearing cavity shall be cooled by the pumped liquid.

2.08 MECHANICAL SEAL

- A. The pump shaft shall be sealed against leakage by a dynamically balanced mechanical seal.
- B. Both the stationary sealing member and mated rotating member's surfaces must be ground and polished.
- C. The stationary seal seat must be double floating and self-aligning during periods of shock loads that will cause deflection, vibration, and axial or radial movement of the pumps shaft.
- D. The seal shall be installed within a separate oil-filled reservoir of the pump pedestal, the oil being both the lubricating and the cooling media.
- E. Drain plug opening shall be provided to check oil for contamination in case of inner seal failure.

2.09 ACCESSORIES

- A. Drain Kit
 - 1. Each pumping unit shall be supplied with a drain kit for ease of maintenance. The kit shall contain a minimum of 10 feet of reinforced plastic hose with a female quick connect fitting at one end and factory installed drain fittings in each pump. Fittings shall include a pipe nipple, bushing, bronze ball valve and male quick connect fitting.
- B. Automatic Air Release Valves

1. An automatic air release valve shall be furnished for each pump. Valves shall be designed to permit the escape of air to the atmosphere during initial priming or unattended re-priming cycles. Upon completion of the priming cycle or re-priming cycle, the valve shall close to prevent re-circulation. Valves shall provide visual indication of valve closure, and shall operate solely on discharge pressure. Valves, which require connection to the suction line, shall not be acceptable.
2. All valve parts exposed to sewage shall be constructed of stainless steel, or similar corrosion resistant materials. Diaphragms, if used, shall be of fabric-reinforced neoprene or similar inert material.
3. A cleanout port, three inches in diameter, shall be provided for ease of inspection, cleanout, and service.
4. Valves shall be field adjustable for varying discharge heads.

2.10 ELECTRICAL AND CONTROL REQUIREMENTS

- A. Comply with Specification Section 11100, Pumps - General.
- B. Motor power requirements shall be as indicated on the Drawings.
- C. The pump motor shall be designed for operation with the voltage, frequency and phase electrical characteristics indicated in the Contract Documents. Motors shall be mounted on each pump and shall conform to the latest applicable NEMA, IEEE, and ANSI standards. The motors shall be rated for continuous duty with a minimum service factor as required by schedules herein.
- D. Motors shall be provided with anti-condensation space heaters, motor winding temperature switches, and tropicalized windings unless otherwise specified.

2.11 CONTROLS

- A. Refer to individual specifications and the Drawings.

2.12 SPARE PARTS

- A. Spare parts shall be provided in accordance with Section 11000, Equipment - General and shall include the following for each pump.

Spare Parts Schedule

Component	Quantity
Complete mechanical shaft seal	1
Sets of gaskets and O ring seals	2

Component	Quantity
Replaceable wear plate	1

2.13 PAINT

- A. Entire pump/motor assembly shall be shop finish coated with manufacturer's standard coating system. This paint system shall be appropriate for the application and shall provide corrosion and chemical protection.

2.14 EQUIPMENT IDENTIFICATION

- A. Equipment nameplates shall comply with Section 11100, Pumps - General.

PART 3 – EXECUTION

3.01 SHOP TESTING

- A. Shop testing shall be in accordance with Section 11000, Equipment - General Provisions and with the following additional requirements.
- B. Hydrostatic Test
- C. Performance Test
- D. Impeller Hardness Test
- E. Certified Reprime Test
 - 1. The Contractor shall furnish a certified reprime test for a minimum of one pump for each pump model submitted. Each pump shall be capable of the reprime lift as listed below. Reprime lift shall be defined as the static height of the pump suction centerline above the liquid level that will prime utilizing the liquid remaining within the pump casing after a pumping cycle with the suction check valve removed. The reprime cycle, pump on to liquid discharge, shall be accomplished within five minutes, maximum.
 - 2. Additional requirements are as follows:
 - a. A ten-foot length of one-inch pipe shall be installed between the pump and the first bend of the discharge piping. This line shall be open to atmosphere to duplicate the action of an air release valve.
 - b. Suction pipe configuration for the reprime test shall incorporate a minimum horizontal run of 2 feet and one 90 degree bend.

- c. The impeller shall be set at the clearances recommended by the pump manufacturer.
 - d. Reprime lift repeatability shall be demonstrated by a minimum of five (5) sequential reprime cycles.
 - e. Liquid to be used in the reprime testing shall be water, free of debris.
3. Reprime performance test data shall be certified by the pump manufacturer and shall be submitted to the Engineer for approval prior to shipment.

3.02 SHIPMENT, DELIVERY, HANDLING AND STORAGE

- A. Shipment, delivery, and handling of equipment and materials shall be in accordance with manufacturer's written instructions.

3.03 INSTALLATION

- A. Install pump in strict accordance with manufacturer's recommendations and Section 11100, Pumps - General.

3.04 FIELD TESTING

- A. Field testing shall be in accordance with Section 11000, Equipment – General and Section 11100, Pumps - General, and shall include:

Field Testing Schedule

Test	Requirement
Field Performance Testing	Yes
Vibration Testing	Yes
Natural Frequency "Bump" Test	Yes
Field Reprime Test	Yes

B. Field Reprime Test

- 1. Each pump shall be given a reprime test in the field. Each pump shall be tested three times, and the elapsed time required to achieve reprime shall be recorded for each test. The average time of the three tests shall be used. This average time must be less than or equal to the specified times. No external devices or vacuum assist units shall be used during reprime tests.
- 2. The test shall be conducted as follows:
 - a. Fill pump casing full of water.

- b. Drain suction pipe.
 - c. Drain liquid level in pump casing to the cutwater tip.
 - d. Record time from instant starter energizes until pump comes to full prime and is pumping at full rated capacity against the specified head. Suction and discharge gauges shall be attached to the pump during the test to confirm when full prime is reached.
 - e. The reprime test shall also be readministered as above, but rather than drain the pump casing to the cutwater tip, the suction check valve shall be removed and the pump brought to prime. Once the pump is pumping at its fully rated capacity the pump shall be shut off. The air valve on the discharge piping shall be opened to assist in draining of the suction leg. The suction leg will drain and a natural siphonage shall occur from the pump casing. The time required for each pump to reprime under this condition shall be recorded. The average time of three tests shall be used.
3. Should the proposed equipment fail to meet the specified performance criteria or fail to reprime within the specified time, the equipment will be rejected. The pump manufacturer shall have seven (7) days to correct any deficiencies prior to a retest. The retest shall be identical to the first test. Should equipment fail to perform as specified during the retest, the Engineer shall direct the equipment be removed from the jobsite and an equipment offering which will perform as specified shall be provided.

3.05 MANUFACTURER'S FIELD SERVICES

- A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 11000, Equipment - General. Field services shall include the following site visits:

Service	Number of Trips	Number of Days/Trip
Installation and Testing	1	1
Startup and Training	1	1
Services after Startup	1	1

[END OF SECTION]

SECTION 11130
SUBMERSIBLE SOLIDS-HANDLING PUMPS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, and place into satisfactory operation submersible, non-clog, solids-handling, end suction centrifugal pumps at the locations shown on the Drawings and as specified herein. All pumps specified herein shall be supplied by the same manufacturer.
- B. Equipment shall be provided in accordance with the requirements of Section 11100, Pumps - General.
- C. The pump and all related equipment shall be designed for the wastewater applications specified herein and shall be suitable for continuous or intermittent operation. The pump shall be bottom suction, side discharge construction and shall be supplied with a discharge connection elbow and integral sliding rail removal system of the pump manufacturer's design matched to the pumps being supplied.

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Comply with Section 11000, Equipment - General.
- B. Comply with Section 11100, Pumps - General.

1.03 ACTION/INFORMATIONAL SUBMITTALS

- A. Provide submittals identified in Section 11000, Equipment - General and Section 11100, Pumps - General in addition to the submittals identified herein.
- B. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Fabrication, assembly, installation, and wiring diagrams.
 - b. Product Data:
 - 1) Manufacturer's literature, illustrations, specifications, paint certification (if required) and engineering data including; dimensions, materials, size, weight of pumping assembly, and part lists for all components in sufficient detail to allow an item-by-item comparison with the Contract Documents.

- 2) Pump performance data and curves showing overall pump efficiencies, required net positive suction head (NPSH), flow rate, head, brake horsepower, motor horsepower, speed, and shut-off head. Curves shall range from minimum flow to shut-off head at full speed and for all speed curves specified. Curves shall indicate Best Efficiency Point (BEP), Preferred Operating Region (POR), and Allowable Operating Region (AOR), as defined in ANSI/HI 9.6.3.
 - 3) Minimum pump submergence.
- c. Motor Data: Furnish certified motor data sheet for previously tested, electrically duplicate motor to that specified, including the following:
- 1) Speed-torque relationship.
 - 2) Efficiency at 1/2, 3/4, and full load.
 - 3) Power factor at 1/2, 3/4, and full load.
 - 4) Slip at full load.
 - 5) Running light, full load and locked rotor current.
 - 6) Temperature rises and results of dielectric tests.
 - 7) Bearing type and lubrication medium
 - 8) Insulation class and temperature ratings.
- d. Testing Plans, Procedures, and Testing Limitations:
- 1) Provide pump Supplier's proposed shop testing plan, including complete list of testing facility limitations.
 - 2) Provide proposed field-testing plan.

C. Informational Submittals:

1. Manufacturer Instructions:
 - a. Provide Supplier's instructions for handling and installing products.
 - b. Setting drawings, templates, and directions for installing anchor bolts and other anchorages.
2. Source Quality Control Submittals:
 - a. Results of shop testing.

- b. Location of nearest permanent service headquarters of pump manufacturer to the Site.
- 3. Field Quality Control Submittals:
 - a. Results of field testing.
 - b. Submit a written report of the results of each visit to Site by pump manufacturer's service representative, including purpose and time of visit, tasks performed, and results obtained.

1.04 CLOSEOUT SUBMITTALS

- A. Submit warranty documentation in compliance with the Contract Documents.
- B. Submit complete installation, operation, and maintenance manuals, including shop and field test reports, maintenance data and schedules, description of operation, and spare parts information. Operation and Maintenance (O&M) manuals shall be submitted in accordance with:
 - 1. Section 01730, Operation and Maintenance Data.
 - 2. Section 11000, Equipment - General.
 - 3. Section 11100, Pumps - General.

1.05 WARRANTY

- A. Warranty shall be as specified in Section 11000, Equipment - General with the exception that the warranty period shall be extended to cover two (2) years.

1.06 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

- A. Design criteria and performance requirements shall be as shown on the Drawings or specified elsewhere in the Contract Documents.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Comply with Section 11100, Pumps - General, except where superseded in this specification section.
- B. Pump Type: Non-clog, submersible, centrifugal pump.
- C. All equipment for the pumps, including motors and bases, shall be provided as a complete unit by the pump manufacturer.

- D. All pumps for same pumping application shall be provided by one manufacturer.

2.02 MANUFACTURERS

- A. Pump Manufacturer:

1. Xylem/Flygt N3000 series.
2. No equal.

2.03 ANCHORAGE

- A. Contractor shall provide anchorage in accordance with Section 11000, Equipment - General and Section 11100, Pumps - General. Anchor quantity, spacing, size, length, and depth of embedment shall be according to manufacturer's recommendations.

2.04 MATERIALS OF CONSTRUCTION

Materials of Construction Schedule

Component	Materials of Construction
Pump Housing and Castings	Cast Iron, ASTM A48, CL35B
Shaft	AISI 400 Series Stainless Steel
Impeller and Insert Ring	A532 Class III Type A (25% Chromium) hard iron alloy (Ni-hard)
Fasteners, Anchorage, and Hardware	AISI Type 316L SS
O-Rings	Nitrile (NBR)
Foot mounted discharge connection elbow	Cast Iron, ASTM A48, CL35B or Ductile Iron ASTM A536
Guide Rails and Brackets	Sch. 40 Type 316 Stainless Steel

2.05 COMPONENTS

- A. Impeller

1. Impeller Type: One-piece, single-suction, non-clogging, multiple-vane, solids-handling, mixed flow type.
2. The impeller blades shall be self-cleaning upon each rotation as they pass across a sharp relief groove in the Insert ring and shall keep the impeller blades clear of debris. The clearance between the insert ring and the impeller leading edges shall be adjustable.
3. Impeller Construction:
 - a. Solids Passage:

- 1) Shall be designed with smooth flow passages to pass a spherical solid of the specified size and to prevent clogging by stringy materials.
 - 2) Impeller shall handle: solids of the specified sphere size, fibrous materials, heavy sludge, and other matter found in normal wastewater applications.
 - b. The impeller shall be bolted, keyed and locked to the pump shaft at the factory. Adhesive or friction type fits are not acceptable.
 4. Impeller Balancing: Dynamically balanced.
- B. Casing/Volute
1. Casing/Volute Type:
 - a. End suction, side discharge construction type having sufficient strength and thickness to withstand all stress and strain from service at full operating pressure and load.
 2. Casing/Volute Construction:
 - a. The volute shall be single piece construction.
 - b. Pump casing shall be designed with a pullout assembly so that the impeller can be withdrawn. The complete rotating assembly shall be capable of being removed from the volute without disturbing the suction piping, discharge piping, or volute.
 - c. Casing shall be equipped with removable suction cover which can be removed for access to the impeller.
 - d. All non-stainless steel metal surfaces coming in contact with the pumped media shall be protected by a factory applied protective coating.
 - e. Pump shall not bear on wet well floor when pump to base elbow connection is engaged.
 3. Solids Passage:
 - a. Passages shall have smooth unobstructed passages for solids. Volute shall have smooth fluid passages large enough at all points to pass any size solids which can pass through the impeller.
 - b. Passage Size: Large enough to pass a 3-inch spherical solid.
 - c. Cleanouts:

- 1) Pump volute shall be provided with a cleanout port to allow for removal of any foreign material blocking or impeding performance of the pump.
 - 2) Provide cleanout handhole near cutwater.
 - 3) Cleanout cover shall be removable.
 - 4) The inner contours of the handhole cover shall match the contours of the casing in which it fits.
- d. Flanges: Integrally cast ANSI Standard flat faced flange with 125-lb drilling.
4. Lifting: Casing/Volute shall be provided with lifting bolts and eye lugs for installation and maintenance of the pumps.

C. Shaft

1. Diameter: Shall be sufficiently large in diameter to safely transmit the maximum torque developed by the drive unit and of such design as to provide a rigid support for the impeller and to prevent excessive vibration.
2. Construction: The shaft shall be heat treated, turned, ground, and polished over its entire length.

D. Bearing Housing & Bearings

1. Type: Permanently lubricated, heavy-duty, upper radial and lower thrust anti-friction ball or tapered roller bearings.
2. Minimum AFBMA L-10 Bearing Life (at all points along the usable portion of the pump curve at maximum pump speed) shall be 50,000 hours
3. Construction:
 - a. Bearing housing shall fully enclose the bearings to prevent entrance of contaminants and shall be designed to provide for axial adjustment of rotating assembly.
 - b. Bearing housing shall be designed with a machined self-centering fit with the stuffing box cover.
 - c. Bearing Lubrication: Bearings shall be permanently lubricated.

E. Sealing of Mating Surfaces:

1. All mating surfaces where watertight sealing is required shall be machined and fitted with O-rings.

2. Fitting shall be such that sealing is accomplished by metal-to-metal contact between machined surfaces. This will result in controlled compression of the O-rings without the requirement of a specific torque limit.
3. Secondary sealing compounds, rectangular gaskets, elliptical O-rings, grease or other devices shall not be acceptable.

F. Discharge Base Elbow and Lifting System:

1. Provide permanently installed slide rail mounting systems for each pump as shown on the Drawings and as specified herein.
2. Slide rail system shall facilitate pump removal from the wet pit for inspection or service without entering the pit or disconnecting piping.
3. The pump shall be provided with a base discharge connection elbow permanently installed in the wet well along with the discharge piping.
4. The discharge connection elbow shall be constructed with a 125 lb. ANSI standard flat faced flange.
5. The base discharge connection elbow shall be mounted either directly to the concrete or onto a baseplate as indicated on the Drawings.
6. The pump shall be automatically connected to the discharge connection elbow when lowered into place and shall be easily removed for inspection or service. Sealing of the pumping unit to the discharge connection elbow shall be accomplished by a simple downward motion of the pump.
7. A sliding guide bracket shall be an integral part of the pump unit. The entire weight of the pump unit shall be guided by the guide bar(s) and pressed tightly against the discharge connection elbow to provide positive sealing under all conditions.
8. The entire sliding rail system shall be designed to safely withstand all stresses imposed thereon by vibration, torque, shock and all possible direct and eccentric loads. No portion of the pump shall bear directly on the floor of the sump.
9. Lower guide bar holders shall be integral with the discharge connection. Guide bars shall be at a minimum Schedule 40, 316 stainless steel pipe of a conservative size that is at least one diameter oversized and adequate for its intended use. The guide bars shall not support any portion of the weight of the pump.
10. Provide upper and intermediate guide brackets, as required and where indicated on the Drawings.
11. All metal-to-metal interfaces where movement might occur shall be non-sparking. The slide mounting system for the influent pumps shall meet or exceed

Underwriters Laboratory requirements for operation in a Class I, Division 1, Group D hazardous location.

2.06 STRUCTURAL STEEL

- A. Comply with Section 11100, Pumps - General.

2.07 DISSIMILAR METALS

- A. Comply with Section 11100, Pumps - General.

2.08 SHAFT SEALS

- A. Shaft Seals: Shaft sealing shall be accomplished by the following method as identified in the schedule below.
 - 1. Mechanical seals shall run in an oil-filled chamber to provide constant lubrication. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication.
 - 2. The lower, primary seal unit, located between the pump and the lubricant chamber shall contain one stationary and one positively driven rotating, industrial duty, corrosion resistant, seal rings. The lower seal shall be independent of the impeller hub.
 - 3. The upper, secondary seal unit, located between the lubricant chamber and the motor housing, chamber shall contain one stationary and one positively driven rotating, industrial duty, corrosion resistant, seal rings.
 - 4. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment and shall be capable of operating in either clockwise or counter-clockwise direction of rotation without damage or loss of seal. The seal system shall not be damaged when run dry. No external source of seal cooling or lubrication water shall be required.
 - 5. The following seal types shall not be considered acceptable nor equal to the dual independent seal specified: shaft seals without positively driven rotating members, or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces. Cartridge type systems will not be acceptable. No system requiring a pressure differential to offset pressure and to effect sealing shall be used.
- B. Shaft Seal

Shaft Seal Schedule

Parameter	Value
Shaft Sealing Arrangement	Tandem Mechanical Component Seal
Seal Flush Source / API Flush Plan	None
Lower Seal Unit – Seal Face Material	Tungsten Carbide
Upper Seal Unit - Seal Face Material	Tungsten Carbide
Metallic Components	316 Stainless Steel
Flexible Components	Nitrile

2.09 ACCESSORIES

- A. All anchor bolts, lifting bolts, eye lugs, etc. necessary for complete installation and maintenance of the pump shall be constructed of Type 316 stainless steel and shall be adequately designed for its intended use.
- B. Lifting Bail
 - 1. Provide a type 316 stainless steel pump lifting bail for each pump.

2.10 ELECTRICAL REQUIREMENTS

- A. Comply with Specification Section 11100, Pumps - General.
- B. The stator, rotor and bearings shall be mounted in a sealed submersible type housing.
- C. Motor shall be provided with motor winding temperature sensors.
- D. The pump and motor shall be specifically designed so that they may be operated partially or completely submerged in the liquid being pumped. The pump shall not require cooling water jackets.
- E. Stators shall be securely held in place via a heat shrink fit.
- F. Electrical service and motor power requirements shall be as indicated on the Drawings. Electrical service options include 460V/3 ph/60 Hz, 230V/3ph/60 Hz, and 230V/1 ph/60 Hz. Provide VFD as required to convert single phase power to three phase.
- G. The pump motor shall be designed for operation with the voltage, frequency and phase electrical characteristics indicated on the Drawings and specified herein. Motors shall be mounted on each pump and shall conform to the latest applicable NEMA, IEEE, and ANSI standards for submersible service. The motors shall be rated for continuous duty with a minimum service factor as required by schedules herein.

- H. Type: Squirrel-cage induction, housed in a watertight chamber.
- I. The stator winding and stator leads shall be moisture resistant.
- J. Motor Insulation: Motor insulation shall be as scheduled herein.
- K. The use of bolts, pins, or other fastening devices requiring penetration of the stator housing shall not be allowed.
- L. Starts Per Hour: The motor shall be guaranteed for continuous unsubmerged duty, capable of sustaining a minimum scheduled starts per hour without overheating.
- M. Motor Bearings: The motor shall be provided with pre lubricated radial and thrust bearings which are designed to carry the entire load which may be imposed upon it under all operating conditions.
- N. All motors shall be housed in enclosures specifically designed for submersible pump application.

Motor Criteria Schedule

Parameter	Value
Enclosure	TEXP
Insulation	Class H
Design	NEMA B
Minimum Service Factor	1.15
Motor Winding Temperature Protection	Temperature Switches
Rated Starts Per Hour, Minimum	15

- O. Cable Entry Water Seal:
 - 1. The cable entry water seal design shall insure a watertight and submersible seal without specific torque requirements.
 - 2. Each pump shall be equipped with separate terminal board that totally isolates the incoming power supply from the pump motor.

2.11 PROTECTIVE DEVICES

- A. Pump shall be supplied with a moisture/seal fail and over-temperature protective relay device. Device shall be provided to panel fabricator loose for installation within the pump control panel.

2.12 PUMP CABLE:

A. Cable Length:

1. Power and control cables between the pumps and the control panel shall be provided by the pump manufacturer. The Contractor, in coordination with the pump manufacturer, shall determine the required cable length. Provide sufficient spool to accommodate pump removal.
2. All pumps for the same application shall be provided with the same length of cable.
3. No splices shall be allowed unless specifically called for in the electrical drawings.

B. Pump Cable Materials: PVC or oil resistant chloroprene rubber jacketed type SPC cable suitable for submersible pump applications.

C. Sizing:

1. In Accordance with NEC and ICEA standards.
2. Cables shall be UL approved.

D. PVC strain relief connectors shall be furnished for all cables.

2.13 CONTROLS

A. Refer to individual specifications and the Drawings.

2.14 SPARE PARTS

A. Spare parts shall be provided in accordance with Section 11000, Equipment - General and shall include the following for each series of pumps.

Spare Parts Schedule

Component	Quantity
Sets of gaskets and O ring seals	2

2.15 PAINT

A. Entire pump/motor assembly, including the base elbow connection, shall be shop finish coated with manufacturer's standard coating system. This paint system shall be appropriate for a raw wastewater application and shall provide corrosion and chemical protection.

2.16 EQUIPMENT IDENTIFICATION

- A. Equipment nameplates shall comply with Section 11100, Pumps - General.

PART 3 – EXECUTION

3.01 SHOP TESTING

- A. Factory testing will not be required. However, the pump manufacturer shall guarantee performance under the rated operating condition.
 - 1. Impeller, motor rating and electrical connections shall be checked.

3.02 SHIPMENT, DELIVERY, HANDLING AND STORAGE

- A. Shipment, delivery, and handling of equipment and materials shall be in accordance with manufacturer's written instructions.

3.03 MANUFACTURER'S FIELD SERVICES

- A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 11100, Pumps - General. Field services shall include the following site visits, as a minimum:

Site Visits Schedule

Service	Number of Trips	Number of Days/Trip
Installation and Testing	1	1
Startup and Training	1	1
Services after Startup	1	1

3.04 INSTALLATION

- A. Install pump in strict accordance with manufacturer's recommendations and Section 11100, Pumps - General.

3.05 FIELD TESTING

- A. Field testing shall be in accordance with Section 11100, Pumps - General, and shall include:

Field Testing Schedule

Test	Requirement
Field Performance Testing	Yes
Vibration Testing	No
Natural Frequency "Bump" Test	No

[END OF SECTION]

SECTION 11170
LIQUID CHEMICAL METERING PUMP SKID

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Contractor shall furnish and install chemical metering pumps at the locations shown on the Drawings and as specified herein. All pumps shall be supplied by the same manufacturer.
- B. Equipment shall be provided in accordance with the requirements of Section 11000, Equipment - General and Section 11100, Pumps - General.

1.02 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

- A. Chemical Properties
 - 1. Pumps and components shall be constructed of materials compatible with the specific chemical's physical properties.
- B. Pump Performance Requirements
 - 1. Design criteria and performance requirements shall be as specified under the individual specifications or shown on the Drawings.
 - 2. Application points shall be as indicated on the Drawings.

1.03 SUBMITTALS

- A. The following items shall be submitted with the Shop Drawings in accordance with, or in addition to the submittal requirements of the Contract Documents; and Section 11000, Equipment - General:
 - 1. Performance Affidavit.
 - 2. Submit pump manufacturer's hydraulic calculations.
 - 3. Shop drawings shall include all pumps and accessories and shall be submitted as a complete system. Partial submittals will be unacceptable.
 - 4. Certification of factory testing.
 - 5. Certification of final acceptance testing.
- B. Warranty

1. Provided extended warranty period of two (2) years.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. The Manufacturer shall be a company specializing in manufacture, assembly, and field performance of mechanical metering pumps with a minimum of five years of experience.
- B. The metering pumps shall be:
 1. Sigma Series pumps as manufactured by Prominent Fluid Controls, Inc.
 2. Equivalent by Wallace and Tiernan.
 3. Equivalent by Pulsafeeder.
 4. Or approved equal.

2.02 MECHANICALLY OPERATED METERING PUMPS

- A. Motor operated chemical metering pumps shall be of the positive displacement, mechanical diaphragm type. The stroke frequency adjust mechanism, driven by a direct coupled, variable speed motor, shall actuate a convex-shaped, teflon-faced composite diaphragm. Solenoid driven pumps will not be accepted.
- B. The manufacturer is responsible for the coordination of corrosion resistant materials for the chemical solution(s) specified. The manufacturer shall include all features as necessary for satisfactory operation of the pumping systems for chemical solutions specified. Pumps shall perform satisfactorily over the full range of solution concentrations specified. Pumps, motors and accessories shall be constructed of appropriately resistant material for the ~~coated with a heavy duty protective epoxy coating resistant to the~~ specified chemical to prevent corrosion.
- C. The metering pumps shall be provided with an oil-lubricated gear reducer and cam-and-spring drive mounted in an aluminum housing. The housing shall be sealed into an outer plastic housing for corrosion protection with heat sink fins for cooling.
- D. The liquid ends shall include cartridge type union or threaded type ball check valves. ~~Conventional threaded valves will not be allowed.~~ Valve service or removal shall not require any disturbances to the pump head pipeworks.
- E. The liquid end shall be physically separated from the drive unit by a back plate with weep hole creating an air gap. An elastomer shaft wiper seal shall prevent contamination of the gear box if the primary diaphragm fails.

~~F. The pump and motor shall be mounted on a common concrete base as indicated on the Drawings. The motor shall be direct coupled to the gear box.~~

G.F. Each pump and motor shall have a corrosion resistant nameplate giving the manufacturer's model, serial number, rating, range, speed, and other pertinent data.

H.G. Acceptable materials of construction shall be as follows, provided that each is chemically compatible. Lower quality materials of construction will not be accepted. More robust materials of construction shall be provided as required to provide excellent resistance to the specific chemical.

<u>Component</u>	<u>Material of Construction</u>
Diaphragm	PTFE faced EPDM with Steel Core
Housing Material	Glass-filled Luranyl
Liquid End Material	Kynar
Ball Check Valve	PVDF with PTFE ~~faced Viton Gasket~~ Seals
Ball Check Valve Balls	Ceramic
O-Ring Seals	Teflon (PCTFE), Viton
Hardware	Hastelloy C

2.03 ELECTRICAL AND CONTROLS REQUIREMENTS

A. Metering pump controls shall be microprocessor-based and shall be capable of remote analog operation. The pump shall accept a remote analog signal such that stroke frequency is proportional to a 4-20 mA signal. A dry contact closure to the "pause" control function shall cause pump to halt operation and illuminate an indicator light on the pump control panel, in either manual or external pacing mode. The pump shall allow setting of a maximum stroke rate which corresponds to the maximum analog signal. Analog-to-digital converters external to the pump shall not be allowed. Local operator controls on the pump shall include stroke length control knob, stroke frequency control knob stroke frequency control up/down keys, program selection key, start/stop key, an LCD display, and indicating lights for fault annunciation. In addition to the analog control capability an SPDT relay output shall be provided for fault indication such as power supply failure, or loss of pacing signal.

B. Local adjustments and settings of the stroke length and stroke frequency shall be achieved when the metering pump control is put in "manual" operation. Feed rate shall be controlled manually via a stroke length control adjuster. A percent scale and vernier shall indicate stroke length in 1% increments. Feed rate shall be infinitely adjustable from 0 through 100%. Repeatable metering accuracy shall be $\pm 2\%$ of full scale, at constant hydraulic conditions, over the operating range.

C. Suction and discharge stroke length and duration shall be adjustable to optimize dosing application of required chemical.

C.D. The electronic control system of the metering pump shall be continuously self-monitoring. In the event of a system error in the microprocessor, the pump shall switch off and an alarm shall be annunciated.

2.04 METERING PUMP SKID

- A. Each pump shall have the ability to function as an isolated pump (i.e., independent of piping and operation of the other pump mounted on the skid assembly). Selection for use of backup pump shall require manual manipulation of valves and controls at the skid.
- B. The chemical feed skid system shall be assembled by the metering pump manufacturer. The chemical feed skid system shall be completely assembled, mounted, calibrated, tested, and delivered to the site on a single skid. Skid assembly shall contain chemical metering pumps, all necessary piping, valves, fittings, supports, electrical controls, and accessories as specified herein. The metering pump skid shall contain the following items:
1. Skid
 2. Metering pumps and motors
 3. Calibration columns
 4. Pulsation dampeners
 5. Pressure gauges with diaphragm seals
 6. Isolation valves
 7. Pressure relief valves
 8. Backpressure valve
 9. Wye strainer(s)
 10. Skid mounted controls
 11. All piping, valves, gaskets, supports, hardware, wiring, junction boxes, and accessories necessary for a fully functioning skid. Piping shall be terminated within 2 inches from the edge of skid. Provide flanges at all piping connections leaving the skid for any pipes > 1/2" and unions for any pipes ≤ 1/2". Electrical cables to the skid shall terminate in the skid-mounted control panel.
- C. All components of the chemical metering system shall be contained within the skid. Skids shall be floor mounted units with bottom, back, and sides of the skid frame constructed from black UV-protected, fusion-welded, high-density polyethylene of a minimum thickness suitable to rigidly support the weight of the equipment and the

chemical metered without warping or bending of any kind. Bolted construction for the frame is not acceptable.

- D. The ~~top and~~ front of the skid shall be constructed of clear plastic material provided as a spray shield. ~~F~~Top shall be removeable and front shall be provided with hinged doors for full access to the skid interior with all piping and equipment able to be easily serviced with the doors open and/or top removed. All fasteners and hardware shall be non-metallic and of suitable strength and thickness to be of solid, rigid construction.
- E. Pedestals shall be provided to elevate the metering pumps above the skid base and all piping and components shall be supported to prevent them from resting on the skid deck. The skid shall incorporate a drip lip with two (2) 1/2" NPT connections for containment drain piping. Skid shall be constructed with forklift truck cut-outs and anchor bolt holes for installation. Skid shall be suitable for outdoor installations.
- F. ~~The wetted end of each pump shall be oriented at the open end of the framework for easy access.~~ All pumps shall be arranged with the pump wet end operator interface and stroke length adjustment facing the open end of the feed system. ~~Where~~Local control panels shall be located on the skid, ~~all panels shall be~~ and mounted on the side so that the control interface faces the top or front open end of the skid.
- G. All components of the skid mounted system (pumps, piping and controls) shall be factory pressure tested with water prior to shipment. Certification of factory testing shall be submitted to the Engineer and included in the Operations and Maintenance Manuals.
- H. All metering pump accessories shall have pressure ratings equal to or greater than the discharge pressure of the associated metering pumps.
- I. All wiring within the skid boundaries shall be performed by the chemical feed system fabricator prior to shipping and shall terminate at the skid-mounted control panel.

2.05 METERING PUMP ACCESSORIES

- A. The metering pump supplier shall furnish accessory equipment as specified herein and as shown on the Drawings including but not limited to the following:
 - 1. Pressure Gauges
 - a. Gauges shall be provided on the discharge of metering pump skid and on each pulsation dampener.
 - b. Gauges shall be PVC housing, nominally 2.5" in diameter.
 - c. Each gauge shall have a pressure range, in psi, suitable to allow the normal pumping pressure to be near the mid-span of the range.

- d. Each gauge shall be provided with a diaphragm seal constructed of materials which are completely resistant to corrosion by the by the pumped chemical.
- e. Each pressure gauge shall also be provided with an isolation valve. Isolation valves shall be PVC with seals that are resistant to the chemical applications.

B. Pressure Relief Valves

- 1. Sizing of the valves shall be the responsibility of the manufacturer.
- 2. Pressure relief valves shall be provided in the discharge piping of each metering pump, prior to any valves, to eliminate the buildup of excess pressure in the system. Valves shall be completely resistant to the chemicals for which they are provided.
- 3. The pressure relief valves shall be fully adjustable.
- 4. Relief vents shall be piped to the suction side of the associated pump.

C. Antisiphon/Back-pressure Valves

- 1. Sizing of the valves shall be the responsibility of the manufacturer.
- 2. Back pressure/anti-siphon valves shall be provided in the discharge pipes of the skid to provide constant back pressure at the chemical metering pump discharge and eliminate siphoning.
- 3. Valves shall be completely resistant to the chemicals for which they are provided.
- 4. The back pressure valve shall be fully adjustable.

D. Pulsation Dampeners

- 1. Diaphragm and body materials and configuration shall be supplied for the specific chemical for which the dampener is used without corrosion, wear, or other cause of abnormally short life.
- 2. Each dampener shall be equipped with a charging valve and gas pad pressure gauge.
- 3. Pulsation dampeners shall be sized appropriately for each pump to remove a minimum of 95% of the pulsations. Sizing of the pulsation dampeners shall be the responsibility of the manufacturer, and calculations shall be submitted with Shop Drawings.

4. Pulsation dampeners shall be of the single diaphragm design, capable of arresting water hammer in the pump discharge lines created by the metering pumps.
5. Pulsation dampeners shall be provided with valves, gauges and fittings necessary for maintaining required air pressure in the air chamber.
6. Materials of construction of diaphragm shall be EPDM and body shall be PVC. All materials shall be corrosion resistant to the chemical fluid pumped.
7. Provide one dampener on the discharge side of each metering pump, located 12" or closer to the pump discharge.
8. Each pulsation dampener shall include an integral pressure gauge.
9. Provide each pulsation dampener with an isolation valve.

E. Calibration Column

1. Calibration columns shall be constructed of transparent PVC and shall be provided with threaded ends. Each calibration column shall be sized such that at 50% pump capacity, the calibration column will be emptied in 60 to 90 seconds.
2. Graduations shall be in mL and gallons. The scale shall also include direct readings in GPH to circumvent the need for calculations.
3. The calibration chamber shall be piped and valved so that each pump shall be able to utilize the calibration chamber without interfering with the operation of the other pump. The top of the chamber shall be piped to a common vent on the skid.

F. Piping, Tubing, Valves, and Appurtenances

1. Provide hard piping on the suction and discharge of each metering pump. Materials of construction shall be completely compatible with the specified chemical.
- ~~2. Provide flexible piping connection and quick connects or unions with flanges between fixed piping and suction and discharge of the pump in order to allow removal of the pump without disturbing the suction or discharge piping. Flexible tubing shall be as follows:~~
 - ~~a. If chemically compatible, provide Class 125 Nexbraid clear braided PVC tubing by Nexgen Hose, Inc. or approved equal.~~
 - ~~b. If PVC tubing is not chemically compatible, provide Teflon hose with Hastelloy C overbraid protection and permanently attached Hastelloy C true union end fittings as manufactured by Resistoflex Company, Marion, NC, or approved equal.~~

- ~~3.2.~~ Isolation valves shall be provided at all equipment connections. Seals shall be compatible with the chemical being pumped. Isolation valves shall be true-union ball valves.
- ~~4.3.~~ Feed system piping shall include an air bleed/flush connection on the suction and discharge of each pump. The bleed/flush connections should be located on the interior of the pump isolation valves to allow for all lines to be purged of air and to allow the pump to be flushed prior to maintenance being performed.
- ~~5.4.~~ All piping and accessory support shall be from the skid base or rear panel. Piping and accessory support from above is not acceptable.
- ~~6.5.~~ All piping and accessories shall be securely fastened to the frame or supported with stand-offs. The use of steel or metal bands or strapping shall not be acceptable.
- ~~7.6.~~ Provide transition fittings for connection of dissimilar materials or provide metering pump accessories manufactured of the same material as the piping.
- ~~8.7.~~ No threaded piping will be allowed on the skids.

2.06 TOOLS, SUPPLIES, AND SPARE PARTS

- A. The equipment manufacturer shall furnish all special tools necessary to disassemble, service, repair, and adjust the equipment.
- B. The manufacturer shall furnish a list of recommended spare parts.
- C. In addition to any other spare parts recommended by the pump manufacturer or skid Supplier, furnish the following spare parts:
 - 1. Two (2) spare pressure gauges with diaphragm seals.
 - 2. One (1) spare pressure relief valve.
 - 3. One (1) spare back pressure valve.
 - 4. One (1) spare pulsation dampener.
 - 5. Two (2) preventive maintenance kits including all components required to rebuild pump head.

PART 3 – EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

- A. The services of a qualified manufacturer's technical representative shall be provided as follows:

<u>Service</u>	<u>Number of Trips</u>	<u>Number of Days/Trip</u>
Installation <u>Supervision</u> and Testing	1	1
Startup and Training	~~2~~ 4	1

- B. Manufacturer's technical representative shall perform the tasks as follows for each set of metering pumps:

1. Witness and check installation.
2. Assist the Contractor in conducting field tests and preparing a written report as specified below.
3. Provide all necessary field adjustments of pressure settings for the pressure relieve valves and backpressure valves.
4. Witness and check start-up of the system.
5. Assist Contractor in making adjustments and modifications as necessary to optimize operation of the system components and to minimize surge pressures.
6. Troubleshoot and correct any mechanical or control problems with the metering pumps and accessories that are noted during tests and start-up.
7. Submit written certification that the system has been properly installed, tested, and adjusted; that the system operates as specified or as required; and that all controls and protective devices operate properly. Indicate date of final acceptance test, as well as a listing of all persons present during the tests.
8. Instruct Owner in the operation and maintenance of equipment.

- C. The Contractor shall be fully informed and shall be responsible to ensure that all Contractor's employees, agents, and/or subcontractors are fully informed as to the hazards and proper procedures associated with working with and around the specified chemicals.

3.02 INSTALLATION

- A. The Contractor shall furnish and install the metering pumps and all associated equipment and accessories as required and specified herein in accordance with manufacturer's instructions, Section 11000, Equipment - General, and the Drawings.
- B. All metallic fasteners, brackets, mounting hardware, and accessories located in the storage and feed areas shall be constructed of materials completely resistant to the specified chemicals.
- C. The Contractor shall support piping adjacent to pumps such that no weight is carried on pump casings.

3.03 TESTING, CLEANING, AND START UP

- A. All pumps shall be shop tested for capacity at rated pressure prior to shipment, with documented results provided.
- B. The Contractor shall demonstrate to the Engineer that the completed systems meet the functional requirements intended and that all components of the system are properly calibrated.
- C. After installation of piping and accessories but before connection of piping to the storage tank and pumps the Contractor shall completely flush the system to clean and remove all foreign matter from the piping system.
- D. After piping system is cleaned, perform complete system hydrostatic tests and operational tests using potable water. The Contractor shall check the functioning of all pump accessories, valves, and feed points and shall repair or replace all malfunctioning or unsatisfactory components. The Contractor shall repair all leaking joints and components identified during the test and through the guarantee period.
- E. Prior to placing the required chemicals in any equipment, each component shall be blow dried to remove all moisture and any other material that could contaminate the chemicals to be used.
- F. Contractor shall demonstrate and document the accuracy of each pump using project-supplied calibration chamber.

[END OF SECTION]

SECTION 15000
BASIC MECHANICAL REQUIREMENTS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install to the required line and grade, all piping together with all fittings and appurtenances, required for a complete installation. Piping to be backfilled and/or encased in concrete is considered to be buried piping. Piping that is not buried is considered to be exposed.
- B. The Contractor shall furnish and install fittings, couplings, connections, sleeves, adapters, harness rods and closure pieces as required to connect pipelines of dissimilar materials and/or sizes herein included under this Section and other concurrent Contracts for a complete installation.
- C. The Contractor shall furnish all labor, materials, equipment, tools, and services required for the furnishing, installation and testing of all piping as shown on the Drawings, specified in this Section, and required for the Work. Piping shall be furnished and installed of the material, sizes, classes, and at the locations shown on the Drawings and/or designated in this Section. Piping shall include all fittings, adapter pieces, couplings, closure pieces, harnessing rods, hardware, bolts, gaskets, wall sleeves, wall pipes, hangers, supports, and other associated appurtenances for required connections to equipment, valves, or structures for a complete installation.
- D. Piping assemblies under 4-inch size shall be generally supported on walls and ceilings, unless otherwise shown on the Drawings or ordered by the Engineer, being kept clear of openings and positioned above "headroom" space. Where practical, such piping shall be run in neat clusters, plumb and level along walls, and parallel to overhead beams.
- E. The Contractor shall provide taps on piping where required or shown on the Drawings. Where pipe or fitting wall thicknesses are insufficient to provide the required number of threads, a boss or pipe saddle shall be installed.
- F. The work shall include, but not be limited to, the following:
 - 1. Connections to existing pipelines.
 - 2. Test excavations necessary to locate or verify existing pipe and appurtenances.
 - 3. Installation of all new pipe and materials required for a complete installation.
 - 4. Cleaning, testing and disinfecting as required.

1.02 MATERIAL CERTIFICATION AND SHOP DRAWINGS

- A. The Contractor shall furnish a Material Certification stating that the pipe materials and specials furnished under this Section conform to all applicable provisions of the corresponding Specifications. Specifically, the Certification shall state compliance with the applicable standards (ASTM, AWWA, etc.) for fabrication and testing.
- B. Shop Drawings for major piping (2-inches in diameter and greater) shall be prepared and submitted in accordance with the Contract Documents.
- C. Shop Drawings shall include, but not be limited to, complete piping layout, pipe material, sizes, class, locations, necessary dimensions, elevations, supports, hanger details, pipe joints, and the details of fittings including methods of joint restraint. No fabrication or installation shall begin until Shop Drawings are approved by the Engineer.

PART 2 – PRODUCTS

2.01 GENERAL

- A. All specials and every length of pipe shall be marked with the manufacturer's name or trademark, size, class, and the date of manufacture. Special care in handling shall be exercised during delivery, distribution, and storage of pipe to avoid damage and unnecessary stresses. Damaged pipe will be rejected and shall be replaced at the Contractor's expense. Pipe and specials stored prior to use shall be stored in such a manner as to keep the interior free from dirt and foreign matter.
- B. Testing of pipe before installation shall be as described in the corresponding ASTM or AWWA Specifications and in the applicable standard specifications listed in the following sections. Testing after the pipe is installed shall be as specified in Part 3.
- C. All buried piping shall have restrained joints for thrust protection unless otherwise specified or shown on the Drawings. All exposed piping shall have flanged joints, unless otherwise specified or shown on the Drawings.
- D. The Drawings indicate work affecting existing piping and appurtenances. The Contractor shall excavate test pits as required of all connections and crossings which may affect the Contractor's work prior to ordering pipe and fittings to determine sufficient information for ordering materials. The Contractor shall take whatever measurements that are required to complete the work as shown or specified.

2.02 WALL PIPES

- A. Where wall sleeves or wall pipes occur in walls that are continuously wet on one or both sides, they shall have water stop flanges at the center of the casting or as shown on the Drawings. Ends of wall pipes shall be flange, mechanical joint, plain end, or bell as shown on the Drawings, or as required for connection to the piping. Wall pipes shall be of the same material as the piping that they are connected to. If welded waterstop

flanges are employed, welds shall be 360 degree continuous on both sides of flange. Unless otherwise shown on the Drawings, waterstop flanges shall conform to the minimum dimensions shown below:

Pipe Size	Waterstop Flange Diameter	Waterstop Flange Thickness
4" - 12"	OD + 3.10"	0.50"
14" - 24"	OD + 4.15"	0.75"
30" - 36"	OD + 4.50"	1.00"
42" - 48"	OD + 5.00"	1.25"
54"	OD + 5.90"	1.50"

2.03 SLEEVES

- A. Unless shown otherwise, all piping passing through walls and floors shall be installed in sleeves or wall castings accurately located before concrete is poured or placed in position during construction of masonry walls. Sleeves passing through floors shall extend from the bottom of the floor to a point 3 inches above the finished floor, unless shown otherwise. Water stop flanges are required on all sleeves located in floors or walls which are continually wet or under hydrostatic pressure on one or both sides of the floor or wall.
- B. Sleeves shall be cast iron or fabricated steel in accordance with details shown on the Drawings. If not shown on the Drawings, the Contractor shall submit to the Engineer the details of sleeves he proposes to install; and no fabrication or installation thereof shall take place until the Engineer's approval is obtained. Steel sleeves shall be fabricated of structural steel plate in accordance with the standards and procedures of AISC and AWS. Steel sleeve surfaces shall receive a commercial sandblast cleaning and then be shop painted in accordance with Section 09900 – Painting.
- C. When shown on the Drawings or otherwise required, the annular space between the installed piping and sleeve shall be completely sealed against a maximum hydrostatic pressure of 20 psig. Seals shall be mechanically interlocked, solid rubber links, trade name "Link-Seal", as manufactured by Garlock Pipeline Technologies (GPT) or equal. Rubber link, seal-type, size, and installation thereof, shall be in strict accordance with the manufacturer's recommendations. For non-fire rated walls and floors, pressure plate shall be glass reinforced nylon plastic with EPDM rubber seal and 316 stainless steel bolts and nuts. For fire rated walls and floors, two independent seals shall be provided consisting of low carbon steel, zinc galvanized pressure plates, silicon rubber seals and 316 stainless steel bolts and nuts.
- D. Cast iron mechanical joint adapter sleeves shall be Clow # 1429, as manufactured by the Clow Corp., or equal. Mechanical joint adapter sleeves shall be provided with suitable gasket, follower ring, and bolts to affect a proper seal. In general, sleeves

installed in walls, floors, or roofs against one side of which will develop a hydrostatic pressure, or through which leakage of liquid will occur, shall be so sealed. If welded waterstop flanges are employed, welds shall be 360 degree continuous on both sides of flange.

2.04 SOLID SLEEVE COUPLINGS (FOR BURIED SERVICE THROUGH 54-INCH)

- A. Solid sleeve couplings shall be used to connect buried service piping where shown on the Drawings. Solid sleeves shall be ductile iron, long body and shall conform to the requirements of ANSI A21.10 (AWWA C110). Unless otherwise shown or specified, solid sleeve couplings shall be Style A11760 as manufactured by American Cast Iron Pipe Co., or equal. Solid sleeve couplings shall be restrained with wedge-type restraining glands to meet the pressures specified in 40 06 20 – Schedules.
- B. Alternatively, EBAA Iron 3800 Mega-Coupling is acceptable.

2.05 SLEEVE TYPE COUPLINGS (FOR EXPOSED SERVICE AND BURIED SERVICE ABOVE 54-INCH)

- A. Sleeve type, flexible couplings shall be furnished and installed where shown on the Drawings or otherwise required to resist internal operating pressures. In addition to that specified herein, harnessed, sleeve type flexible couplings shall be provided on all exposed pipe 3 inches and larger in diameter that spans any expansion joint in a building or structure.
- B. Materials shall be of high strength steel and couplings shall be rated for the same pressures as the connecting piping.
- C. Gaskets shall be rubber. Bolts and nuts shall be alloy steel, corrosion-resistant and prime coated.
- D. Harnessing for exposed applications shall be by rodding across the sleeve type coupling to the nearest pipe joint on either side of the coupling using threaded rods and rod tabs unless otherwise approved by the Engineer.
- E. Couplings shall be as manufactured by Smith-Blair Model 411, Romac Industries Model 400, Dresser Industries Style 38, or equal as required and shown on the Drawings. All couplings shall be provided without interior pipe stop.
- F. Couplings shall be provided with manufacturer's fusion bonded epoxy painting system.

2.06 FLANGED COUPLING ADAPTERS

- A. Flanged coupling adapters shall be furnished as required and as shown on the Drawings.
- B. Flanged coupling adapters shall be of ductile iron or carbon steel construction and shall be rated for the same pressure as the connected piping.

- C. All flanged coupling adapters shall be harnessed by tying the adapter to the nearest pipe joint flange using threaded rods and rod tabs unless otherwise approved by the Engineer.
- D. Flanged coupling adapters shall be manufactured by Smith-Blair Model 912 or 913, Romac Industries Model FCG or FC 400, Dresser Industries Model 128-W, or equal.
- E. Flanged coupling adapters shall be provided with manufacturer's fusion bonded epoxy painting system.

2.07 RESTRAINED FLANGE COUPLING ADAPTERS

- A. Description: Wedge style restrained flanging system for adapting and restraining plain end pipe to flanged pipe or fitting.
- B. Products and Manufacturers: Provide one of the following:
 - 1. Series 2100, as manufactured by EBAA.
 - 2. Or approved equal.
- C. Pressure and Service: Same as connected piping.
- D. Material: Ductile iron.
- E. Gasket: Recommended by the manufacturer.
- F. Coating: Manufacturer's fusion bonded epoxy painting system.
- G. Bolts and Nuts: Alloy steel, corrosion-resistant, primer-coated.

2.08 DISMANTLING JOINTS

- A. Dismantling joints shall be furnished at locations shown on the Drawings.
- B. Dismantling joints for sizes less than 12-inch shall be of ductile iron or carbon steel construction and shall be rated for the same pressure as the connected piping. Dismantling joints for sizes greater than 12-inches shall be of carbon steel construction and shall be rated for the same pressure as the connected piping.
- C. Flanges for dismantling joints shall match the bolt pattern and pressure rating of the flanges for the connected piping.
- D. All dismantling joints shall be restrained utilizing restraining rods provided by the manufacturer. Restraining rods shall be constructed from ASTM A193 Grade B7 steel. Restraining rods and restraint system shall be installed in strict accordance with manufacturer's recommendations.

- E. Dismantling joints shall be provided with manufacturer's fusion bonded epoxy painting system.
- F. Dismantling joints shall be manufactured by Smith Blair Model 975, Romac Industries Model DJ400, or equal.

2.09 GROOVED COUPLINGS

- A. Grooved end pipe couplings shall be furnished as specified or shown on the Drawings.
- B. Materials shall be of malleable iron and couplings shall be rated for the same pressures as the connecting piping.
- C. Gaskets shall be rubber. Bolts and nuts shall be heat treated carbon steel track bolts and shall be plated.
- D. After installation, buried couplings shall receive two heavy coats of an approved coal tar which is compatible with the finish of the coupling. Exposed couplings shall be painted in accordance with Section 09900 – Painting.
- E. Couplings shall be manufactured by Victaulic Company of America Style 31 or equal.

2.10 TAPPING SLEEVES AND TAPPING SADDLES

- A. Tapping sleeves shall be similar to Mueller Outlet Seal, American Uniseal or Kennedy Square Seal. All sleeves shall have a minimum working pressure of 150 psi. All sleeves larger than twelve (12) inches shall be ductile iron. All taps shall be machine drilled; no burned taps will be allowed.
- B. Tapping saddles may be used on mains sixteen (16) inches and larger where the required tap size does not exceed one-half the size of the main (i.e. 8-inch tapping saddle for use on a 16-inch main). Tapping saddles shall be manufactured of ductile iron providing a factor of safety of at least 2.5 at a working pressure of 250 psi. Saddles shall be equipped with a standard AWWA C-110-77 flange connection on the branch. Sealing gaskets shall be "O" ring type, high quality molded rubber having an approximate seventy durometer hardness, placed into a groove on the curved surface of the tapping saddles. Straps shall be of alloy steel. The tapping saddle shall be the American tapping saddle, U.S. Pipe tapping saddle, or equal. All taps shall be machine cut, no burned taps will be allowed.

2.11 UNIONS

- A. For ductile iron, carbon steel, and grey cast iron pipes assembled with threaded joints and malleable iron fittings, unions shall conform to ANSI B16.39.
- B. For copper piping, unions shall have ground joints and conform to ANSI B16.18.
- C. For PVC and CPVC piping, unions shall be socket weld type with Viton O-ring.

2.12 THERMOPLASTIC TUBING AND FITTINGS

- A. Thermoplastic tubing shall be manufactured from polyallomer tubing. Tubing shall be protected from ultraviolet radiation degradation with a black coating or integral color conforming to ASTM D-1248, Type 1, Class C, Category 3. Fittings and connectors used with thermoplastic tubing shall be the flareless tube type constructed of brass conforming to SAE CA377, SAE CA360 or equal. Brass sleeves shall be used.
- B. Assembly of the thermoplastic tubing shall consist of pushing the tubing into the fitting and hand tightening the nut with final tightening with a wrench. Care shall be taken not to overtighten the nut. Plastic tube racks and bend holders shall be provided for holding the tubing in position. Needle valves used with thermoplastic tubing shall be the globe type constructed with a brass body, stem and seat and Buna-N "O"-ring seals. Installation shall be in accordance with the manufacturer's recommendations. Thermoplastic tubing, shall be the Impolene (polyallomer) system and needle valves, fittings and connectors shall be the Poly-Flo with 261 UB Universal Nut and Sleeve system as manufactured by Imperial Eastman, or equal.

2.13 FLEXIBLE RESTRAINED EXPANSION JOINTS

- A. Restrained expansion joints shall be manufactured of 60-42-10 ductile iron conforming to material and other applicable requirements of ANSI/AWWA C153/A21.53.
- B. Each pressure containing component shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the materials requirements of, and tested in accordance with, ANSI/AWWA C213 and shall meet or exceed the requirements of ANSI/AWWA C550.
- C. Seals shall conform to the applicable requirements of ANSI/AWWA C111/A21.11.
- D. All bolts used in the assemblies shall be stainless steel and shall be coated with a premium quality epoxy.
- E. Flanged ends shall comply with ANSI/AWWA C110/A21.10, with the addition of O-ring groove and O-ring.
- F. Mechanical joint ends shall comply with ANSI/AWWA C153/A21.53.
- G. Restrained expansion joints shall have a minimum pressure rating of 350 psi with a minimum safety factor of 3:1. Each assembly shall be tested at 350 psi before shipment.
- H. Restrained expansion joints shall provide for self-restraint without tie rods and shall provide for expansion and contraction capabilities cast as an integral part of the end connection.
- I. Flexible restrained expansion joints shall consist of an expansion joint designed and cast as an integral part of a ball and socket type flexible joint having a minimum of 15 degrees deflection per ball.

- J. Restrained expansion joints shall be the Single Ball or Double Ball FLEX-TEND Expansion Joint as manufactured by EBAA Iron Inc., or equal.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. All piping shall be installed by skilled workmen and in accordance with the best standard practice for piping installation as shown on the Drawings, specified or recommended by the pipe manufacturer. Proper tools and appliances for the safe and convenient handling and installing of the pipe and fittings shall be used. Great care shall be taken to prevent any pipe coating from being damaged on the inside or outside of the pipe and fittings. All pieces shall be carefully examined for defects, and no piece shall be installed which is known to be cracked, damaged, or otherwise defective. If any defective pieces should be discovered after having been installed, it shall be removed and replaced with a sound one in a satisfactory manner by the Contractor and at his own expense. Pipe and fittings shall be thoroughly cleaned before they are installed and shall be kept clean until they are accepted in the complete work. All piping connections to equipment shall be provided with unions or coupling flanges located so that piping may be readily dismantled from the equipment. At certain applications, Dresser, Victaulic, or equal, couplings may also be used. All piping shall be installed in such a manner that it will be free to expand and contract without injury to itself or to structures and equipment to which it is connected. All piping shall be erected to accurate lines and grades with no abrupt changes in line or grade and shall be supported and braced against movement, temporary, or permanent. All exposed piping shall be installed with vertical and horizontal angles properly related to adjoining surfaces or pipes to give the appearance of good workmanship. Unless otherwise shown or approved, provided a minimum headroom clearance under all piping of 7 feet 6 inches.
- B. Unless otherwise shown or specified, all waste and vent piping shall pitch uniformly at a 1/4-inch per foot grade and accessible cleanouts shall be furnished and installed as shown and as required by local building codes. Installed length of waste and vent piping shall be determined from field measurements in lieu of the Drawings.
- C. All excavation shall be made in such a manner and to such widths as will provide ample room for properly installing the pipe and permit thorough compaction of backfill around the pipe. The minimum trench widths shall be in strict accordance with the "Trench Width Excavation Limits" as shown on the Drawings. All excavation and trenching shall be done in strict accordance with these specifications and all applicable parts of the OSHA Regulations, 29CFR 1926, Subpart P.
- D. All excavation required by this Contract shall be unclassified. No additional payment will be made for rock excavation required for the installation of pipe or structures shown on the Drawings.

- E. Enlargements of the trench shall be made as needed to give ample space for operations at pipe joints. The width of the trench shall be limited to the maximum dimensions shown on the Drawings, except where a wider trench is needed for the installation of and work within sheeting and bracing. Except where otherwise specified, excavation slopes shall be flat enough to avoid slides which will cause disturbance of the subgrade, damage to adjacent areas, or endanger the lives or safety of persons in the vicinity.
- F. Hand excavation shall be employed wherever, in the opinion of the Engineer, it is necessary for the protection of existing utilities, poles, trees, pavements, or obstructions.
- G. No greater length of trench in any location shall be left open, in advance of pipe laying, than shall be authorized or directed by the Engineer and, in general, such length shall be limited to approximately one hundred (100) feet. The Contractor shall excavate the trenches to the full depth, width and grade indicated on the Drawings including the relevant requirements for bedding. The trench bottoms shall then be examined by the Engineer as to the condition and bearing value before any pipe is laid or bedding is placed.
- H. No pressure testing shall be performed until the pipe has been properly backfilled in place. All pipe passing through walls and/or floors shall be provided with wall pipes or sleeves in accordance with the specifications and the details shown on the Drawings. All wall pipes shall be of ductile iron and shall have a water stop located in the center of the wall. Each wall pipe shall be of the same class, thickness, and interior coating as the piping to which it is joined. All buried wall pipes shall have a coal tar outside coating on exposed surfaces.
- I. Joint deflection shall not exceed 75% of the manufacturer's allowable deflection.
- J. Excavation and backfilling shall conform to the requirements of Section 02200 – Earthwork, and as specified herein. Maximum trench widths shall conform to the Trench Width Excavation Limits shown on the Drawings. All exposed, submerged, and buried piping shall be adequately supported and braced by means of hangers, concrete piers, pipe supports, or otherwise as may be required by the location.
- K. Following proper preparation of the trench subgrade, pipe and fittings shall be carefully lowered into the trench so as to prevent dirt and other foreign substances from gaining entrance into the pipe and fittings. Proper facilities shall be provided for lowering sections of pipe into trenches. Under no circumstances shall any of the materials be dropped or dumped into the trench.
- L. Water shall be kept out of the trench until jointing and backfilling are completed. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no water, earth, or other substance will enter the pipes, fitting, or valves. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored as required.

- M. All piping shall be installed in such a manner that it will be free to expand and/or contract without injury to itself or to structures and equipment to which it is connected. All piping shall be erected to accurate lines and grades with no abrupt changes in line or grade and shall be supported and braced against movement, temporary, or permanent. All exposed piping shall be installed with vertical and horizontal angles properly related to adjoining surfaces or pipes to give the appearance of good workmanship. Pipes crossing within a vertical distance of less than or equal to one (1) foot shall be encased and supported with concrete at the point of crossing to prevent damage to the adjacent pipes as shown on the Drawings.
- N. The full length of each section of pipe shall rest solidly upon the bed of the trench, with recesses excavated to accommodate bells, couplings, joints, and fittings. Before joints are made, each pipe shall be well bedded on a solid foundation; and no pipe shall be brought into position until the preceding length has been thoroughly bedded and secured in place. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid by the Contractor at his own expense. Pipe shall not be laid in water or when trench conditions are unsuitable for work.
- O. Proper and suitable tools and appliances for the safe convenient handling and laying of pipe shall be used and shall in general agree with manufacturer's recommendations.
- P. At the close of each work day, the end of the pipeline shall be tightly sealed with a cap or plug so that no water, dirt, or other foreign substance may enter the pipeline, and this plug shall be kept in place until pipe laying is resumed.
- Q. During the laying of pipe, each pipe manufacturer shall provide his own supervisor to instruct the Contractor's pipe laying personnel in the correct procedure to be followed.
- R. Ordinarily only full lengths of pipe (as furnished by the pipe manufacturer) shall be used exceptions: closure pieces at manholes and areas where joint deflection is required.
- S. For gravity sewer installations, the Contractor shall use a laser device to maintain the trench and pipe alignment. The laser device shall be re-checked for correct elevation and pipe alignment prior to pipe installation if the device is left in the pipe overnight. Corrected invert elevations at each manhole and any adjustments will be coordinated and approved by the Engineer.
- T. At the close of Work each day, pipeline trenches shall be completely backfilled. In paved areas the surfaces shall be restored to allow for traffic over the trench during non-working hours. Under no conditions shall any pipeline trench be left open during non-working hours.

3.02 JOINTS IN PIPING

- A. Restrained joints shall be provided on all pipe joints as specified herein and shown on the Drawings. Restrained joints shall be made up similar to that for push-on joints.
- B. Push-on joints include a single rubber gasket which fits into the bell end of the pipe. The gasket shall be wiped clean, flexed and then placed in the socket. Any bulges in the gasket which might interfere with the entry of the plain end of the pipe shall be removed. A thin film of lubricant shall be applied to the gasket surface which will come into contact with the spigot end of the pipe. The lubricant shall be furnished by the pipe manufacturer. The plain end of the pipe, which is tapered for ease of assembly, shall be wiped clean and a thick film of lubricant applied to the outside. The pipe shall be aligned and carefully entered into the socket until it just makes contact with the gasket. The joint assembly shall be completed by entering the pipe past the gasket until it makes contact with the bottom of the socket. The pipe shall be pulled "home" with an approved jack assembly as recommended by the pipe manufacturer. If assembly is not accomplished by reasonable force, the plain end shall be removed, and the condition corrected.
- C. Flanged joints shall be brought to exact alignment and all gaskets and bolts or studs inserted in their proper places. Bolts or studs shall be uniformly tightened around the joints. Where stud bolts are used, the bolts shall be uniformly centered in the connections and equal pressure applied to each nut on the stud. Pipes in all lines subject to temperature changes shall be cut short and cold sprung into place to compensate for expansion when hot.
- D. Mechanical joints shall be made up with gaskets, glands and bolts. When a joint is to be made up, the bell or socket and plain end shall be cleaned and washed with a solution of mild soap in water; the gland and gasket shall be slid onto the plain end and the end then entered into the socket until it is fully "home" on the centering ring. The gasket shall then be painted with soapy water and slid into position, followed by the gland. All bolts shall be inserted and made up hand tight and then tightened alternately to bring the gland into position evenly. Excessive tightening of the bolts shall be avoided. All nuts shall be pulled up using a torque wrench which will not permit unequal stresses in the bolts. Torque shall not exceed the recommendations of the manufacturer of the pipe and bolts for the various sizes. Care shall be taken to assure that the pipe remains fully "home" while the joint is being made. Joints shall conform to the applicable AWWA Specifications.
- E. Threaded and/or screwed joints shall have long tapered full depth threads to be made with the appropriate paste or jointing compound, depending on the type of fluid to be processed through the pipe. All pipe up to, and including 1-1/2-inches, shall be reamed to remove burr and stood on end and well pounded to remove scale and dirt. Wrenches on valves and fittings shall be applied directly over the joint being tightened. Not more than three pipe threads shall be exposed at each connection. Pipe, in all lines subject to temperature changes shall be cut short and cold sprung into place to compensate for expansion when hot. Joints in all piping used for chlorine gas lines shall be made up with a glycerine and litharge cement. Joints in plastic piping (PVC/CPVC) shall be laid and

joints made with compounds recommended by the manufacturer. Installation shall conform to the requirements of ASTM D2774 and ASTM D2855. Unions required adjacent to valves and equipment.

- F. Soldered joints shall have the burrs removed and both the outside of pipe and the inside of fittings shall be thoroughly cleaned by proper tools recommended for that purpose. Flux shall be applied to both pipe and inside of fittings and the pipe placed into fittings and rotated to insure equal distribution of flux. Joints shall be heated and solder applied until it shows uniformly around the end of joints between fitting and pipe. All joints shall be allowed to self-cool to prevent the chilling of solder. Combination flux and solder paste manufactured by a reputable manufacturer is acceptable. Unions required adjacent to valves and equipment.
- G. Welded joints shall be made by competent operators in a first class workmanlike manner, in complete accordance with ANSI B31.1 and AWWA C206. Welding electrodes shall conform to ASTM A233, and welding rod shall conform to ASTM A251. Only skilled welders capable of meeting the qualification tests for the type of welding which they are performing shall be employed. Tests, if so required, shall be made at the expense of the Contractor, if so ordered by the Engineer. Unions shall be required adjacent to valves and equipment.
- H. Copper joints shall be thoroughly cleaned and the end of pipes uniformly flared by a suitable tool to the bevels of the fittings used. Wrenches shall be applied to the bodies of fittings where the joint is being made and in no case to a joint previously made. Dimensions of tubing and copper piping shall be in complete accordance with the fittings used. No flare joints shall be made on piping not suited for flare joints. Installations for propane gas shall be in accordance with NFPA 54 and/or 58.
- I. Solvent or adhesive welded joints in plastic piping shall be accomplished in strict accordance with the pipe manufacturer's recommendations, including necessary field cuttings, sanding of pipe ends, joint support during setting period, etc. Care shall be taken that no droppings or deposits of adhesive or material remain inside the assembled piping. Solvent or adhesive material shall be compatible with the pipe itself, being a product approved by the pipe manufacturer. Unions are required adjacent to valves and equipment. Sleeve-type expansion joints shall be supplied in exposed piping to permit 1-inch minimum of expansion per 100 feet of pipe length.
- J. Dielectric isolation such as flange isolation kits, dielectric unions, or similar, shall be installed wherever dissimilar metals are connected according to the following table.

	Zinc	Galvanized Steel	Aluminum	Cast Iron	Ductile Iron	Mild Steel/ Carbon Steel	Copper	Brass	Stainless Steel
Zinc			•	•	•	•	•	•	•
Galvanized Steel			•	•	•	•	•	•	•
Aluminum	•	•		•	•	•	•	•	•
Cast Iron	•	•	•				•	•	•
Ductile Iron	•	•	•				•	•	•
Mild Steel/ Carbon Steel	•	•	•				•	•	•
Copper	•	•	•	•	•	•			•
Brass	•	•	•	•	•	•			•
Stainless Steel	•	•	•	•	•	•	•	•	

Notes:

• signifies dielectric isolation is required between the two materials noted.

Consult Engineer for items not listed in table.

Provide flange isolation kits for all flanged connections of dissimilar metals and hardware including connections to equipment.

Contractor shall include all isolation descriptions with piping submittals.

- K. Eccentric reducers shall be installed where air or water pockets would otherwise occur in mains because of a reduction in pipe size.
- L. Joints in polypropylene and polyvinylidene fluoride pipe shall be butt fusion weld. All butt welding shall follow the requirements of ASTM D-2657 and the manufacturer's recommendations.

3.03 FLUSHING AND TESTING

- A. All piping shall be properly flushed and tested unless specifically exempted elsewhere in the Specifications or otherwise approved by the Engineer. Air and gas pipelines shall be flushed and tested with compressed air. Gravity sewer piping shall be flushed and tested as specified in Section 02640 – Utility Structures. All other liquid conveying pipelines shall be flushed and tested with water. The Contractor shall furnish and install all means and apparatus necessary for getting the air or water into the pipeline for flushing and testing including pumps, compressors, gauges, and meters, any necessary plugs and caps, and any required blow-off piping and fittings, etc., complete with any necessary reaction blocking to prevent pipe movement during the flushing and testing. All pipelines shall be flushed and tested in such lengths or sections as agreed upon among the

Owner, Engineer, and Contractor. Owner or Engineer shall provide test pressure. Test pressures shall be as measured at the lowest point of the pipe segment being tested. The Contractor shall give the Owner and Engineer reasonable notice of the time when he intends to test portions of the pipelines. The Engineer reserves the right, within reason, to request flushing and testing of any section or portion of a pipeline.

- B. The Contractor shall provide water for all flushing and testing of liquid conveying pipelines. Raw water or non-potable water may be used for flushing and testing liquid pipelines not connected to the potable water system. Only potable water shall be used for flushing and testing the potable water system.
- C. Air and gas piping shall be completely and thoroughly cleaned of all foreign matter, scale, and dirt prior to start-up of the air or gas system.
- D. At the conclusion of the installation work, the Contractor shall thoroughly clean all new liquid conveying pipe by flushing with water or other means to remove all dirt, stones, pieces of wood, etc., which may have entered the pipe during the construction period. If after this cleaning any obstructions remain, they shall be corrected by the Contractor, at his own expense, to the satisfaction of the Engineer. Liquid conveying pipelines shall be flushed at the rate of at least 2.5 feet per second for a duration suitable to the Engineer or shall be flushed by other methods approved by the Engineer.
- E. Compressed/service air and gas piping shall be flushed by removing end caps from the distribution lines and operating one (1) compressor, in accordance with the manufacturer's instructions.
- F. After flushing, all air piping shall be pressure and leak tested prior to coating and wrapping of welded joints. Immediately upon successful completion of the pressure and leak test, welded joints shall be thoroughly cleaned of all foreign matter, scale, rust, and discoloration and coated in accordance with the Specifications.
- G. All process air piping shall be leak tested by applying a soap solution to each joint. Leak tests shall be conducted with one (1) blower in service at normal operating pressure.
- H. During testing the piping shall show no leakage. Any leaks or defective piping disclosed by the leakage test shall be repaired or replaced by the Contractor, at his own expense, and the test repeated until all such piping shows tight.
- I. All buried process air piping shall be pressurized to 25 psig and tested for leaks by applying a soap solution to each joint. The air supply shall be stopped and the pipe pressure monitored. System pressure shall not fall by more than 0.5% of the 25 psig test pressure over a one-hour test period. Should the system fail to hold the required pressure for one hour, the cause shall be determined and corrected and the test repeated until a successful test of the entire system is obtained.
- J. Field leakage tests shall be performed for all submerged process air piping. The procedure shall consist of operating the system under clear nonpotable water for visual

identification of all leaks. All field leakage tests shall be witnessed by the Engineer. All submerged piping shall be installed free of any leaks.

- K. After flushing, all liquid conveying pipelines shall be hydrostatically tested at the test pressure specified. The procedure used for the hydrostatic test shall be in accordance with the requirements of AWWA C600. Each pipeline shall be filled with water for a period of no less than 24 hours and then subjected to the specified test pressure for 2 hours. During this test, exposed piping shall show no leakage. Allowable leakage in buried piping shall be in accordance with AWWA C600.
- L. Any leaks or defective pipe disclosed by the hydrostatic test shall be repaired or replaced by the Contractor, at his own expense, and the test repeated until all such piping shows tight.
- M. After flushing, all gas piping shall be leak tested in accordance with all local codes and regulations and in conformance with the recommendations or requirements of any National Institute or Association for the specific service application.

3.04 PAINTING AND COLOR-CODING SYSTEM

- A. All exposed piping specified shall be color coded in accordance with the Owner's standard color designation system for pipe recognition and in accordance with Section 15030 – Piping and Equipment Identification Systems. In the absence of a standard color designation system, the Engineer will establish a standard color designation for each piping service category from color charts submitted by the Contractor in compliance with Section 09900 – Painting.
- B. All piping specified in this Section shall be painted in accordance with Section 09900 – Painting, except as follows:
 - 1. Copper pipe
 - 2. Stainless steel pipe. Flanges and supports or hangers shall be painted.

[END OF SECTION]

SECTION 15006

DUCTILE IRON PIPE AND FITTINGS

PART 1 GENERAL

1.01 SCOPE

- A. All ductile iron pipe and specials shall be marked with the manufacturer's name or trademark, size, weight, thickness class, the date of manufacture, and the word "Ductile".
- B. Ductile iron pipe (DIP) of the sizes shown or specified shall conform to ANSI A21.51 (AWWA C151), Grade 60 42 10 for ductile iron pipe centrifugally cast in metal molds or sand lined molds. All ductile iron pipe shall conform to ANSI A21.50 (AWWA C150) for thickness design and shall be supplied in 18 or 20 foot nominal lengths or as required to meet the requirements of the Drawings. Fittings and specials shall be ductile iron, conforming to the requirements of ANSI A21.10 (AWWA C110) or ANSI A21.53 (AWWA C153).
- C. Minimum Class 53 pipe shall be used for flanged spools.

PART 2 PRODUCTS

2.01 DUCTILE IRON PIPE AND FITTINGS

- A. All pipe and fittings, with the exception of glass lined pipe and sleeves, shall be cement mortar lined. Linings shall conform to American Standard Specifications for Cement Mortar Lining for Ductile Iron Pipe and Fittings, ANSI A21.4 (AWWA C104) and shall be standard thickness. The mortar lining shall be protected with the bituminous seal coat. All buried DIP and fittings shall have a bituminous coating on the exterior surfaces in accordance with ANSI A21.51 (AWWA C151). All exposed DIP and fittings shall have a shop applied prime coat in accordance with Section 09900 - Painting.
- B. Glass lined ductile iron pipe shall be furnished and installed where specified in the Exterior Piping System Schedule. The finished lining shall be from 0.008 inch to 0.012 inch thick, hardness of from 5 to 6 on the Mohs Scale, density of from 2.5 to 3.0 grams per cubic centimeter as measured in accordance with the requirements of ASTM D792 and be capable of withstanding a thermal shock of 350°F without crazing, blistering, or spalling. The lining shall be Ervite Type SG 14, as manufactured by the Ervite Corporation, Erie, Pa., Ferroch MEH 32, by Water Works Supply & Mfg., Co., Marysville, CA, or equal.
- C. Cutting of glass lined pipe in the field shall be limited to only one piece per run of pipe, and this shall be for closure purposes only. Spalling of the glass liner shall be no more than 1/8 inch back from the cut. Flanges and bolt holes on spool pieces shall be aligned prior to glassing and shall be sealed and tested prior to shipment in accordance with the manufacturer's recommendation. Warping of flanges and/or pipe may be cause for rejection as determined by the Engineer.
- D. Requirements for various types of joints are described in the following paragraphs. UNLESS OTHERWISE NOTED HEREIN OR ON THE DRAWINGS, ALL EXPOSED DUCTILE IRON PIPING SHALL HAVE FLANGED JOINTS.
- E. Flanged joints and fittings shall have a minimum pressure rating of 250 psi with 125 lb. American Standard flanges. All flanges and fittings shall conform to the requirements of ANSI B16.1. Flanges shall be ductile iron and shall be of the threaded or screw on type. The

face of the flanges shall be machined after installation of the flange to the pipe. No raised surface shall be allowed on flanges. Flanged pipe shall conform to the requirements of ANSI Specification A21.15, (AWWA C115). Pipe lengths shall be fabricated to meet the requirements of the Drawings.

- F. Gaskets shall be the "Ring Gasket" type, 1/8 inch minimum thickness, cloth inserted rubber, red rubber or neoprene and shall be suitable for the service intended. Gaskets for glass lined pipe shall be TORUSEAL flange gasket, or equal. Bolts shall be of the size and length called for and in accordance with the "American Standard" and comply with the requirements of the ANSI/AWWA Standards. The bolts for flanged joints shall be a minimum ASTM A307; Grade B carbon steel and be in accordance with ANSI A21.10, (AWWA C110). The bolts shall have hexagonal heads and nuts, no washers shall be used.
- G. Bell and spigot pipe shall be provided with push on, O ring rubber gasket, compression type joints and shall conform to the requirements of ANSI A21.11 (AWWA C111). Fittings and specials shall be supplied with mechanical joints as specified for mechanical joint pipe. If required by installation conditions, pipe shall have cast on lugs for adequately tying it together.
- H. Mechanical joints and fittings shall conform to the requirements of ANSI A21.11, (AWWA C111). Joints shall be made employing a tapered rubber gasket forced into a tapered groove with a ductile iron follower ring. If required by installation conditions, pipe and fittings shall have cast on lugs for adequately tying the pipe and fittings together. These shall be in conformance with standard practice and as outlined under the appropriate AWWA Specifications.
- I. Bolts for mechanical joints shall be high strength corrosion resistant low-alloy steel tee-head bolts with hexagonal nuts.
- J. Mechanical coupling joint pipe and fittings shall be split type, shouldered end. Coupling materials shall be malleable iron. Couplings shall have a minimum pressure rating and service equal to that of the connected piping. Gaskets shall be of rubber. Bolts and nuts shall be heat treated carbon steel track bolts and shall be plated. After installation, buried couplings shall receive two heavy coats of coal tar epoxy (min. 24 mil thickness) which is compatible with the finish of the couplings. Couplings shall be as manufactured by Victaulic Company of America Style 31, or equal.
- K. Restrained joint pipe shall consist of factory manufactured bolted retainer rings, ductile iron locking segments held in place by rubber retainers, or ductile iron retaining rings that lock over the bell of the joint and are secured to prevent rotation, and factory welded retainer beads or rings on the spigot of the pipe. All components of the bolted or snap ring assemblies shall be constructed of corrosion-resistant, high strength, low-alloy steel. Restrained joint pipe shall be Flex-Ring or Lock-Ring type joints as manufactured by American Ductile Iron Pipe Company, HP LOK or TR Flex as manufactured by US Pipe, Bolt-Lok or Snap-Lok as manufactured by Griffin Pipe Products, TR Flex or Super Lock as manufactured by Clow Water Systems Co., or approved equal.
- L. Restrained fittings for piping systems 16-inches in diameter and greater shall have factory restraint systems identical to the factory restrained joint pipe specified in Item K above. All fittings shall be minimum pressure Class 250 unless otherwise specified.
- M. Restrained fittings for pipe systems 14-inches in diameter and smaller shall be Mechanical Joint fittings with restraint assemblies such as Stargrip by Star Pipe Systems, Mega Lug by EBAA Iron, ONE LOK by Sigma, Grip Ring by Romac, or approved equal. Where threaded-rods are allowed, the rods and tabs shall be designed for the specified restraint system

design pressure, shall have lengths less than 10 feet between fittings, and shall be painted with two heavy coats of coal tar epoxy after installation.

- N. The manufactured systems for thrust restraint indicated above shall be used where restrained joint ductile iron pipe and fittings are specified or indicated on the drawings. Gripping gaskets are not an acceptable form of restraint. Thrust restraint and harnessing systems such as threaded-rods, friction clamps, retainer glands shall be used only where specifically specified herein, indicated on the drawings or if allowed by the Engineer in isolated applications where conditions warrant and necessitate their use. Concrete thrust blocks may be used in accordance with the schedule indicated on the drawings, if applicable.
- O. All buried ductile iron pipe shall be polywrapped.

[END OF SECTION]

SECTION 15008

PVC PIPE

PART 1 GENERAL

1.01 SCOPE

- A. Reference Section 15000, Basic Mechanical Requirements.

PART 2 PRODUCTS

2.01 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

- A. PVC pipe and fittings shall be manufactured in accordance with ASTM D 1785, D 1784 and F 441, "normal impact" pipe, Schedule 40 or 80 as specified.
- B. Fittings used with this pipe shall be socket type or flanged type as specified herein or indicated on the Drawings. Plastic piping shall be installed in full accordance with the manufacturer's recommendations for the specific installation. No field bending or distortion of the pipe will be permitted.
- C. PVC pipe shall be Type 1 Grade 1 conforming to ASTM D 1784 and D 1785. Fittings shall conform to the following standard specifications:
1. Socket Type SDR 26
 2. Socket Type SDR 18 or 19 (C-900)
- D. Provide flanged fittings of the same material as the specified pipe and material conforming to ANSI B16.5 at all valves and equipment except at true (double) union valves. Flange gaskets shall be natural rubber or other material fully compatible with the fluid being conveyed. Where flanged piping is used with chemical systems, the gasket material shall conform to the requirements of the following table. Flange bolts shall be type 316 stainless steel minimum, with higher grade materials used where necessary for fluid (chemical) compatibility.

Chemical	Acceptable Gasket Material
Ammonium Hydroxide	EPDM
Aluminum Sulfate	EPDM, Viton
Ammonium Sulfate	EPDM
Calcium Hypochlorite	Viton
Carbon Dioxide Solution	Viton
Chlorine Solution	Viton
Chlorine Dioxide Solution	Viton
Ferric Chloride	EPDM, Viton
Ferric Sulfate	EPDM, Viton
Hydrochloric Acid	Viton
Hydrofluosilicic Acid	Viton
Lime Slurry	EPDM, Viton
Magnesium Chloride	EPDM, Viton

Chemical	Acceptable Gasket Material
Magnesium Hydroxide	EPDM, Viton
Methanol	EPDM
Ozone Solution	Viton
Phosphoric Acid	Viton
Polyaluminum Chloride	EPDM, Viton
Polymer	Viton
Potassium Permanganate	EPDM
Powdered Activated Carbon Slurry	EPDM, Viton
Sodium Bisulfite	EPDM, Viton
Sodium Hydroxide (Caustic)	EPDM
Sodium Hypochlorite	Viton
Sodium Permanganate	Teflon, Hypalon, Silicone, AFLAS, Kalrez, Santoprene
Sodium Silicate	EPDM, Viton
Sodium Thiosulfate	EPDM, Viton
Sulfur Dioxide Solution	EPDM, Viton
Sulfuric Acid	Viton
Zinc Orthophosphate	EPDM, Viton

- E. C900-Class 200 shall be in sizes between 4 inches and 12 inches and shall meet the requirements of AWWA C900 "Poly Vinyl Chloride (PVC) Pressure Pipe" and shall conform to all the requirements of ASTM D1784 and ASTM D2241. The pipe shall be a minimum of DR 14 and shall be capable of withstanding the overburden pressures determined by the depth of burial in the field.
1. Pipe material shall be made from clean, virgin, NSF approved Class 12454-A PVC compound conforming to resin specification ASTM D1784. Standard laying lengths shall be 20-feet (± 1 inch). Random lengths of not more than 15% of the total footage of each size may be shipped in lieu of the standard lengths. Reruns of reclaimed material shall not be accepted.
 2. The pipe shall have bell and spigot ends with push-on, O-ring rubber gasket, compression type joints conforming to the requirements of ASTM 2672. Elastomeric gaskets shall conform to the requirements of ASTM F477.
 3. Minimum pipe stiffness (F/dY) at 5% deflection shall be 914 psi for all sizes when tested in accordance with D2241.

4. The pipe shall be designed to pass a quick burst test pressure of 985 psi applied in 60 to 70 seconds when tested in accordance with ASTM D1599, as referenced in ASTM D2241.
 5. Fittings for C900-Class 200, DR 14 shall be ductile iron, bolted mechanical joint.
- F. C900-Class 150 shall be in sizes between 4 inches and 12 inches and shall meet the requirements of AWWA C900 "Poly Vinyl Chlorine (PVC) Pressure Pipe" and shall conform to all the requirements of ASTM D1784 and ASTM D2241. The pipe shall be a minimum of DR 18 and shall be capable of withstanding the overburden pressures determined by the depth of burial in the field.
1. Pipe material shall be made from clean, virgin, NSF approved Class 12454-A PVC compound conforming to resin specification ASTM D1784. Standard laying lengths shall be 20-feet (± 1 inch). Random lengths of not more than 15% of the total footage of each size may be shipped in lieu of the standard lengths. Reruns of reclaimed material shall not be accepted.
 2. The pipe shall have bell and spigot ends with push-on, O-ring rubber gasket, compression type joints conforming to the requirements of ASTM 2677. Elastomeric gaskets shall conform to the requirements of ASTM F477.
 3. Minimum pipe stiffness (F/dY) at 5% deflection shall be 435 psi for all sizes when tested in accordance with D2241.
 4. The pipe shall be designed to pass a quick burst test pressure of 755 psi applied in 60 to 70 seconds when tested in accordance with ASTM D1599, as referenced in ASTM D2241.
 5. Fittings for C900-Class 150, DR 18 shall be ductile iron, bolted mechanical joint.
- G. PVC pressure rated pipe (PR 160) shall be in sizes between 1 1/2 inches and 12 inches and shall conform to all the requirements of ASTM D1784 and ASTM D2241 and shall be a minimum of SDR 26 and shall be capable of withstanding the overburden pressures determined by the depth of burial in the field.
1. Pipe material shall be made from clean, virgin, NSF approved Class 12454-A PVC compound conforming to resin specification ASTM D1784. Standard laying lengths shall be 20-feet ($1\pm$ inch). Random lengths of not more than 15% of the total footage of each size may be shipped in lieu of the standard lengths. Reruns of reclaimed materials shall not be accepted.
 2. The pipe shall have bell and spigot ends with push-on, O-ring rubber gasket, compression type joints conforming to the requirements of ASTM 2672. Elastomeric gaskets shall conform to the requirements of ASTM F477.
 3. Minimum pipe stiffness (F/dY) at 5% deflection shall be 135 psi for all sizes when tested in accordance with ASTM D2241.
 4. The pipe shall be designed to pass a quick burst test pressure of 500 psi applied

in 60 to 70 seconds when tested in accordance with ASTM D1599, as referenced in ASTM D2241.

5. The pipe shall be designed to pass for 1000 hours a sustained test pressure of 340 psi when tested in accordance with ASTM D1598, as referenced in ASTM D2241.
- H. Fittings for PR 160, SDR 26 shall be PVC and designed for the pipe being supplied.
- I. Perforated and closed drainage pipe and fittings shall be rigid PVC pipe, Schedule 40 unless otherwise shown or specified with solvent welded type joints, or approved equal. Pipe shall be slotted or have two rows of 1/4-inch diameter holes spaced 4-inches apart along the circumference of the pipe. Longitudinal spacing of holes shall be 5-inches maximum.

[END OF SECTION]

SECTION 15030

PIPING AND EQUIPMENT IDENTIFICATION SYSTEMS

PART 1 GENERAL

1.01 REQUIREMENTS

- A. The Contractor shall furnish and install all components of the system for identification of piping and equipment as specified hereinafter. The system shall include the application of color coding to all new and altered plant piping. The Contractor shall paint the equipment and piping of all Contracts in the colors herein specified, and in accordance with the requirements of Section 09900, Painting.
- B. In addition to the legends specified herein the Engineer may order the Contractor to furnish and install additional identification legends and arrows at no additional cost to the Owner. Such additional signs may be requested near completion of the work and shall be limited to no more than five (5) signs for each type specified herein. The legends and color combinations for additional signs shall conform to the requirements specified herein.
- C. The Contractor shall submit a schedule of the colors and designations proposed in accordance with Section 01300, Submittals, and this Section. A minimum of four (4) color charts with cross references to the colors listed herein shall be included with the Submittal.

PART 2 PRODUCTS

2.01 TRACER WIRE

- A. All nonmetallic pipe shall be installed with two insulated 10 or 12gauge hard drawn copper clad steel core locating wires (minimum breaking strength of 1000 pounds) with color coded HDPE coating attached to the carrier pipe using (minimum) two-inch wide duct tape. Tape shall be at every joint and four to five feet spacing. Locating wires shall terminate four or more inches above the concrete valve pad and fold back inside a three-inch PVC access pipe. A continuity test shall be performed by the HDD Contractor in the presence of the County's inspector. Wires shall be installed on terminal water lines leading to fire hydrant. Access to tracer wires at the hydrant valve, shall be provided when the hydrant is more than 10 feet from the water main.

2.02 PIPING BAND

- A. All new and altered piping shall receive identification bands. Such bands shall be 6 inches wide, neatly made by masking, and spaced at intervals of 30 inches on centers regardless of the diameter of the pipe being painted. The Contractor may use approved precut and prefinished metal bands on piping, in lieu of the masked and painted bands, where approved by the Engineer.

2.02 VALVE ID

- A. All valve locations shall be identified with a concrete valve pad containing a bronze disc embedded in concrete.

2.03 PIPING IDENTIFICATION LEGEND

- A. The Contractor shall apply identification legends to all types and sections of piping as shown

on the Drawings or as designated by the Engineer. Such legends shall be in the form of plain block lettering giving the name of the pipe content in full or abbreviated form, and showing the direction of flow by arrows. All lettering and arrows shall be of the plastic snap on type, Seton nameplate "setmarks", or equal, or they shall be formed by stenciling in an approved manner using white or black as directed and shall have an overall height in inches in accordance with the following table:

<u>Diameter of Pipe or Pipe Covering</u>	<u>Height of Lettering</u>
3/4 to 1-1/4 inches	1/2-inches
1-1/2 to 2-inches	3/4-inches
2-1/2 to 6-inches	1-1/4-inches
8 to 10-inches	2-1/2-inches
Over 10-inches	3-1/2-inches

- B. Identification lettering shall be located midway between color coding bands where possible. Identification lettering and arrows shall be placed as directed by the Engineer, but shall generally be located each fifteen (15) feet in pipe length, and shall be properly inclined to the pipe axis to facilitate easy reading. In the event lettering and arrow identifications are required for piping less than 3/4 inch in diameter, the Contractor shall furnish and attach approved color coded tags where instructed.

C. Piping and Equipment Identification

Service	Legend	Base	Band
Sanitary and Process Drains	Drain	Grey	-
Filtrate	Filtrate Drain	Grey	-
Sludge Digested Primary	DPS	Medium Brown	-
Supernatant	Supernatant	Light Brown	-
Digested Waste Activated Sludge	DWAS	Medium Brown	-
Process Air	Process Air	Dark Green	-
Chlorine Solution	Chlorine Solution	Not Painted	-
Potable Cold Water	Potable Water	Light Blue	-
Potable Hot Water	Potable Water-Hot	Light Blue	-
Nonpotable Water	Nonpotable Water	Purple	-
Nonpotable Water Hydrant	-	Purple	-
Seal Water Piping	Seal Water	Light Green	-
Natural Gas Piping	Natural Gas	Safety Orange	-
Caustic Solution	Caustic Solution	Alternating Orange and Yellow Tape	-
Hydrants	-	Red	-
Alum	Alum	Not Painted	-

Sanitary and Process Drains	Drain	356 Dune Brown	-
Filtrate Drains	Filtrate Drain	356 Dune Brown	-
Primary Sludge	Primary Sludge	334 Light Brown	306 Light Grey
Return Activated Sludge	Return Act. Sludge	334 Light Brown	303 Dark Blue
Waste Activated Sludge	Waste Act. Sludge	334 Light Brown	300 Aqua
Thickened Sludge	Thickened Sludge	334 Light Brown	339 Medium Yellow
Scum Piping	Scum	334 Light Brown	305 Olive Green
Service Air	-	365 Vista Green	-
Process Air	Process Air	365 Vista Green	-
Chlorine Gas	Chlorine Gas	319 Light Yellow	-
Chlorine Solution	Chlorine Solution	339 Medium Yellow	-
Spray Piping	-	307 Medium Green	303 Dark Blue
Potable Cold Water	Potable Water	301 Light Blue	-
Potable Hot Water	Potable Water-Hot	303 Dark Blue	-
Nonpotable Water	Nonpotable Water	300 Aqua Green	315 Tile Red
Heating (HVAC) Piping	HVAC	324 Orange	-
Seal Water Piping	Seal Water	336 Jade Green	-
Natural Gas Piping	Natural Gas	315 Tile Red	-
Sump Discharge Piping	Sump Pump Disch.	332 French Grey	-
Dewatering Pump Piping	-	300 Aqua Green	-
Grit Pumping	Grit	300 Aqua Green	315 Tile Red
Caustic Solution	Caustic Solution	-	-
All valves, pumps, motors, hoist and monorails	-	324 Orange	-
Scum Operators, Scum Collectors, Slide Gate Frames and Hose Lines	-	305 Olive Green	-
Hydrants	-	319 Light Yellow	-

[END OF SECTION]

SECTION 15095

VALVES, GENERAL

PART 1 GENERAL

1.01 SCOPE

- A. The Contractor shall furnish and install, complete with all assemblies and accessories, all valves shown on the Drawings and specified herein including all fittings, appurtenances and transition pieces required for a complete and operable installation.
- B. All valves shall be constructed of first quality materials which have strength, wearing, and corrosion resistance characteristics entirely suitable for the types of service for which the individual valves are designated. Except where noted otherwise, valves designated for water service shall conform to pertinent sections of the latest revision of AWWA C500 Specifications. Cast iron valve bodies and parts shall meet the requirements of the latest revision of ASTM Designation A 126, "Standard Specifications for Gray Iron Castings for Valves, Flanges, and Pipe Fittings, Class B."
- C. All valve body castings shall be clean, sound, and without defects of any kind. No plugging, welding, or repairing of defects will be allowed.
- D. Valves shall have flanged ends for exposed service and mechanical joint ends for buried service, unless otherwise shown on the Drawings or specified herein. Flanged ends shall be flat faced, 125 lb. American Standard unless otherwise shown or specified in accordance with ANSI B16.1. All bolt heads and nuts shall be hexagonal of American Standard size. The Contractor shall be responsible for coordinating connecting piping. Valves with screwed ends shall be made tight with Teflon tape. Unions are required at all screwed joint valves.

1.02 SUBMITTALS

- A. The Contractor shall furnish to the Owner, through the Engineer, a Performance Affidavit where required in individual valve specifications, utilizing the format specified in Section 11000, Equipment General Provisions. Performance tests shall be conducted in accordance with the latest revision of AWWA C500 and affidavits shall conform to the requirements of the Specifications
- B. Shop Drawings conforming to the requirements of Section 01300, Submittals, are required for all valves, and accessories. Submittals shall include all layout dimensions, size and materials of construction for all components, information on support and anchoring where necessary, pneumatic and hydraulic characteristics and complete descriptive information to demonstrate full compliance with the Documents. Shop Drawings for electrically operated/controlled valves shall include all details, notes, and diagrams which clearly identify required coordination with the electrical power supply and remote status and alarm indicating devices. Electrical control schematic diagrams shall be submitted with the Shop Drawings for all electrical controls. Diagrams shall be drawn using a ladder type format in accordance with JIC standards. Shop Drawings for pneumatically operated/controlled valves shall include all details, notes, and diagrams which clearly identify required coordination with the compressed air (service air) system and electrical controls.

- C. Operation and maintenance manuals and installation instructions shall be submitted for all valves and accessories in accordance with the Specifications. The manufacturer(s) shall delete all information which does not apply to the equipment being furnished.

1.03 Contractor RESPONSIBILITIES

- A. The Contractor shall provide the services of a qualified representative of the manufacturer(s) of the equipment named below to check out and certify the installation(s), to supervise the initial operation, and to instruct the Owner's operating personnel in proper operation and maintenance procedures in accordance with the following schedule:

Item	Valve/Operator Type	Minimum On-Site Time Requirements
1.	Automatic Control Check Valve	One (1) 8-hour day
2.	Surge Anticipators	One (1) 8-hour day
3.	Motor Operated Modulating Valves	One (1) 8-hour day
4.	Motor Operated Open-Close Valves (required only if manufacturer is other than for Item 3 above)	One (1) 8-hour day
5.	Pneumatic Hydraulic Cylinder Operated Valves	One (1) 8-hour day

- B. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor. The manufacturer's representative shall sign in and out at the office of the Engineer's Resident Project Representative on each day he is at the project.
- C. A written report covering the representative's findings and installation approval shall be mailed directly to the Engineer covering all inspection and outlining in detail any deficiencies notes.
- D. The times specified are exclusive of travel time to and from the facility and shall not be construed as to relieve the manufacturer of any additional visits to provide sufficient service to place the equipment in satisfactory operation.

PART 2 PRODUCTS

2.01 FLOW INDICATORS

- A. Flow indicators shall be the Akron ball type as manufactured by Brooks Instrument Co., Fischer and Porter, or equal, and shall have bronze bodies, glass dome, and plastic ball.

2.02 CORPORATION STOPS

- A. Corporation stops shall be manufactured from cast bronze with machined fitting surfaces, and in accordance with AWWA C 800 latest, in sizes 1 inch up to including 2 inches. The inlet connection shall be AWWA standard corporation stop thread. The outlet connection shall be a packjoint outlet for copper or plastic tubing. Corporation stops with compression joint outlets for copper or plastic tubing shall be Type FB 1102 as manufactured by Ford Meter Box Company, or approved equal.

2.03 FLOOR BOXES

- A. Floor boxes shall be provided for all nut operated or floor accessed valves. Floor boxes shall

be of the adjustable, sliding type, cast iron, suitable to withstand heavy traffic, as manufactured by James B. Clow & Sons, Kennedy Valve Mfg. Co., or equal. The covers shall be marked with appropriate designations of piping contents (i.e.: water, sewer) and bases shall be the round type. All nut operated valves in this Section shall be clearly identified by stainless steel or laminated plastic identification tags. The tags shall be permanently affixed to the inside of the floor boxes, under grating, etc. and shall bear the embossed letters which clearly identify each valve by its appropriate designation.

- B. Two (2) valve operating wrenches shall be supplied in 4 foot lengths with tee handles for each size nut supplied. Valve wrenches shall be Model No. F 2520 as manufactured by James B. Clow & Sons, Kennedy Valve Mfg. Co., Figure No. 122, or equal.

2.04 VALVE BOXES

- A. The Contractor shall furnish and install valve boxes as shown on the Drawings and specified herein.
- B. All valve boxes shall be placed so as not to transmit shock or stress to the valve and shall be centered and plumb over the operating nut of the valve. The ground in the trench upon which the valve boxes rest shall be thoroughly compacted to prevent settlement. The boxes shall be fitted together securely and set so that the cover is flush with the finished grade of the adjacent surface. A concrete pad as detailed on the Drawings shall be provided around the valve box, sloped outwards.
- C. All valve boxes shall be 2 piece cast iron, sliding type, 5 1/4" shaft, with heavy duty traffic weight collar and the lid marked with the appropriate carrier product (i.e.: WATER). Boxes shall be as manufactured by Clow Corp. No. F 2452, Tyler Corp. Series 6855 or 6865 approved equal. James B. Clow & Sons, Kennedy Valve Mfg. Co., Charlotte Pipe and Foundry Company, or equal.

2.05 STRAINERS

- A. Y Strainers shall be Y pattern cast iron body, flanged or screwed ends with stainless steel or Monel, 20 mesh strainers. Strainers shall be 200 psi, cold water service strainers, as manufactured by WATTS, Crane Co., Zurn, or equal.
- B. Caustic service Y strainers shall be provided as shown on the drawings. Strainers shall be full port full flow design manufactured of 304 or 316 stainless steel body. Y strainers shall be furnished with flanged ends. The strainer screen shall be 1/32 inch perforation, easily removable, manufactured of the same material as the valve body.
- C. Stainless steel Y strainers shall be provided as shown on the drawings. Strainers shall be full port full flow design manufactured of 304 or 316 stainless steel body. Y strainers shall be furnished with flanged ends. The strainer screen shall be 1/32 inch perforation, easily removable, manufactured of the same material as the valve body.
- D. PVC and CPVC y-strainers shall be provided in PVC and CPVC piping and as shown on the Drawings. Strainer shall be provided with PVC or CPVC body and end cap, EPDM or Viton seal as required for the chemical service, and 20 mesh screen. Temperature rating shall be 30°F to 140°F, and pressure rating shall be 150 psi @ 70°F, non-shock. PVC and CPVC y-Strainers shall be as manufactured by Asahi/America, Hayward, or equal.
- E. Manually cleaned strainers shall be the duplex basket tapered plug type.

1. Strainers 3 inches in diameter and larger shall have flanged ends conforming to ANSI B16.1 125/150 pound standard.
 2. Strainers less than 3 inches in diameter shall have screwed end connectors, unless otherwise shown on the Drawings.
 3. Strainers shall be constructed with an ASTM A48, Class 30 cast iron body, ductile iron trim, removable 0.045 inch staggered hole perforation, 304 stainless steel filter baskets and gauges on the inlet and outlet.
 4. All strainers shall be suitable for 125 psi service.
 5. Switching flow from one basket to the other shall be accomplished by moving the handle through a 180° arc. The switching operation shall not stop flow through the strainer and shall provide for on line removal of either basket with the other basket functional. The plug shall be automatically positioned with integral stops and shall be easily lifted and reseated under pressure.
 6. The strainer shall be designed to minimize the possibility of material bypassing the plug while being rotated and to prevent debris from building up under the plug. The strainer covers shall be designed for quick opening with swing away yoke.
 7. Each basket compartment shall have a side drain outlet.
 8. All strainers shall be provided with support legs.
 9. Duplex basket strainers shall be similar to the Model 53BTX as manufactured by Hayward, or equal.
- F. PVC and CPVC simplex basket strainers shall be provided in PVC and CPVC piping as shown on the Drawings. 1/2"-4" strainers shall be one-piece molded body with (3) ports to facilitate straight-thru flow pattern or u-shape flow pattern as required. Connections shall be true union type to ease installation/future maintenance. The cover, vent plug, and drain plug shall all be hand-removable, requiring no tools. EPDM or Viton seals shall be used as required for chemical service, and internal baskets shall be 1/32" perforation (20-mesh) for 1/2"-1" sizes, and 1/8" perforation for 1-1/2"-8" sizes. 6" and 8" strainers shall be fabricated construction and shall contain flanged connections as standard. The pressure rating for 1/2"-8" sizes shall be 150 psi @ 70°F, non-shock. Strainers shall be manufactured by Hayward Industrial Products, or equal.

2.06 QUICK DISCONNECT COUPLINGS

- A. Quick disconnect type coupling for compressed/service air shall be provided where indicated on the Drawings. Coupling shall provide for instantaneous shutoff in socket end when lines are disconnected. Couplings shall be constructed of 316 stainless steel with a BUNA N O ring and integral safety lock. Couplings shall comply with Military Specification 4109 (interchangeable with standard plug of the same size).

2.07 BACKFLOW PREVENTERS

- A. Backflow preventer shall be the size shown on the Drawings and shall be of the double check valve principle. Backflow preventer installation shall include isolation valves and four test cocks, furnished as an assembly. For backflow preventers less than 2-1/2", the installation assembly also shall include a strainer. Isolation valves for backflow preventers shall be ball

valves, except for size 2-1/2" and larger which shall be resilient seat gate valves. Test cocks shall be located as recommended by the manufacturer to facilitate functional testing of the assembly. The backflow preventer shall be a WATTS 709, or equal.

- B. Reduced Pressure Backflow Preventer shall be of the size shown on the Drawings, and shall be of the reduced pressure principle type in accordance with AWWA Standards C510 and C511, with two (2) independent operating spring loaded check valves and one (1) spring loaded, diaphragm actuated, differential pressure relief valve shall be installed between the check valves. Backflow preventer shall be bronze body construction, with EPT rubber discs and Buna N and nylon diaphragm. Screws and springs shall be of stainless steel. End connections shall be screwed, unless otherwise specified or shown on the Drawings. Reduced pressure backflow preventer installations shall include isolation valves and four test cocks, furnished as an assembly. For reduced pressure backflow preventers less than 2-1/2" the installation assembly also shall include a strainer. Isolation valves for reduced pressure backflow preventers shall be ball valves, except for sizes 2-1/2" and larger which shall be resilient seat gate valves. Test cocks shall be located as recommended by the manufacturer to facilitate functional testing of the assembly. The reduced pressure backflow preventer shall be as manufactured by Beeco Division, Hersey Products Inc., Aergap Model 6CM, WATTS 909, or equal.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Except where noted otherwise herein, all valves shall be installing and tested in accordance with the latest revision of AWWA C500. Before installation, all valves shall be lubricated, manually opened and closed to check their operation and the interior of the valves shall be thoroughly cleaned. Valves shall be placed in the positions shown on the Drawings. Joints shall be made as directed under the Piping Specifications. The valves shall be so located that they are easily accessible for operating purposes, and shall bear no stresses due to loads from the adjacent pipe. The Contractor shall be responsible for coordinating connecting piping.
- B. All valves shall be tested at the operating pressures at which the particular line will be used. Any leakage or "sweating" of joints shall be stopped, and all joints shall be tight. All motor operated and cylinder operated valves shall be tested for control operation as directed by the Engineer.
- C. Provide valves in quantity, size, and type with all required accessories as shown on the Drawings.
- D. Install all valves and appurtenances in accordance with manufacturer's instructions. Install suitable corporation stops at all points shown or required where air binding of pipe lines might occur. Install all valves so that operating handwheels or wrenches may be conveniently turned from operating floor but without interfering with access, and as approved by Engineer. Unless otherwise approved, install all valves plumb and level. Valves shall be installed free from distortion and strain caused by misaligned piping, equipment or other causes.
- E. Valve boxes shall be set plumb, and centered with the bodies directly over the valves so that traffic loads are not transmitted to the valve. Earth fill shall be carefully tamped around each valve box to a distance of 4 feet on all sides of the box, or to the undisturbed trench face, if less than 4 feet.

3.02 SHOP AND FIELD TESTING

A. Shop and field testing of valves shall be as follows:

1. Certified factory testing shall be provided for all components of the valve and operator system. Valves and operators shall be shop tested in accordance with the requirements in the latest revision of AWWA C500, including performance tests, leakage test, hydrostatic tests, and proof of design tests. The manufacturer through the Contractor shall submit certified copies of the reports covering the test for acceptance by the Engineer.
2. Shop testing shall be provided for the operators consisting of a complete functional check of each unit. Any deficiencies found in shop testing shall be corrected prior to shipment. The system supplier through the Contractor shall submit written certification that shop tests for the electrical/pneumatic system and all controls were successfully conducted and that these components provide the functions specified and required for proper operation of the valve operator system.
3. The Contractor shall conduct field tests to check and adjust system components, and to test and adjust operation of the overall system. Preliminary field tests shall be conducted prior to start up with final field tests conducted during start up. The factory service representative shall assist the Contractor during all field testing and prepare a written report describing test methods, and changes made during the testing, and summarizing test results. The service representative shall certify proper operation of the valve operator system upon successful completion of the final acceptance field testing.
4. Preliminary and final field tests shall be conducted at a time approved by the Engineer. The Engineer shall witness all field testing.
5. All costs in connection with field testing of equipment such as energy, light, lubricants, water, instruments, labor, equipment, temporary facilities for test purposes, etc. shall be borne by the Contractor. The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the Owner formally takes over the operation thereof.
6. Preliminary field tests shall be conducted prior to start up and shall include a functional check of the entire valve operator system and all system components. Preliminary field tests shall demonstrate that the valve operator system performs according to specifications and that all equipment, valves, controls, alarms, interlocks, etc., function properly. The preliminary field test report must be approved by the Engineer prior to conducting final field acceptance tests. Based on results of preliminary field tests, the Contractor shall make any adjustments required to settings, etc., to achieve the required valve closing time and operation specified or otherwise directed by the Engineer.
7. Final field acceptance tests shall be conducted simultaneously with the start up and field testing of the pumps, air compressors, process air blowers, etc. Field tests shall be conducted for the full range of operating modes and conditions specified and as directed by the Engineer. Each of the valves shall be tested at minimum, maximum, and normal head/flow conditions, and under all specified conditions of opening and closing. Performance of pneumatic valves and compressed air system under normal operating conditions and during simulated power failures shall be checked.
8. Field testing shall include optimization of opening and closing times of the valves. The Contractor shall provide the means for accurate measurement of pipeline pressures as directed by the Engineer. Valve opening and closing times shall be adjusted based on

process requirements to optimize operation of the valves. Final valve opening and closing times as determined by field tests shall be approved by the Engineer prior to final acceptance of the system.

[END OF SECTION]

SECTION 15100
VALVE OPERATORS AND ELECTRIC VALVE ACTUATORS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Equipment shall be provided in accordance with the requirements of Section 11000, Equipment - General and Section 15000, Basic Mechanical Requirements.
- B. Valve operators and electric valve actuators shall be designed to unseat, open or close, and seat the valve under the most adverse operating condition to which the valves will be subjected.
- C. Operator mounting arrangements shall be as indicated on the Drawings or as directed by the manufacturer and/or Engineer. There shall be no mounting restrictions on the electric valve actuator.
- D. The valve operators and electric actuators shall be the full and undivided responsibility of the valve manufacturer in order to ensure complete coordination of the components and to provide unit responsibility. Electric operators must be mounted and shop tested by valve manufacturer.

1.02 SUBMITTALS

- A. The following items shall be submitted in accordance with the Contract Documents and in addition to the submittal requirements specified under Section 11000, Equipment - General:
 - 1. Manufacturer's information and catalog data showing compliance with this specification and a full description of the product.
 - 2. Shop Drawings.
 - a. Mounting adapter shop drawings.
 - b. Wiring diagrams.
 - c. Design calculations.
 - 3. O&M Manuals.
 - 4. Certification that the force required to operate all valves is as specified herein.
 - 5. Shop test certifications, including certification from the valve manufacturer that the valve/actuator assembly was tested at the valve manufacturer's facility.

1.03 WARRANTY AND GUARANTEE

- A. Warranty and Guarantee shall be as specified in Section 11000, Equipment – General with the exception that the warranty period shall be for two (2) years for valves, gearboxes, and actuators.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Electric actuators shall be provided where shown on the Drawings.
- B. Manual operators shall be provided on all valves which do not receive electric actuators. Manual operator type shall be as specified herein and as shown on the Drawings.
- C. Quarter turn valves 8" and greater in size shall have geared operators. Gate valves 14" and greater in size shall have geared operators.
- D. Operators/actuators shall be furnished with conservatively sized extension bonnets, extension stems, or torque tubes, and all required appurtenances required for a complete installation. Operators furnished with extension bonnets shall include stainless steel extension stems, or stainless steel torque tubes.

2.02 MANUAL OPERATORS

- A. Unless otherwise specified or shown on the Drawings, manual operator type shall be as follows:
 - 1. Buried valves shall be equipped with nut operators, extended stems, and valve boxes. Where the depth of the operating nut is more than 4 feet below finish grade, a valve operator extension shall be provided to bring the operating nut to within 18-24 inches of the surface.
 - 2. Exposed valves up to 6-inch shall be lever operated (except gate valves).
 - 3. Exposed valves 8-inches and larger shall be handwheel operated.
 - 4. Exposed gate valves shall be handwheel operated.
 - 5. Valves with centerline of operator located more than 6-feet above the floor or platform from which it is to be operated shall have a chainwheel operator unless otherwise indicated on the Drawings.
- B. Manual operators shall be rigidly attached to the valve body unless otherwise specified or shown on the Drawings.

- C. All operators shall turn counter-clockwise to open and shall have the open direction clearly and permanently marked.
- D. Valve operators shall be designed so that the force required to operate the handwheel, lever, or chain (including breakaway torque requirements) does not exceed 80 pounds applied at the extremity of handwheel or chainwheel operator. Design pressures for sizing of valve operators shall be the piping test pressure for the piping in which the valve is to be installed.
- E. Handwheels for valves operators shall not be less than 12 inches in diameter. The maximum diameter of any handwheel shall not exceed 24”.
- F. Nut operators shall have standard 2-inch square AWWA operating nuts.

2.03 GEAR OPERATORS

- A. The operator shall be cable of withstanding a minimum input torque of 300 ft-lbs. on the operating nuts or a minimum pull of 200 lbs. on the handwheel without damage to the operator components between the input and the stops. Operators on valves 30-inch and larger shall be equipped with an AWWA input shaft stop.
- B. Worm gears shall be constructed in accordance AWWA C517/C504 and shall be IP68 rated for continuous duty to 50 feet.
- C. Test certificates substantiating AWWA approval shall be submitted with gear operator manufacturer's signature.
- D. Operators shall be enclosed in a ductile iron housing with outboard seals to protect the bearings and other internal components. Shaft and quadrant shall be supported on permanently angular contact bearings. Input shaft and fasteners shall be constructed of stainless steel. Gears shall be efficiency optimized, 3-stage gear reduction type.
- E. Externally adjustable open and closed position stops shall be provided. The adjustable closed position stop shall be used to set closing torque and provide adjustment to compensate for change in pressure differential or flow direction.
- F. Valves and gear actuators for buried or submerged service shall have seals on all shafts and gaskets on the valve and actuator covers to prevent entry of water. Actuators shall be 90% grease filled. Actuator mounting brackets for buried or submerged service shall be totally enclosed and shall have gasket seals.
- G. Gears shall include a device for back winding protection to prevent undesirable reverse rotation of the gear train at the extents of travel when holding a residual applied torque.
- H. Buried valves shall be provided with an over-torque protection device rated for a minimum shear force trip torque of 450 ft-lbs. Gearbox torque limiter shall be Aunspach Model D87 Torq Master, or approved equal.

- I. Gears shall be provided with a nameplate indicating serial number, ratio, and number of turns.
- J. Gears shall be Rotork Model IW-RL-MD-RAW or approved equal.

2.04 ELECTRIC VALVE ACTUATORS

- A. Electric Actuators shall be open/close service or modulating service as specified.
- B. Manufacturers
 - 1. Rotork.
 - 2. Auma.
 - 3. EIM.
 - 4. Or approved equal.
- C. Performance Criteria
 - 1. Ambient Temperature Rating: -20 to +158 degrees F.
 - 2. Ambient Humidity: 100 percent.
 - 3. Power Supply: 460-volt, three-phase, 60 Hertz, unless otherwise indicated in the Contract Documents.
 - 4. Control Voltage: 120 VAC, single phase, 60 Hertz.
 - 5. Torques: As determined by valve manufacturer.
 - 6. Duty Cycle: As specified herein.
- D. Performance Requirements
 - 1. The actuators shall be designed for indoor and outdoor service and shall be capable of mounting in any position.
 - 2. Torque capacity of the actuators shall be sufficient to operate the valves at the maximum pressure differential, with a safety factor of 1.5. Actuators in modulating service will be selected such that the required dynamic valve torque is no more than 60% of the electric actuator's maximum rated breakaway of torque.
 - 3. Operating time for full limits of travel shall be not more than 2 seconds per inch diameter of the valve, +/- 50 percent through 20 inches; +/- 30 percent for valves 24 inches and larger. Operating time shall not be less than 60 seconds for all modulating valves.

4. Actuators shall be capable of operating in ambient temperatures ranging from 0 degrees F – 160 degrees F.
 5. For open/close (non-modulating) actuators, the gearing, motor and contactor shall be capable of 60 starts per hour without overheating.
 6. For modulating actuators, the gearing, motor and contactor shall be capable of 1200 starts per hour without overheating.
- E. The actuators shall include, in one integral housing, individual compartments for the motor, gearing, wiring terminals, and control circuits. The terminal compartment shall be separated from the inner electrical components of the actuator by means of a watertight seal. The inner seal shall protect the motor and all other internal electrical elements of the actuator from entrance of moisture and dust when the terminal cover is removed. Double cartridge shaft seals shall be provided on the hand wheel and output shafts for weatherproof protection. All external fasteners shall be stainless steel. Actuators shall be o-ring sealed, watertight to IP66/IP68 21 feet for 72hrs, NEMA 4 or 6, unless otherwise specified. Actuators located in corrosive areas shall be NEMA 4X. Actuators located in classified areas shall be NEMA 7 suitable for use in Class 1, Division 1 or 2, Group D environments.
- F. The actuators shall be provided with externally operable and lockable 480VAC circuit breakers integral to the control housing. Disconnect shall be minimum 16 amp, fused, with a stainless steel enclosure. Disconnect switch shall be shipped separate and loose from the actuator.
- G. All gearing shall be hardened alloy steel or bronze and shall be rated at twice the output torque of the operator and shall be designed to withstand the stall torque of the motor without failure. Output drive gearing shall consist of a worm shaft and worm gear pinion operating in an oil bath. The worm gear pinion shall be alloy bronze. Worm gear drive shall be self-locking to prevent creeping of the valve disc in an intermediate position. Heavy-duty grease shall protect gearing and sealed ball bearings of the main shaft for five years without changing. Motor reduction gearing shall be spur or planetary gearing and shall allow for field repair and change in gear ratio. For quarter turn applications, overtravel of the operator shall be prevented by internal mechanical stops cast into the actuator.
- H. A mechanical dial position indicator shall be furnished to continuously indicate the position of the valve at and between the fully open and fully closed positions. The indicator shall be driven by gearing driven off of the main worm gear pinion and shall operate when the actuator is in either the electrical mode or manual mode.
- I. A handwheel shall be permanently attached for manual operation. A gear assembly shall be provided between the handwheel and the worm shaft if required to reduce the force necessary to operate the handwheel to less than 40 pounds. A positive declutch mechanism shall engage the handwheel when required. When the actuator is set in the declutched position for handwheel operation, it shall return automatically to electric

operation when actuator motor is energized. The handwheel shall not rotate during electric operation nor shall a fused motor prevent handwheel operation.

- J. The drive motor shall be specifically designed for actuator service and shall be characterized by high starting torque and low inertia. Motors shall be reversible squirrel cage AC induction type motors and shall be specifically designed for open/close or modulating service where required. DC motor actuators with integral gearing, will not be accepted. Motors shall be totally enclosed, non-ventilated, with NEMA Class F insulation minimum (Class H for modulating actuators) and a maximum continuous temperature rating of 120 degree C (rise plus ambient). The electric motor shall have a time rating of at least 15 minutes at 104°F (40°C) or twice the valve stroking time, whichever is longer, at an average load of at least 33% of maximum valve torque. Motor bearings shall be permanently lubricated by premium lubricant. The motor shall have plug and socket electrical connection or hardwired. The actuator shall include a device to ensure that the motor runs with the correct rotation for the required direction of valve travel with either phase sequence of the three-phase power supply connected to the actuator. The motor shall include single phase protection. A suitable thermal protection device shall be incorporated in the motor or motor starter circuits, connected to a tripping device. Fast acting fuses shall be provided to protect solid state components. The motor shall be capable of starting against the rated load in either the open or close direction when voltage to the motor terminals is plus or minus ten (10) percent of nameplate rating.
1. Open/Close actuators shall be furnished with electro-mechanical reversing starters.
 2. Modulating actuators shall be furnished with solid state reversing starters utilizing thyristors.
- K. Leads from the motor shall be brought to the control circuit (limit switch) compartment without external piping or conduit box. The following items shall be located in the control circuit compartment.
1. Torque limit switches shall be provided to de-energize the motor control circuit in the event of a stall when attempting to unseat a jammed valve and when torque is exceeded during valve travel. Each actuator shall have an open direction torque switch and a close direction torque switch. The torque switches shall be mechanically operated and able to be set in torque units. Torque switches shall be calibrated prior to the actuator's assembly to the valve.
 2. Travel limit switches shall be provided to de-energize the motor control circuit when the actuator reaches the limits of travel in the open and close directions. The limit switch drive shall be of the counter gear type and "in step" with the actuator output drive at all times in either the electrical or manual mode of operation. A minimum of six (6) contacts, three (3) normally open and three (3) normally closed, shall be supplied at each end of valve travel. Four (4) additional

contacts shall be provided to report end of travel or any desired position between ends of travel.

- L. Modulating actuators shall have a position feedback potentiometer mounted directly to the valve actuator gearing inside the gearing compartment. The potentiometer shall provide a 4-20 mA signal corresponding to valve position. Modulating valve actuators shall be designed to respond to either a 4-20mADC analog signal.
 - 1. Modulating valve actuators designed to respond to a 4-20mADC signal shall be provided with a valve positioner which shall position the valve proportional to an externally generated 4-20mADC signal. The valve positioning control circuitry shall position the valve by comparing the command signal with the present valve position as indicated by the feedback potentiometer. The positioner shall be field adjustable to fail to the "open," "closed," or "last" position on loss of 4-20 mADC command signal.
- M. The electrical terminals shall be housed in a double sealed terminal compartment isolated from the rest of the actuator components. The actuators shall be furnished with fuses inside of the terminal compartment. A quantity of two – ¾ inch NPT conduit entries shall be furnished.
- N. Actuators shall contain wiring and terminals for the following control functions. All dry contacts shall be rated for 5A at 250VAC.
 - 1. Open, Close, and Stop commands from external dry contacts (utilizing internal 120VAC power supply) and/or from an external signal of 12V to 120V. The inputs for the open, close, stop signals shall be field selectable to be respond to either maintained or momentary remote signals. In momentary mode, the actuator shall have internal latching circuitry that causes the operator to drive the valve to its limit of travel upon receipt of the momentary contact signal unless a stop signal is received.
 - 2. Emergency override input from a normally closed or normally open contact. The actuator shall either open or close (field selectable) upon receiving the emergency override input.
 - 3. Provide remote Local-Off-Remote selector switch, Open/Close pushbuttons, and Open/Closed pilot lights for a remote manual control station. The remote Local-Off-Remote selector switch and Open/Close pushbuttons shall be a dry contact input to the actuator control circuitry. The Open/Closed pilot lights shall be powered from the valve actuator control power.
 - 4. Four (4) unpowered contacts shall be provided which can be selected to indicate valve "Opened" and "Closed" position, "Remote" status of the actuator, and fail status of the actuator. The fail status contacts shall activate upon motor overtemperature and actuator overtorque as a minimum.

5. Terminals for 4-20mADC position command and 4-20mADC position feedback as described above for modulating actuators.

O. Local Controls

1. Actuators shall be furnished with a Local-Off-Remote selector switch; Open, Close, and Stop pushbuttons for local control; a red lamp indicating closed and a green lamp indicating open. L-O-R switch shall be padlockable in any of the three positions.
 - a. When the LOR is in the "Local" position, open/close control shall be by the open and close pushbuttons on the actuator. The stop push button shall stop the actuator travel.
 - b. When the LOR is in the "Off" position, the actuator shall not operate.
 - c. When the LOR is in the "Remote" position, the actuator shall be controlled by remote inputs from the PLC or from the remote manual controls station.
2. The local controls shall be arranged so that the direction of travel can be reversed without the necessity of stopping the actuator.

P. Remote Manual Control Station

1. Where indicated on the Drawings, provide remote manual control station with a self-contained, double sealed enclosure. NEMA rating shall match that of the actuator.
2. Actuators shall have the capability of being provided with a remote manual control station, which is a "mirror image" of the actuator face
3. Remote manual control station shall be suitable for remote connection to an electric actuator located up to 325 feet away.
4. Remote manual control station shall provide local control functionality and shall include a backlit LCD display and terminals for connecting the remote manual control station to the host actuator.
5. Adjustments to the actuator configuration settings shall not require removal of any covers and shall be capable of being accomplished using a Bluetooth wireless interface.
6. Where indicated on the Drawings, manual actuator controls shall be furnished in a separate NEMA 4X stainless steel enclosure (NEMA 7 if located in a classified area).

2.05 NAMEPLATES

- A. Nameplates shall be provided on each item of equipment. Equipment nameplates shall be type 316 stainless steel bearing the equipment name and equipment number legibly engraved in 3/4 inch high letters. Nameplates shall be attached to the equipment in an accessible location with stainless steel screws.

2.06 PAINT

- A. Actuator shall be factory coated in accordance with the manufacturer's standard paint system.

2.07 SPARE PARTS

- A. Provide spare parts as recommended by manufacturer.

PART 3 – EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

- A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 11000 – Equipment - General and shall include the following site visits for electric actuators:

Service	Number of Trips	Number of Days/Trip
Installation and Testing	1	1
Startup and Training	1	1

3.02 INSTALLATION

- A. All valve actuators shall be installed in accordance with the manufacturer's published recommendations and the applicable Specification Sections for valves.

3.03 SHOP TESTING

- A. Shop testing shall be in accordance with Section 11000, Equipment - General and with the following additional requirements:
 - 1. Test each valve actuator in manufacturer's shop in conformance with AWWA C542.
 - 2. Conduct a complete functional check of each unit. Correct any deficiencies found in shop testing prior to shipment.
 - 3. Submit written certification that:

- a. Shop tests for the electrical system and all controls were successfully conducted;
 - b. Electrical system and all controls provide the functions specified and required for proper operation of the valve operator system.
- 4. Each actuator shall be performance tested and individual test certificates shall be supplied. The test equipment shall simulate each typical valve load and the following parameters should be recorded:
 - a. Current at maximum torque setting.
 - b. Torque at maximum torque setting.
 - c. Flash Test Voltage.
 - d. Actuator Output Speed or Operating Time.
 - e. In addition, the test certificate should record details of specification, such as gear ratios for both manual and automatic drive, closing direction, and wiring diagram code number.
 - f. Verification of actuator torque rating with valve.

3.04 FIELD TESTS

- A. Field testing shall be in accordance with Section 11000, Equipment - General and with the following additional requirements:
 - 1. Valve actuators shall be field-tested together with the associated valves.
 - 2. Test all valves at the operating pressures at which the particular line will be used.
 - 3. Test all valves for control operation as directed.
 - 4. Field testing shall include optimization of opening and closing times of the valves. Valve opening and closing times shall be adjusted based on process requirements to optimize operation of the valves. Final valve opening and closing times as determined by field tests shall be approved by the Engineer prior to final acceptance of the system.
- B. Preliminary Field Tests
 - 1. General: Preliminary field tests shall be conducted prior to start-up and shall include a functional check of the entire valve operator system and all system components.

2. Scope: Preliminary field tests shall demonstrate that the valve operator system performs according to specifications and that all equipment, valves, controls, alarms, interlocks, etc., function properly.
3. Based on results of preliminary field tests, the Contractor shall make any adjustments required to settings, etc., to achieve the required valve closing time and operation, as specified or otherwise directed.

C. Final Field Tests

1. Final field tests shall be conducted in accordance with the latest revision of AWWA C542.
2. Final field tests shall be conducted for the full range of operating modes and conditions specified and as directed by the Engineer. Each of the valves shall be tested at minimum, maximum, and normal head/flow conditions, and under all specified conditions of opening and closing.
3. Certification of Equipment Compliance: After the final field tests are completed and passed, submit affidavit according to Section 11000, Equipment - General.

[END OF SECTION]

SECTION 15101
BUTTERFLY VALVES

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Reference Section 15000 – Basic Mechanical Requirements.

1.02 SUBMITTALS

- A. Submittals shall be in accordance with submittal requirements of the Contract Documents and Section 11000, Equipment – General. In addition to any relevant submittal requirements within these Sections, the following shall also be submitted:
 - 1. Shop drawings and dimensional information including valve lay length.
 - 2. Performance and leak shop test results.
 - 3. Equipment literature and cut sheets.
 - 4. Statement of compliance with AWWA C504.
 - 5. Warranty information.
 - 6. Operation and maintenance manuals.

1.03 REFERENCES

- A. American Bearing Manufacturers Association (ABMA).
- B. ANSI B16.1, Cast-Iron Pipe Flanges and Flanged Fittings.
- C. ANSI B16.34, Valves-Flanged, Threaded and Welding end. (ASME B16.34).
- D. API STD 609, Butterfly Valves: Double Flanged, Lug-Type and Wafer-Type.
- E. ASTM A126, Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
- F. ASTM A536, Specification for Ductile Iron Castings.
- G. AWWA C504, Rubber-Seated Butterfly Valves.
- H. AWWA C550, Protective Interior Coatings for Valves and Hydrants.
- I. AWWA Manual M49, Butterfly Valves: Torque, Head Loss, and Cavitation Analysis.

PART 2 – PRODUCTS

2.01 BUTTERFLY VALVES (LIQUID SERVICE)

- A. Butterfly valves shall be of the rubber-seated, bi-directional, tight-closing type conforming to the latest revision of AWWA C504. The manufacturer shall have a minimum of 5 years of experience in manufacturing butterfly valves of the sizes required in accordance with AWWA C504. All butterfly valves shall be the product of one manufacturer.
- B. Butterfly valves shall be as manufactured by:
1. DeZurik Model BAW
 2. Pratt
 3. Mueller Co.
 4. GA Industries
 5. Or approved equal.
- C. Materials of Construction

Materials of Construction Schedule

Component	Materials of Construction
Valve Body	Cast Iron ASTM A 126, Grade B, ASTM A 48, Class 40 or Ductile Iron ASTM A536, Grade 65 45 12
Valve Disc	Ductile Iron, ASTM A536, Grade 65-45-12
Valve Shaft	Type 316 Stainless Steel
Shaft Seal	Grade E Bronze, ASTM B505 copper alloy UNS #C93200
Disc Trim	Type 316 Stainless Steel or Monel
Seat and O-rings	EPDM or other synthetic rubber suitable for the application
Fasteners and Hardware	Type 316 Stainless Steel

- D. Each valve shall be performance and leak tested as specified in AWWA C504 revised as follows: In addition to the testing requirements of AWWA C504, each butterfly valve shall be thoroughly cleaned and opened and closed at least three (3) times prior to testing. Certified copies of the test results shall be submitted to the Engineer for approval prior to shipment of the valve.
- E. Butterfly valves shall be Class 150B, unless otherwise indicated, and of the short body design with mechanical joint or flanged ends, as shown on the Drawings. Flanged end

valves shall include 125 lb. flanged ends faced and drilled per ANSI B16.1 standard for cast iron flanges. Mechanical joint ends shall meet the requirements of AWWA C111/ANSI A21.11.

- F. Where required to meet design operating conditions, valve bodies shall be manufactured of higher strength materials. Valve bodies shall have integral hubs for housing shaft bearings and seals.
- G. Butterfly valves shall be of the concentric or eccentric shaft types. Valve discs shall provide a full 360-degree seating surface with no external ribs transverse to flow, and shall comply with the latest revision of AWWA C504. The valve manufacturer shall furnish Shop Drawings which include end clearance dimensions when the disc is in the fully open position.
- H. The resilient valve seat shall be designed to seat against a pressure differential of 150 psi on either side of the valve, unless otherwise indicated. The seat shall be molded in and vulcanized to the valve body and shall fully encapsulate interior of valve body, fully rubber lined valve.
 - 1. The seats shall be factory tested according to AWWA C504 at a test pressure of 150 psig, unless otherwise indicated, and post adjusted for differential pressures indicated herein.
 - 2. Compression between the seat and disc edge shall be adjustable from both the upstream and downstream side of the valve disc and the seat shall be field replaceable without disassembly of the disc and shaft.
 - 3. Seat shall withstand 75lb per inch pull when tested in accordance with ASTM D429, Method B.
- I. Valve shafts shall be one-piece or two-piece units suitably sized to transmit the torques required to operate the valves under the conditions listed in the valve schedule with appropriate safety factor. Shafts shall be securely attached to valve disc by means of conservatively sized corrosion-resistant taper pins, threaded at one end and secured with lockwashers and nuts (i.e., mechanically attached). Provide O-ring seal on taper pin if required to prevent leakage. Shaft key shall be constructed of corrosion-resistant material.
- J. Shaft bearings shall be contained in the integral hubs of the valve body and shall be the permanently self-lubricated, corrosion resistant, sleeve type of teflon or heavy-duty bronze. The valve assembly shall be furnished with a factory set two-way thrust bearing designed to center the valve disc in the valve seat at all times. End cover bolts shall be of stainless steel construction.
- K. The shaft seal shall be either the cartridge type with at least two O-rings, monolithic V-Type, U-Cup Type, or pull down packing type.

1. If monolithic V-Type, U-Cup Type, or pull down packings are utilized, it shall be self-adjusting, self-compensating type. Packing shall be as manufactured by Chevron, or equal. Butterfly valves with pull down packings shall be designed with an extension bonnet so that repacking can be done without removal of the actuator. For buried valves with pull down packing the packing gland cover assembly shall be heavy duty, soil and water resistant. Stuffing boxes for pull down packing shall have a depth sufficient to accept at least four rings of self-compensating type packing specifically selected for the operating pressures to be encountered.
 2. The "O" ring type shaft seal shall be contained in a removable bronze cartridge. The cartridge materials shall meet the requirements of AWWA C504 for bronze, Grade E. The "O" ring material shall be compatible for use with reclaimed water or wastewater and per ASTM D-2000 with a hardness of 70 Shore A Durometer.
- L. Manual operators for butterfly valves 18-inches in diameter or larger shall be the worm gear type conforming to AWWA C504. Manual operators for butterfly valves mounted above 6 feet from the operating floor shall be equipped with worm gear chainwheel actuators. Operators shall be equipped with adjustable AWWA limit stops, shall be sized according to Table IV for Class 150B, and shall require a minimum of 15 turns for 90 degrees or full stem valve travel. The capacity of the manual operator shall be adequate to drive the valve under the differential pressure of 150 psi and maximum anticipated flow, unless otherwise indicated.
1. Worm gears shall be constructed in accordance with AWWA C504 and shall be IP68 rated continuous duty to 50ft. Gears shall incorporate backwinding protection to prevent undesired reverse rotation of the gear train at the extents (i.e. fully closed position) of travel when holding a residual applied torque. Output shaft of gearbox shall be a splined connection to operating nut. Gears shall be able to be mounted on valves at 90 degrees or 270-degree positions. Gearbox handwheel shall not interfere with valve body or other components.
- M. The manufacturer shall certify that the butterfly valves are capable of operating in continuous duty service under the design test pressures and design flow conditions.
- N. All external ferrous components and surfaces of the valves, with the exception of stainless steel and finished or bearing surfaces, shall be shop painted in accordance with AWWA C504 with two coats (10 mils min. dry film thickness) of the manufacturer's premium epoxy for corrosion resistance. Damaged surfaces shall be repaired in accordance with the manufacturer's recommendations.
- O. Valves shall be coated inside. Steel, cast-iron, and ductile iron surfaces, except machined surfaces, shall be epoxy-coated in accordance with AWWA C550.
- P. Valve shall include equipment tag that indicates direction of flow.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Install butterfly valves in accordance with the manufacturer's instructions and requirements of applicable AWWA standards.
- B. Install valves plumb and level. Install all valves to be free from distortion and strain caused by misaligned piping, equipment, and other causes.
- C. Position butterfly valves so that, when valve is fully open, valve disc does not conflict with piping system elements upstream and downstream of valve.
- D. Exposed Valves:
 - 1. Provide supports for large or heavy valves and appurtenances as shown or required to prevent strain on adjoining piping.
- E. Operators:
 - 1. Install valves so that operating levers can be conveniently turned from operating floor without interfering with access to other valves, piping, structure, and equipment, and as approved by Engineer.
 - 2. Avoid placing operators at angles to floors or walls.
 - 3. Orient chain operators out of way of walking areas.
 - 4. Install valves so that indicator arrows are visible from floor level.
 - 5. For motor-operated valves located lower than five feet above operating floor, orient motor actuator to allow convenient access to pushbuttons and handwheel.

[END OF SECTION]

SECTION 15104

BALL VALVES

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Reference Section 15000 – Basic Mechanical Requirements.
- B. Valves required for chemical service shall be constructed of materials suitable for the intended service.

1.02 SUBMITTALS

- A. Submittals shall be in accordance with submittal requirements of Contract Documents and Section 11000, Equipment – General. In addition to any relevant submittal requirements within these Sections, the following shall also be submitted:
 - 1. Shop drawings and dimensional information including valve lay length.
 - 2. Performance and leak shop test results.
 - 3. Equipment literature and cut sheets.
 - 4. Statement of compliance with AWWA C507.
 - 5. Warranty information.
 - 6. Operation and maintenance manuals.

1.03 REFERENCES

- A. American Bearing Manufacturers Association (ABMA).
- B. ANSI B16.1, Cast-Iron Pipe Flanges and Flanged Fittings.
- C. ANSI B16.34, Valves-Flanged, Threaded and Welding end. (ASME B16.34).
- D. ASTM A126, Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
- E. ASTM A536, Specification for Ductile Iron Castings.
- F. AWWA C507, Ball Valves, 6-inch through 48-inch.
- G. AWWA C550, Protective Interior Coatings for Valves and Hydrants.

PART 2 – PRODUCTS

2.01 BALL VALVES

- A. Ball valves shall be of the full port, single seated, metal to metal seated, tight-closing type conforming to the latest revision of AWWA C507 Specifications. The manufacturer shall have a minimum of 5 years of experience in manufacturing ball valves of the sizes required in accordance with AWWA C507 Specifications. All ball valves shall be the product of one manufacturer.
- B. Ball valves shall be as manufactured by:
1. Dezurik (Willamette)
 2. Or approved equal.

Materials of Construction Schedule

Component	Materials of Construction
Valve Body	Cast Iron ASTM A 48, Class 35 or Ductile Iron ASTM A536 GR 65-45-12
Ball	Cast Iron ASTM A48, Class 35
Trunnions	Bronze
Body Seats	400 Series Monel
Ball Seats	ASTM A276, Type 316 Stainless Steel
Shaft	17-4P Stainless Steel or Chrome Molybdenum Steel, ASTM A 322 Grade 4140
Seat and O-rings	EPDM or Buna-N
Fasteners and Hardware	Type 316 Stainless Steel
Torque Unit Components	As specified herein

- C. Each valve shall be performance and leak tested as specified in AWWA C507 revised as follows: In addition to the testing requirements of AWWA C507, each ball valve shall be thoroughly cleaned and opened and closed at least three (3) times prior to testing. Certified copies of the test results shall be submitted to the Engineer for approval prior to shipment of the valve.
- D. Ball valves shall be AWWA Class 150, unless otherwise indicated in the valve schedules, design with flanged ends, and installed as shown on the Drawings.
- E. The valve body shall be constructed of epoxy coated cast or ductile iron with a full, unrestricted circular inlet and outlet, with nominal opening diameter equal to the rated size of the valve.

- F. Each valve body shall be provided with flanged ends conforming in diameter and drilling to ANSI B16.1, Class 125. All flanges shall be flat faced and finished to true plan surfaces within a tolerance limit of 0.005 inch. Each flange face shall be perpendicular to the longitudinal axis of the valve within a maximum angular variation tolerance of 0.002 inch per foot of flange diameter. Flange faces shall have concentric or spiral serrated finish.
- G. The body shall provide rigid means for supporting the valve operating mechanism without the necessity of additional supports and shall be of such design that it shall be capable of receiving the complete ball sub assembly. The valve body shall have integral hubs for housing shaft bearings and seals.
- H. The body shall have a rigidly attached metal seat. The body seat shall be machined, ground, and polished for contact with the seat mounted on the ball.
- I. The ball shall be constructed of epoxy coated cast iron in accordance with AWWA C507 and with a full unobstructed, circular waterway with a diameter equal to the rated size of the valve. It shall have trunnion supports cast integral on the axis of rotation. An extension of one trunnion, called the operating shaft, shall pass through a shaft seal chamber and connect to the valve operation mechanism.
- J. The plug shall have a stainless steel seat mounted thereon which shall properly align with the body seat when the valve is in the closed position. The surfaces of the seat ring shall be spherically generated and shall be machined, ground, and polished for contact with the body seat.
- K. The plug trunnions shall be fitted with bronze bearings of sufficient difference in hardness from the body bushings to eliminate seizing and galling.
- L. Bearing pressure shall not exceed 1500 psi at full differential pressure of 150 psi. Valve designs employing Teflon coated or other non-metallic bearing material will not be acceptable.
- M. Bearings shall be machined in accurate alignment for reception of the valve ball trunnions.
- N. Valve shafts shall be integral with the ball and shall connect the ball to the torque unit. The shaft shall be suitably sized to transmit the torques required to operate the valves under the conditions specified with appropriate safety factor. Shafts shall be securely attached to valve plug by means of conservatively sized corrosion-resistant taper pins, threaded at one end and secured with lockwashers and nuts (i.e.: mechanically attached). Provide O-ring seal on taper pin if required to prevent leakage. Shaft key shall be constructed of corrosion-resistant material.
- O. Shaft bearings shall be contained in the integral hubs of the valve body and shall be the permanently self-lubricated, corrosion resistant, sleeve type of heavy-duty bronze. The valve assembly shall be furnished with a factory set thrust bearing designed to center

the valve plug in the valve seat at all times. End cover bolts shall be of stainless steel construction.

- P. A shaft seal shall be provided of the type utilizing a plug shaft stuffing box, four (4) "O" ring seals, a bronze retainer, and a corrosion resistant steel lock ring.
- Q. Manual operators for ball valves 18-inches in diameter or larger shall be the worm gear or travelling nut type conforming to AWWA C507. Manual operators for ball valves mounted above 6 feet from the operating floor shall be equipped with worm gear chainwheel actuators. Operators shall be equipped with adjustable AWWA limit stops and shall require a minimum of 15 turns for 90 degrees or full stem valve travel. The capacity of the manual operator shall be adequate to drive the valve under the differential pressure of 150 psi and maximum anticipated flow, unless otherwise indicated in the appropriate valve schedule. Provide electric motor operators where required and in accordance with Section 15100 – Valve Operators and Electric Valve Actuators.
- R. The torque unit (valve operating mechanism) shall be of the traveling-nut type and shall be a product of the valve manufacturer. The assembly shall be mounted and attached to the valve body. The torque unit shall be designed to accept a manual, cylinder, or electric motor actuator. The torque unit housing shall employ the following:
 - 1. A traveling crosshead to impart positive rotary movement to the plug which will move transversely to the valve shaft.
 - 2. A cylinder piston rod or stainless steel Type 416 threaded leadscrew (reach rod or stem) with the crosshead directly attached thereto.
 - 3. A rotator lever (of cast steel construction).
 - 4. A matched set of interconnecting links (of cast steel construction) connecting the traveling crosshead to the rotator lever.
- S. The traveling crosshead shall be confined to permit linear motion only and to prevent it from any tendency to rotate due to linkage reaction. A plug shaft support bearing shall be supplied on the cover.
- T. The torque unit shall be so designed that during the first 50 percent of stroke in closing the flow area is reduced by approximately 81 percent. The remaining 19 percent of flow area shall be gradually reduced to a complete shutoff throughout the last 50 percent of the closing stroke.
- U. The torque unit shall be totally enclosed in a suitable housing with a removable cover and shall be capable of being inspected, lubricated, adjusted and repaired without interfering with or removing the valve from the line and shall be permanently lubricated. All parts shall be of first class workmanship, easily replaceable, and manufactured of materials suited for the purpose. All parts subject to rubbing shall be of significantly

different hardness to prevent galling and shall be sized to result in a maximum bearing stress at full load of 2,000 psi. The main shaft shall be replaceable without removing the torque unit housing and while the valve is in the line under pressure.

- V. The manufacturer shall certify that the ball valves are capable of operating in continuous duty service under the working and test pressures and design flow conditions.
- W. Each valve shall be hydrostatically tested and tested for bubble tightness after the operator has been mounted and adjusted. Copies of the hydrostatic and leakage test certification and certification of conformance shall be submitted to the Engineer prior to shipment.
- X. All internal and external ferrous components and surfaces of the valves, with the exception of stainless steel and finished or bearing surfaces, shall be shop painted with two coats (10 mils min. dry film thickness) of the manufacturer's premium epoxy for corrosion resistance. Damaged surfaces shall be repaired in accordance with the manufacturer's recommendations.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Install ball valves in accordance with the manufacturer's instructions and requirements of applicable AWWA standards.
- B. Install valves plumb and level. Install all valves to be free from distortion and strain caused by misaligned piping, equipment, and other causes.
- C. Exposed Valves:
 - 1. Provide supports for large or heavy valves and appurtenances as shown or required to prevent strain on adjoining piping.
- D. Operators:
 - 1. Install valves so that operating levers can be conveniently turned from operating floor without interfering with access to other valves, piping, structure, and equipment, and as approved by Engineer.
 - 2. Avoid placing operators at angles to floors or walls.
 - 3. Orient chain operators out of way of walking areas.
 - 4. Install valves so that indicator arrows are visible from floor level.
 - 5. For motor-operated valves located lower than five feet above operating floor, orient motor actuator to allow convenient access to pushbuttons and handwheel.

[END OF SECTION]

SECTION 15105
CHECK VALVES

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Reference Section 15000 – Basic Mechanical Requirements.
- B. Valves shall be constructed of materials suitable for the intended service and compatible with wastewater and reclaimed water with a chlorine residual.

PART 2 – PRODUCTS

2.01 SWING CHECK VALVES ≤ 3-INCH (LIQUID SERVICE)

- A. Unless otherwise specified, check valves 3-inches and less shall be bronze, Y-pattern, swing check valves of the regrinding type.
- B. Valves shall have a minimum 200 psi non-shock cold water pressure rating.
- C. Valves shall be as manufactured by:
 - 1. Jenkins Bros. Corp.
 - 2. Crane Company.
 - 3. Or approved equal.

2.02 RUBBER FLAPPER SWING CHECK VALVES > 3-INCH (LIQUID SERVICE)

- A. Check valves larger than 3-inches shall be rubber flapper swing check valves conforming to the latest revision of AWWA C508 Specifications. The manufacturer shall have a minimum of 5 years of experience in manufacturing check valves of the sizes required in accordance with AWWA C508 Specifications. All check valves shall be the product of one manufacturer.
- B. Check valves shall be:
 - 1. Dezurik/APCO Model CRF.
 - 2. Or approved equal.
 - a. Check valve designs vary with respect to lay length. Contractor shall be responsible for design modifications and alterations in the Work required to accommodate check valves that differ in dimension or other characteristics.

C. Materials of Construction

Materials of Construction Schedule

Component	Materials of Construction
Body and Cover	Cast Iron, ASTM A 126, Grade B or Ductile Iron ASTM A 536 Grade 65-45-12
Ball	Cast Iron ASTM A48, Class 35
Body Plug	Iron ATSM A 48, Class 40
Rubber Flapper and O-ring	Nitrile or other synthetic rubber suitable for the application
Bolts, Fasteners, and Hardware	Type 316 Stainless Steel
Compression Spring	Type 316 Stainless Steel

- D. Each valve shall be performance and leak tested as specified in AWWA C508. Certified copies of the test results shall be submitted to the Engineer for approval prior to shipment of the valve.
- E. Check valves shall be Class 150B, unless otherwise indicated, with mechanical joint or flanged end connections, as shown on the Drawings.
- F. Body seat shall be on a 45-degree angle to the centerline of the pipe and possess non-slam characteristics.
- G. Valve shall be rated for a minimum cold working pressure of 175 psi.
- H. Valve design shall be such that flapper does not swing from a hinge pin, but rather flexes open. The flapper shall be captured between the body and valve cover to permit the disc to flex open and closed. Disc design shall provide for positive sealing.
- I. Hinge section of the rubber flapper shall be designed to accelerate closing due to an elastic spring effect. High-strength fabric shall be integrally molded into the rubber over the disc and bar to form a flexible joint giving the flapper a high cycle life.
- J. Internal flow area of valve body shall be elastomer lined for resistance to abrasion.
- K. With the exception of the valve body and seat, all parts in contact with liquid shall be manufactured from noncorrosive materials. Internal corrosive surfaces shall be shop painted with two coats of epoxy for corrosion resistance. Exterior surfaces shall be painted in accordance with the requirements of Section 09900 – Painting.
- L. External Spring Adjustment
1. Valves shall be provided with externally adjustable spring return that accelerates flapper closure before flow reversal can occur.

2. Helical compression spring shall be externally adjustable without removing the cover from the valve or removing the valve from service.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Install check valves in accordance with the manufacturer's instructions and requirements of applicable AWWA standards.
- B. Install valves plumb and level. Install all valves to be free from distortion and strain caused by misaligned piping, equipment, and other causes.
- C. Position butterfly valves so that, when valve is fully open, valve disc does not conflict with piping system elements upstream and downstream of valve.
- D. Exposed Valves:
 1. Provide supports for large or heavy valves and appurtenances as shown or required to prevent strain on adjoining piping.

[END OF SECTION]

SECTION 15107
FIRE HYDRANTS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Reference Section 15000, Basic Mechanical Requirements.

PART 2 – PRODUCTS

2.01 FIRE HYDRANTS

- A. Fire hydrants shall be in accordance with the latest versions of Pinellas County Standard Engineering Details and Pinellas County Material Specification Manual.
- B. Inlet shall be 6-inch mechanical joint.
- C. Main valve opening of the hydrant shall not be less than 5-1/4".
- D. Hydrant nozzles shall include two (2) hose nozzles and one (1) pumper nozzle.
- E. Hydrant shall be painted chrome yellow with white bonnet dome.
- F. Approved products:
 - 1. American AVK Nostalgic 2780 Series.
 - 2. American Flow Control B-84-B.
 - 3. American Flow Control Waterous Pacer.
 - 4. Clow Medallion.
 - 5. Kennedy Gardian K81-D.
 - 6. Mueller Super Centurion A-423.
 - 7. US Pipe Metropolitan M-94.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Install hydrants in accordance with Section 15000, Basic Mechanical Requirements and the manufacturer's instructions.

[END OF SECTION]

SECTION 15108

GATE VALVES (INCLUDING KNIFE GATE VALVES)

PART 1 GENERAL

1.01 SCOPE

- A. Reference Section 15000, Basic Mechanical Requirements.

PART 2 PRODUCTS

2.01 GATE VALVES

- A. All gate valves between 2 inches and less than 4 inches shall be iron body, bronze trimmed, wedge disc, and minimum 150 psi non shock cold water pressure rating. Exposed valves shall be of the outside screw and yoke (OS&Y), ANSI B 16.1, 125 pound flanges and shall be as manufactured by the Crane Company, Jenkins Bros. Corp., or equal.
- B. Valves less than 2 inches shall be of bronze body, rising stem, wedge disc and minimum 300 psi non shock cold water pressure rating. Valves shall have screwed ends or as specified otherwise.
- C. Gate valves 4 inches through 16 inches shall be of the non-rising stem design, shall fully comply with the requirements of AWWA C509 for resilient seated gate valves and shall be the Iowa Valve Co., Mueller Co., Crane Co., or equal.. Gate valves shall be designed for a minimum working pressure of 250 psi and a test pressure of 500 psi.
- D. Gate valve body and bonnet shall be cast iron conforming to ASTM A126, Class B with resilient seat gate and O ring seals. The gate shall be cast iron with a vulcanized rubber coating with no metal to metal contact when in the fully closed position and a smooth unobstructed waterway when in the fully opened position. Gate valves 18 inches and larger shall fully comply with the requirements of AWWA C500 and shall be double disc parallel seat with bypass and inside screw spur geared operator, unless otherwise specified or shown on the Drawings. Valves shall be American Darling Series 50, Mueller, or equal.
- E. Valves shall be flanged mechanical joint as shown on the Drawings, with non-rising stems, and with a 2-inch square standard AWWA operating nuts unless otherwise shown on the Drawings or specified herein.
- F. All internal ferrous components and surfaces of the valves, with the exception of stainless steel and finished or bearing surfaces, shall be shop painted with two coats (10 mils min. dry film thickness) of the manufacturer's premium epoxy for corrosion resistance. Damaged surfaces shall be repaired in accordance with the manufacturer's recommendations.
- G. Exterior Valve Coatings: All exterior surfaces of iron body gate valves shall be clean, dry and free from rust and grease before coating. For buried service, the exterior ferrous parts of all valves shall be coated at the factory with an asphaltic coating in accordance with ANSI/AWWA C151 latest revisions. Prior to backfilling, all uncoated nuts, bolts, glands, rods and other parts of joints shall be coated in the field with coal tar epoxy equal to Koppers Bitumastic No. 300 M.

2.02 KNIFE GATES VALVES

- A. Knife gate valves shall be cast iron conforming to ASTM A126, Class B with resilient ring seal seat. The gate shall be stainless steel with a beveled, knife-like edge. The knife gate valve shall be flanged in accordance with ANSI B-16.1, 125 pound flange with a handwheel operator as manufactured by DeZurik, or equal

B. [END OF SECTION]

SECTION 15109

PLUG VALVES

PART 1 GENERAL

(NOT USED)

PART 2 PRODUCTS

2.01 PLUG VALVES

- A. Plug valves shall be of the non lubricated, eccentric seating plug type with synthetic rubber faced plugs as manufactured by DeZurik Company, Pratt, Milliken, or equal. All valves shall be provided with limit stops and rotate 90° from fully open to fully shut. The minimum working pressure for all valves shall be 150 psi, and the test pressure shall be at least 270 psi for valves up through 12-inch and at least 230 psi for valves 14-inch and larger. The port area of valves shall be at least 80 percent of full pipe area for valves less than 24 inches and 70 percent for valves 24 inches and larger, unless otherwise specified herein. The body materials shall be of epoxy coated cast iron or semi steel, unless specified otherwise. Seats shall have a welded overlay of 90 percent pure nickel and machined to a finish containing no stress cracks. Plug facings shall be of Hycar, or equal and completely suitable for use with domestic sewage.
- B. The shaft seal shall be either the bronze cartridge type with at least two O Rings, monolithic V Type, U-Cup Type, or pull-down packing type. If monolithic V Type, U-Cup Type, or pull-down packings are utilized, it shall be self-adjusting, self-compensating type. Packing shall be as manufactured by Chevron, or equal. Plug valves with pull down packings shall be designed with an extension bonnet so that repacking can be done without removal of the actuator.
- C. All buried valves shall have mechanical joint ends (unless otherwise shown), conforming to ANSI A21.11 (AWWA C 111), and shall be operated with a standard AWWA 2-inch square nut through a totally enclosed worm gear actuator. Valve boxes shall be installed with all buried plug valves and shall be as specified herein.
- D. Unless otherwise shown, all exposed valves 4 inches in diameter and larger shall have flanged ends conforming to ANSI B16.1 125/150 pound standard with face to face dimensions of standard plug valves. Valves smaller than 4 inches in diameter shall have screwed ends, unless otherwise noted.
- E. Valves 8 inches in diameter and larger shall be handwheel or floorstand operated where required or indicated on the Drawings through totally enclosed worm gear actuators, unless otherwise specified or shown on the Drawings. Valves 6 inches in diameter and smaller shall have lever operators, unless otherwise specified or noted on the Drawings. Manual operators for plug valves mounted above 6 feet from the operating floor shall be equipped with worm gear chainwheel actuators.
- F. The manufacturer shall certify that the plug valves are capable of operating in continuous duty service under these pressures and flow conditions.
- G. Each valve shall be hydrostatically tested and tested for bubble tightness after the operator has been mounted and adjusted. Copies of the hydrostatic and leakage test certification and certification of conformance shall be submitted to the Engineer prior to shipment.

- H. All internal and external ferrous components and surfaces of the valves, with the exception of stainless steel and finished or bearing surfaces, shall be shop painted with two coats (10 mils min. dry film thickness) of the manufacturer's premium epoxy for corrosion resistance. Damaged surfaces shall be repaired in accordance with the manufacturer's recommendations.

[END OF SECTION]

SECTION 15114

MISCELLANEOUS VALVES

PART 1 GENERAL

1.01 THE REQUIREMENT

- A. Reference Section 15000, Basic Mechanical Requirements.
- B. Valves intended for chemical service shall be constructed of materials suitable for the intended service.

PART 2 PRODUCTS

2.01 GLOBE VALVES (SERVICE/COMPRESSED AIR)

- A. Globe valves (service/compressed air) shall be bronze body and bonnet with brass stem and stainless steel regrindable disc plug. Valves shall be Jenkins Valve Fig. 546 P, Crane Co., or approved equal with minimum 300 psi non shock cold water pressure rating and screwed ends.

2.02 SOLENOID VALVES

- A. Three-way two position solenoid valves shall be of the two-coil type. Both coils shall be normally closed, and each shall open independently when energized. The valve shall be of forged brass body and bonnet with a Buna "N" diaphragm and screwed ends. The solenoid's internal parts shall be of 300 and 400 series stainless steel. The valve shall have a safe body working pressure of 125 psi and shall be as manufactured by ASCO Valves, Automatic Switch Co., or equal, for 120V, 60 Hz, single phase operation. Solenoid enclosure shall be NEMA 4 watertight.
- B. Two-way solenoid valves shall be normally closed and shall open when the solenoid is energized, unless otherwise noted. The valve shall be of forged brass body and bonnet with a BUNA "N" diaphragm and screwed ends. The solenoid's internal parts shall be of 300 and 400 series stainless steel. The valve shall have a safe body working pressure of 125 psi, and shall be as manufactured by ASCO Valves, Automatic Switch Co., or equal, for 120-volt, 60 Hz, single phase operation. Solenoid enclosure shall be NEMA 4 watertight.
- C. Four-way two position solenoid valves shall be of the single coil type and shall be normally closed and shall open when the solenoid is energized (i.e. fail closed). The remainder of the four-way two position solenoid valves shall be of the two-coil type. Both coils shall be normally closed, and each shall open independently when energized. The valve shall be of forged brass body and bonnet with a Buna "N" diaphragm and screwed ends. The solenoid's internal parts shall be of 300 and 400 series stainless steel. The valve shall have a safe body working pressure of 125 psi and shall be as manufactured by ASCO Valves, Automatic Switch Co. or equal, for 120V, 60 Hz, single phase operation. Solenoid enclosure shall be NEMA 4 watertight. The solenoid valve shall be provided with a manual override.

2.03 PRESSURE RELIEF, REDUCING, AND REGULATING VALVES

- A. Pressure relief valves 1 inch and under shall have bronze bodies and above 1 inch shall have cast iron bodies, bronze fitted with grey iron diaphragm base and straight chamber and phosphorus bronze diaphragm. The ratio of the diaphragm area to the seat area shall be

adequate to overcome sticking. The seat disc shall be of non-corrodible, non-sticking material capable of withstanding extreme temperatures. Valves shall permit dismantling for repairs and cleaning without being removed from the line. Valves shall conform to the ASME Boiler Construction Code as approved by both the Underwriters Lab., and the National Board of Boiler Pressure Vessel Inspectors. All valves shall be designed for a minimum working pressure at least equal to the working pressure of the corresponding pipeline and shall have adjustment over a range of at least 20 percent above or below the required setting pressure of the installation.

- B. Pressure relief valves (non-potable water service) shall be diaphragm activated, single seat, pilot operated and shall maintain a constant upstream pressure by relieving excess pressure. The valve shall be normally closed and shall open to maintain the required back pressure when the valve inlet pressure reaches the pilot control set point. The initial pilot control setting shall be 78 psi. The stem shall be stainless steel and shall be guided through the center for 100% of the stem travel. The main valve throttling plug shall be provided with V port sections to insure precise control at low flow rates. All internal metal parts shall be bronze or stainless steel. The control pilot shall be direct acting, spring loaded, and adjustable with bronze body and stainless-steel trim. The diaphragm and seat disc shall be BUNA N. The valve shall be of the angle or globe pattern as shown on the Drawings and shall be fully repairable in the line. The pressure relief valve shall be the Model 428CP as manufactured by Bailey, Fresno, California, or equal.
- C. Pressure reducing and regulating valves (water service) 1/2 inch and under shall be bronze and above 1/2 inch shall have cast iron bodies bronze fitted. Valves shall be constructed with full openings and capable of supplying a full flow of water at reduced pressure. Valves shall be so constructed that repairs can be made without removing the valves from the line. The valves shall be equipped with a sedimentation chamber and stainless steel or bronze strainer. Pressure reducing and regulating valves shall be the back pressure sustaining type and shall operate over a range at differential pressures from 5 to 120 psi. Reducing and regulating valves shall meet or exceed the requirements of ASSE 1003 (ANSI A112.26.2) and shall be Model 616R, as manufactured by Fisher Controls, WATTS Series 25 AUB, GA, or equal.

2.04 SEWAGE AIR and VACUUM/PRESSURE AIR RELEASE VALVES

- A. Sewage air and vacuum/pressure air release valve assemblies shall be installed at all the locations specified herein or indicated on the Drawings and shall be installed complete with all appurtenant piping and valves as required for a complete and operable installation. The valves shall be constructed of cast iron with stainless steel float, and all working parts shall be bronze, brass, stainless steel, or other corrosion resistant material. The valves shall be designed for a minimum working pressure of 150 psi and a test pressure of 300 psi. The valves shall include isolation valve and backflushing attachments which shall consist of blow off valves, quick disconnect couplings, and a minimum of 5 feet of rubber hose suitable for backflushing without dismantling the valve. All air and vacuum valves shall be provided with "soft seating" material to provide drip tight closure at 1 to 65 psig. The exhaust from the valve shall be piped to a suitable disposal point. All valves 1-inch diameter and larger shall have a 1/4-inch min. diameter drain plug.
- B. The pressure air release valves shall have a 2 inch (minimum) threaded connection. The pressure air release valves shall have a discharge capacity of scfm, minimum, at a differential pressure range from 3 psi to 65 psi, and an orifice of 1/4 inch diameter, minimum.
- C. All internal and external ferrous components and surfaces of the valves, with the exception

of stainless steel and finished or bearing surfaces, shall be shop painted with two coats (10 mils min. dry film thickness) of the manufacturer's premium epoxy for corrosion resistance. Damaged surfaces shall be repaired in accordance with the manufacturer's recommendations.

- D. The air and vacuum valves and pressure air release valves shall be similar to the following types and models as manufactured by the Crispin Valve Division of Multiplex Manufacturing Co. or approved equal.

Location	Size	Discg. Cap @ 2 psi	Intake Cap @ 5 psi	ARV/PRV Model #	Connection
WAS	2"	125 scfm	200 scfm	SL20AB/SL20	Threaded
Int. Lift Station	3"	N/A	1500 scfm	SVR-31-121	Threaded
RAS	3"	325 scfm	1500 scfm	S30AB/SL20B	Threaded

2.05 PRESSURE AIR RELEASE VALVE (POTABLE WATER ONLY)

- A. The pressure air release valve shall be constructed of cast iron with stainless steel trim and stainless-steel float, and all working parts shall be bronze, brass, stainless steel, or other corrosion resistant material. The valves shall be designed for a minimum working pressure of 150 psi and a test pressure of 300 psi. All valves shall be provided with "soft seating" material to provide drip-tight closure at 1 to 65 psig. All valves shall be provided with a vacuum check.
- B. All internal and external ferrous components and surfaces of the valves, with the exception of stainless steel and finished or bearing surfaces, shall be shop painted with two coats (10 mils min. dry film thickness) of the manufacturer's premium (NSF approved) epoxy for corrosion resistance. Damaged surfaces shall be repaired in accordance with the manufacturer's recommendations.
- C. The pressure air release valve shall be the following types and models as manufactured by the Crispin Valve Division of Multiplex Manufacturing Co., or equal.

Location	Size	PRV Discharge Capacity @ 2 psi	Model #	Connection
All	2"	45 SCFM	PL20/V5	Screwed

2.06 HOSE VALVES

- A. Hose valves shall be 300 lbs. non-shock cold water angle or globe valves, Fig. 112/113 as manufactured by Jenkins Valve Co., or equal. Valves shall be bronze bodied with Buna N or neoprene disc and bronze bonnet and packing nut. Valve stem, gland, and lock nut shall be brass. Valve shall be provided with 3-inch diameter malleable iron handwheel, cap and chain, and 3/4 inch or 1-inch (or 2 inch near flushing connections) hose connection outlet.

2.07 NEEDLE VALVES

- A. Needle valves shall be bronze body and spindle with follower gland and shall be 400 psi, non-shock cold water needle valves, Figure 743 G as manufactured by Jenkins Bros., Corp., Crane Co. No. 88, or equal.
- B. Needle valves (service air) shall be bronze body, with stainless steel stem. Valves shall be Jenkins Valve Fig. 741G, Crane Co. or equal and shall have minimum 400 psi non shock cold water pressure rating and screwed ends.

2.08 PINCH VALVES

- A. Pinch valves shall be of the full metal body mechanical pinch type with flanged joint ends on both body and rubber sleeve. Port areas shall be 100% of the full pipe area through the entire valve length. Flanges shall be of one size larger than pipeline size to allow extra thickness of rubber. Mating pipeline flanges shall be standard reducing flange with I.D. to exactly match valve I.D. All internal valve metal parts are to be completely protected by the rubber pinch tube. The rubber pinch tube shall be one-piece construction with integral flanges drilled to ANSI 125# standard. The pinch tube shall also be Nylon reinforced with an exterior wrapping of 1/8" thick neoprene. Handwheel closing mechanism shall be double acting and pinch the sleeve equally from two sides. The stem shall be non-rising and have a non-rising handwheel. There shall be no cast part in the operating mechanism. Each valve shall have flanges conforming to ANSI B16.1, Class 125 lb. Valves shall be Series "75 DW" as manufactured by Red Valve Co., Inc. or equal.

2.09 MUD VALVES

- A. Mud valves shall be cast iron body with bronze stem, stem nut, disc ring, and seat ring. Bolts and nuts shall be corrosion resistant. Mud valve shall be flanged with non-rising stem. Mud valve shall be Model F 3075 as manufactured by Clow, or equal.

2.10 TELESCOPING VALVES

- A. Telescoping valves shall be of the size shown on the Drawings. The valves shall be rising stem lift with stainless steel tube body material. All connecting bails and hardware shall be stainless steel. Minimum wall thickness for the tube shall be 1/8". At the point where the sliding tube enters the vertical stationary pipe a seal shall be affected by means of a wiper gasket retained by a stainless-steel holding flange. The friction seal flange shall have a neoprene or Buna N wiper gasket. The valves shall have two V notched weirs located at 180 degrees to each other (maximum travel 36"). The valve lift mechanism shall be ball bearing supported with torque plate, mounted on offset type cast iron pedestal. Provide electric motor operator in weather tight enclosure to be mounted on valve floorstand. The operator shall be suitable for the intended operation and sized for the telescoping valve that it is used with. The electric operator shall raise and lower the telescoping valve at a rate of 1 FPM. Provide pushbutton station for operation in stainless steel NEMA 4 enclosure. The operator shall have a manual hand crank that does not turn during electric operation. The motor drive shall be a Limitorque valve controller, or equal. Telescoping valves shall be as manufactured by Waterman Industries, Inc., or equal.

2.11 TAPPING SLEEVES

- A. Tapping sleeves shall conform to the requirements of AWWA C110/A21.10 latest revision.

2.12 SAMPLING COCKS AND HOSE BIBBS

- A. Sampling cocks and hose bibbs shall be provided and installed where indicated on the drawings and shall be 3/4 inch bronze body, rubber composition disc, garden hose valves.

2.13 VALVE BOXES

- A. Furnish, assemble, and place a valve box over the operating nut for each buried valve. The valve box shall be designed so as to prevent the transmission of surface loads directly to the valve or piping.
- B. Valve boxes shall be of the adjustable slide type of suitable length with an interior diameter of not less than 5 inches. The valve boxes shall be manufactured of cast iron and shall be adjustable for elevation and shall be set to allow equal movement above and below finished grade. The castings shall be manufactured clean, even grain, gray cast iron conforming to ASTM A48 Class 30B for Gray Iron Castings; and shall be smooth, true to pattern, free from blow holes, sand holes, projections and other harmful defects. The seating surfaces of both the cover and the top section shall be machined so that the cover will not rock after it has been seated. The valve boxes shall be coated inside and outside with an asphaltic coating prior to machining, so that the machined seating surfaces will be free of any coating. Cast iron valve box assemblies shall be Clow Corp. No. F 2452, Tyler Corp. Series 6855 or 6865 approved equal.
- C. Valve extension stems shall be provided for all buried valves when operating nut is deeper than 3 feet below final grade.

2.14 VALVE VAULTS

- A. Valve vaults shall be constructed of precast or cast in place concrete with dimensions as shown on the Drawings. Concrete shall have a minimum compressive strength of 4,500 psi at 28 days. The steel reinforcement for the structures shall be designed and constructed to withstand the loads expected. The cover for the valve vault shall be as shown on the Drawings as approved by the Engineer.

2.15 SERVICE SADDLES

- A. Service Saddles: Service saddles shall have ductile iron bodies in accordance with ASTM A536, latest revision, with double stainless steel straps. Ductile iron body shall have a fusion bonded nylon coating with a minimum thickness of 12 mils. Straps shall be Type 304 stainless steel with premium grade Type 304 stainless steel bolts and Type 304 stainless steel washers and nuts. The nuts shall be Teflon coated. The gasket material shall be an elastomeric compound resistant to degradation by oil, natural gas, acids, alkalies, most aliphatic fluids and chloramines in potable water. The outlet to the saddle shall have CC threads. Service saddles shall be Rockwell No. 317 or an equal approved by the Engineer.

2.16 CORPORATION STOPS

- A. Corporation stops shall be manufactured from cast bronze with machined fitting surfaces, and in accordance with AWWA C 800 latest, in sizes 1 inch up to including 2 inches. The inlet connection shall be AWWA standard corporation stop thread. The outlet connection shall be a packjoint outlet for copper or plastic tubing. Corporation stops with compression joint outlets for copper or plastic tubing shall be Type FB 1102 as manufactured by Ford Meter Box Company, or approved equal.

2.17 CURB STOPS

- A. Curb stops shall be AWWA C 800 approved ball valve, roundway, with check, with lock wing cast on stop body and operating tee cap to provide for locking the stop in closed position. Curb stops for use with copper or plastic services shall have an inlet connection with a compression joint and an outlet connection with female iron pipe thread, as manufactured by Ford Meter Box Company B41 with padlock wings, or approved equal.

2.18 TIE RODS

- A. When prior approval is obtained from the Engineer, ductile iron pipe, fittings, and valves may be restrained using tie bolt joint restraint. All bolts, nuts, washers, tie rods and other fasteners for the joint restraint system shall be manufactured of Type 316 Stainless Steel. Tie rods shall have a minimum diameter of 3/4 inch. The number of tie rods required per joint shall be as recommended by the manufacturer.

[END OF SECTION]

SECTION 15140
PIPE SUPPORTS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Furnish all equipment, labor, materials, and design calculations required to provide pipe supports in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 15000, Basic Mechanical Requirements.

1.03 SUBMITTALS

- A. Pipe support submittals will not be reviewed prior to review and acceptance of pipe layout submittal. Pipe support submittal shall be fully coordinated with approved pipe layout submittal. Contractor shall use approved piping layout submittal drawings to show proposed pipe support type and location with accurate dimensions to demonstrate that supports meet all specified requirements.
- B. Applicable and associated cut sheets and drawings for materials and support components shall be submitted with the Shop Drawings in accordance with or in addition to the submittal requirements of the Contract Documents and Section 15000, Basic Mechanical Requirements.
 - 1. Catalog cut information on all system components such as pipe supports, hangers, guides, anchors, and channel-type support.
 - 2. Drawings of the piping support systems, locating each support, brace, hanger, guide, component, and anchor. Identify support, hanger, guide and anchor type by catalog number and Shop Drawing detail number.
 - 3. With each piping support system Shop Drawing, the Contractor shall attach calculations prepared and sealed by a Professional Engineer, licensed in the State of Florida, showing that the piping support system complies with the specified requirements, including all building code requirements pertaining to support of piping and other non-structural components.
 - 4. Table showing the manufacturer's recommended hanger support spacing for PVC pipe.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Pipe supports shall be manufactured products, where possible.
- B. The Contractor shall be responsible for the design of all piping support systems unless noted otherwise herein or specifically detailed on the Contract Drawings. The absence of pipe supports and details on the Drawings shall not relieve the Contractor of the responsibility of providing a delegated pipe support design that is signed and stamped by a registered Professional Engineer, licensed in the State of Florida. Standard details for pipe supports have been included on the Drawings to define minimum requirements as to the types of Contractor-designed pipe supports that will be acceptable.
- C. Where a specific location or type of support is shown on the Drawings, the location and type shall be incorporated in the Contractor's pipe support design.
- D. Where special pipe support fabrications are required, products and execution shall be as specified in other related and referenced Sections of the Specifications.
- E. Existing piping support systems to support new piping shall only be used if the Contractor submits supporting calculations demonstrating that the existing supports are adequate for the load imparted by the new piping.
- F. Contractor's pipe support design shall include, but not be limited to, the following criteria and loads imposed on the piping system:
 - 1. Thrust loads based on the design pressures specified. Pipe support design shall not utilize process equipment for thrust restraint or support of piping loads.
 - 2. Dead loads and live loads per the latest version of ASCE 7-10 and Florida Building Code if more stringent. Loads shall include, but not be limited to, the following:
 - a. Weight of pipe.
 - b. Weight of pipe contents.
 - c. Weight of insulation, where present.
 - d. Wind loads.
 - 3. Loads associated with thermal expansion and contraction of the piping system over the full range of potential temperatures the piping system could experience that should include, but not be limited to, the following:
 - a. Ambient temperature range per local historical weather data (historic high and low obtained from NOAA).

- b. Process operating temperature range.
 - c. Exposure to sunlight where applicable.
- 4. Additional pipe support design considerations shall include the following:
 - a. A minimum safety factor of 2 or as approved by the Engineer, based upon the yield strength of the support material, shall be used for pipe supports, braces, hangers, and guides as well as for beam and column members used in channel-type support systems.
 - b. The horizontal pipe hanger and/or floor support spacing shall be as recommended by the pipe and/or hanger manufacturer but shall not exceed 10 feet on center unless indicated otherwise herein or on the Drawings.
 - c. The design, sizing, and spacing of anchors, including concrete anchors, shall be based on withstanding shear and pullout loads imposed by loading at each support. The minimum anchor size shall be ½ inches in diameter.

2.02 HANGERS AND SUPPORTS

- A. All piping shall be adequately supported and braced by means of steel hangers and/or supports, concrete piers, supplemental lateral bracing components, pre-fabricated brackets, or otherwise as may be required by the location and forces applied per governing code, including gravity and lateral forces from seismic and/or wind.
- B. Generally, concrete supports shall be used where pipe centerline is less than 3 feet above floor, and hangers above 6 feet unless specified or shown otherwise.
- C. Supports shall be not more than 10 feet on center for steel and cast iron, 5 feet on center for plastic unless otherwise shown on the Drawings or required by the specific manufacturer.
- D. All necessary inserts or appurtenances shall be furnished and installed in the concrete or structures for adequately securing hangers and supports to the structure.
 - 1. Metal pipe support materials, where stainless steel pipe is supported, shall be Type 316L stainless steel.
 - 2. Metal pipe support materials, where carbon steel, ductile or other ferrous pipe is supported, shall be galvanized carbon steel unless indicated otherwise on the Drawings or in the Specifications or by the Engineer.
 - 3. Metal pipe supports indicated as standard type pipe hangers are designed and detailed for gravity loading only. Resulting lateral loads from wind, seismic, or other lateral loads per code, or special loading conditions during construction, shall be applied to the pipe in accordance with the governing building code. Supplemental lateral stiffening members (when necessary) shall be provided along

pipe or at gravity supports using appropriate supplemental members and connections when required by calculations. The Contractor shall include design calculations and details with all pipe hanger and support submissions for review by the Engineer. The main structure and structural components that will support the pipe hangers and other appurtenant components of the facility have been designed to resist all resulting secondary lateral loading from pipe hangers and other non-structural members for gravity and resulting lateral loads.

E. Hangers and supports shall conform to the following requirements:

1. All hangers and supports shall be type 316L stainless steel, hot dip galvanized, or properly coated steel piping as specified herein.
2. All fabricated metal hangers and supports shall be capable of adjustment after installation. Different types of hangers and supports along a pipe length, including bends, shall be kept to a minimum.
3. Hanger rods shall be straight and vertical. Chain, wire, strap, or perforated bar hangers shall not be used. Hangers shall not be suspended from other piping.
4. Vertical piping shall be properly supported at each floor and between floors by stays or braces to prevent rattling and vibration.
5. Supports and hangers for plastic and FRP piping shall include wide saddles or bands as recommended by the manufacturer and approved by the Engineer to distribute load and thus avoid localized deformation of the pipe.
6. Hangers and supports shall prevent contact between dissimilar metals by use of copper plated, rubber, vinyl coated, or stainless-steel hangers.
7. Ferrous pipes to be painted shall be painted in accordance with Section 09900, Painting. Ferrous pipes that require painting or galvanizing shall be supported by galvanized hangers and supports. Stainless steel piping shall be supported by stainless steel saddles and straps (if required).
8. Copper piping shall be supported by plastic coated or copper plated steel hangers and supports.
9. Plastic piping shall be supported by plastic coated steel hangers and supports.
10. Hangers and supports shall provide for thermal expansion throughout the full operating temperature range.
11. Expansion and adhesive type anchors used for pipe hangers and supports shall be Type 316 stainless steel.

F. Metallic hangers and supports may be standard make by Anvil International, Inc., "Witch" by Carpenter & Paterson, Ltd., B-Line Systems, Inc., or equal; and data on the

types and sizes to be used shall be furnished to the Engineer for approval. Metallic support system brackets, rods, support clips, clevis hangers, hardware, etc. shall be cast iron or welded steel construction. All gravity type hangers and supports shall be restrained laterally to resist loading as required by the governing code.

- G. Non-metallic support system shall be a heavy-duty channel framing system. Channel frames shall be manufactured by the pultrusion process using corrosion grade polyester or vinyl ester resins. All fiberglass construction shall include suitable ultraviolet inhibitors for UV exposure and shall have a flame spread rating of 25 or less per ASTM E84. Piping accessories, pipe clamps, clevis hangers, support posts, support racks, fasteners, etc., shall be constructed of vinyl ester or polyurethane resin. Non-metallic support systems shall be standard make Aickinstrut by Aickinstrut, Inc., Unistrut Fiberglass by Unistrut, Inc., Enduro Fiberglass Systems, or equal. The Contractor shall submit data on the types and sizes of approval. Unless otherwise shown or specified the Contractor shall provide support spacings in conformance with the pipe and support system manufacturer's requirements.

PART 3 – EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

- A. Support piping connections to equipment by pipe support and not by the equipment.
- B. Support large or heavy valves, fittings, flow meters, and appurtenances independently of the connected piping.
- C. Support no pipe from the pipe above it.
- D. Support piping at changes in direction or in elevation, adjacent to flexible joints, expansion joints, and couplings, and where shown.
- E. The Contractor shall not install piping supports and hangers in equipment access areas or bridge crane runs.
- F. Brace hanging pipes against horizontal movement by both longitudinal and lateral sway bracing.
- G. Install pipe anchors (fixed supports and/or guides) where shown and/or as may otherwise be required to withstand expansion thrust loads and to direct and control thermal expansion. The Contractor may install additional pipe anchors and flexible couplings to facilitate piping installation, provided that complete details describing location, pipe supports, and hydraulic thrust protection are submitted.

[END OF SECTION]

SECTION 16000

BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish all labor, materials, tools, and equipment, and perform all work and services necessary for, or incidental, to the furnishing and installation of all electrical work as shown on the Drawings, and as specified in accordance with the provisions of the Contract Documents and completely coordinate with the work of other trades involved in the general construction. Although such work is not specifically shown or specified, all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation shall be furnished and installed as part of this work. The Contractor shall obtain approved Shop Drawings showing wiring diagrams, connection diagrams, roughing-in and hook up details for all equipment and comply therewith. All electrical work shall be complete and left in operating condition in accordance with the intent of the Drawings and the Specifications for the electrical work.
- B. Where the word "Contractor" appears in these Division 16 Technical Specifications it shall be construed to mean the electrical subcontractor.
- C. Reference Section 17000 - Instrumentation and Control – General for scope of work details as they relate to the Division 17 subcontractor.
- D. Maintaining the operation of these facilities during the duration of the construction period is essential and required. The Contractor shall furnish and install temporary equipment as required to maintain facility operation. Reference individual Specifications for construction sequencing and specific operational constraint information.
- E. All electrical equipment shall conform to the applicable NEMA specifications. All electrical equipment shall be properly identified in accordance with these Specifications and Contract Drawings. All panelboards, starters, control panels, cabinet enclosures, junction boxes, pull boxes, and equipment switches shall be identified per the requirements of Section 16195 – Electrical Identification
- F. All materials, equipment, sizes and capacities of electrical equipment incorporated in the project shall conform to the latest requirements of the current National Electric Code, the National Electrical Manufacturer's Association, the State and local electrical codes, and to applicable rules and regulations of the local electrical utility serving the project.
- G. All material and equipment must be the product of an established and reputable manufacturer; must be new and of first class construction; must be designed and guaranteed to perform the service required; and must bear the label of approval of the Underwriters Laboratories, Inc., where such approval is available for the product of the listed manufacturer as approved by the Engineer.

- H. When a specified or indicated item has been superseded or is no longer available, the manufacturer's latest equivalent type or model of material or equipment as approved by the Engineer shall be furnished and installed at no additional cost to the Owner.
- I. Where the Contractor's selection of equipment of specified manufacturers or additionally approved manufacturers requires changes or additions to the system design, the Contractor shall be responsible in all respects for the modifications to all system designs, subject to approval of the Engineer. The Contractor's bid shall include all costs for all work of the Contract for all trades made necessary by such changes, additions or modifications or resulting from any approved substitution.
- J. Furnish and install controls for each piece of equipment requiring the controls under this Contract. The controls shall be the size and type recommended by the manufacturer for the application and as otherwise specified or indicated on the Drawings. Refer to Divisions 01 and 17 of the Specifications for control, connection and coordination descriptions and requirements.
- K. Furnish and install all stands, racks, brackets, supports, and similar equipment required to properly serve the equipment which is furnished under this Contract, or equipment otherwise specified or indicated on the Drawings.

1.02 DRAWINGS

- A. The Contractor shall furnish, install, and place in satisfactory condition ready for operation, all conduits, cables, and all other material needed for the complete lighting, power, control and other electrical systems shown or indicated in the Contract Drawings. Additional conduits and the required wiring shall be installed by the Contractor wherever needed to complete the installation of the specific equipment furnished.

1.03 EQUIPMENT LOCATION

- A. The Drawings show the general location of feeders, transformers, outlets, conduits, and circuit arrangements. Because of the small scale of the Drawings, it is not possible to indicate all of the details involved. The Contractor shall carefully investigate the structural and finish conditions affecting all of his work and shall arrange such work accordingly; furnishing such fittings, junction boxes, and accessories as may be required to meet such conditions. The Contractor shall refer to the entire Drawing set to verify openings, special surfaces, and location of other equipment, or other special equipment prior to roughing-in for panels, switches, and other outlets. The Contractor shall verify all equipment dimensions to insure that proposed equipment will fit properly in spaces indicated.
- B. Where outlets are shown near identified equipment furnished by this or other Contractors, it is the intent of the Specifications and Drawings that the outlet be located at the equipment to be served. The Contractor shall coordinate the location of these outlets to be near the final location of the equipment served whether placed correctly or incorrectly on the Drawings.

1.04 LOCAL CONDITIONS

- A. The Contractor shall examine the site and become familiar with conditions affecting the work. The Contractor shall investigate, determine, and verify locations of any overhead

or buried utilities on or near the site, and shall determine such locations in conjunction with all public and/or private utility companies and with all authorities having jurisdiction. All costs, both temporary and permanent to connect all utilities, shall be included in the Bid. The Contractor shall be responsible for scheduling and coordinating with the local utility for temporary and permanent services.

- B. In addition, the Contractor shall relocate all duct banks, lighting fixtures, receptacles, switches, boxes, and other electrical equipment as necessary to facilitate the Work included in this project. Costs for such work shall be included in the Bid.
- C. The Contractor shall be responsible for coordinating all construction related issues and electric utility equipment with the electrical utility and the Owner.

1.05 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions, Section 01300 - Submittals and the requirements of the individual specification sections, the Contractor shall obtain from the equipment manufacturer and submit the following:
 - 1. Shop Drawings.
 - 2. Operation and Maintenance Manuals.
 - 3. Spare Parts List.
 - 4. Special Tools List.
 - 5. Proposed Testing Methods and Reports of Certified Shop Tests.
 - 6. Reports of Certified Field Tests.
 - 7. Manufacturer's Representative's Certification.
- B. Submittals shall be sufficiently complete in detail to enable the Engineer to determine compliance with Contract requirements.
- C. Submittals will be approved only to the extent of the information shown. Approval of an item of equipment shall not be construed to mean approval for components of that item for which the Contractor has provided no information.
- D. Some individual Division 16 specification sections may require a Compliance, Deviations, and Exceptions (CD&E) letter to be submitted. If the CD&E letter is required and shop drawings are submitted without the letter, the submittal will be rejected. The letter shall include all comments, deviations and exceptions taken to the Drawings and Specifications by the Contractor and Equipment Manufacturer/Supplier. This letter shall include a copy of this specification section. In the left margin beside each and every paragraph/item, a letter "C", "D", or "E" shall be typed or written in. The letter "C" shall be for full compliance with the requirement. The letter "D" shall be for a deviation from the requirement. The letter "E" shall be for taking exception to a requirement. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions is not

acceptable. The CD&E letter shall also address deviations, and exceptions taken to each Drawing related to this Specification Section.

1.06 APPLICABLE CODES AND REQUIREMENTS

A. Conformance

1. All work, equipment and materials furnished shall conform with the existing rules, requirements and specifications of the following:
 - a. Insurance Rating Organization having jurisdiction
 - b. The serving electrical utility company
 - c. The currently adopted edition of the National Electrical Code (NEC)
 - d. The National Electric Manufacturers Association (NEMA)
 - e. The Institute of Electrical and Electronic Engineers (IEEE)
 - f. The Insulated Cable Engineers Association (ICEA)
 - g. The American Society of Testing Materials (ASTM)
 - h. The American National Standards Institute (ANSI)
 - i. The requirements of the Occupational Safety Hazards Act (OSHA)
 - j. The National Electrical Contractors Association (NECA) Standard of Installation
 - k. National Fire Protection Association (NFPA)
 - l. International Electrical Testing Association (NETA)
 - m. Florida Building Code 2020 (7th Edition)
 - n. All other applicable Federal, State and local laws and/or ordinances.
2. All material and equipment shall bear the inspection labels of Underwriters Laboratories, Inc., if the material and equipment is of the class inspected by said laboratories.
3. All work shall be in accordance with local codes.

B. Nonconformance

1. Any paragraph of requirements in these Specifications, or Drawings, deviating from the rules, requirements and Specifications of the above organizations shall be invalid and their (the above organizations) requirements shall hold precedent thereto. The Contractor shall be held responsible for adherence to all rules, requirements and specifications as set forth above. Any additional work or material necessary for adherence will not be allowed as an extra, but shall be included in the Bid. Ignorance of any rule, requirement, or Specification shall not be allowed as an excuse for nonconformity. Acceptance by the Engineer does not relieve the Contractor from

the expense involved for the correction of any errors which may exist in the drawings submitted or in the satisfactory operation of any equipment.

C. Certification

1. Upon completion of the work, the Contractor shall obtain certificate(s) of inspection and approval from the National Board of Fire Underwriters or similar inspection organization having jurisdiction and shall deliver same to the Engineer and Owner.

1.07 PERMITS AND INSPECTIONS

- A. The Contractor shall refer to the individual specifications.

1.08 TEMPORARY LIGHTING AND POWER

- A. The Contractor shall refer to the individual specifications.

1.09 TESTS

- A. Upon completion of the installation, the Contractor shall perform tests for operation, load (Phase) balance overloads, and short circuits. Tests shall be made with and to the satisfaction of Owner and Engineer.
- B. The Contractor shall perform all field tests and shall provide all labor, equipment, and incidentals required for testing and shall pay for electric power required for the tests. All defective material and workmanship disclosed shall be corrected by the Contractor at no cost to Owner. The Contractor shall show by demonstration in service that all circuits and devices are in good operating condition. Test shall be such that each item of control equipment will function not less than five (5) times.
- C. The grounding system shall be tested to assure continuity and compliance with the requirement that ground resistances do not exceed five (5) ohms when measured by a megohmmeter or equivalent device. Due to soil conditions and/or other unforeseen field conditions, ground resistances greater than five (5) ohms may be acceptable if approved by the Engineer. Ground resistance measurements of each grounding electrode shall be taken and certified by the Contractor. Upon completion of the Project, the Contractor shall submit to the Engineer the measured ground resistance of each ground rod and grounding system, indicating the location of the rod and grounding system as well as the resistance and soil conditions at the time the measurements were made. Ground resistance measurements shall be made in normally dry weather not less than 48 hours after rainfall and with the ground under test isolated from other grounds. Ground resistance shall also be measured from each piece of equipment to the grounding electrode. Reference Section 16170 - Grounding and Bonding, for additional requirements.
- D. Each lighting and power distribution panelboard shall be tested with main circuit breaker disconnected from the feeder, branches connected, branch circuit breakers closed, all fixtures in place and permanently connected, lamps removed or omitted from the fixtures, and all wall switches closed.
- E. Insulation resistance testing of all incoming and outgoing cables for switchgear, motor control centers, lighting and power distribution panelboards, and similar equipment shall

be done after the cables are in place and just prior to final terminations. All data shall be recorded, as per Exhibit "A", attached to the end of Part 1 of this Section.

- F. Feeder circuits shall be tested with the feeder conductors disconnected from the supplied equipment. Each individual power circuit shall be tested at the panel or motor control center with the power equipment connected for proper operation.
- G. Megohmmeter tests of the insulation resistance of rotating machines and power feeders shall be conducted. The results will be accepted when the megger shows the insulation resistance to be not less than one megohm per 100 volts at 10°C using a 1,000-volt megger.
- H. All transformers shall be Megohmmeter tested in accordance with the manufacturer's recommendations.
- I. The Contractor shall furnish all equipment and personnel as required for testing.
- J. Refer to each individual specification section for detailed test requirements.
- K. The Contractor shall complete the installation and field testing of the electrical installation at least two (2) weeks prior to the start-up and testing of all other equipment. During the period between the completion of electrical installation and the start-up and testing of all other equipment, the Contractor shall make all components of the Work available as it is completed for their use in performing Preliminary and Final Field Tests.
- L. Before each test commences, the Contractor shall submit a detailed test procedure, and also provide test engineer resume, manpower and scheduling information for the approval by the Engineer. In addition, the Contractor shall furnish detailed test procedures for any of his equipment required as part of the field tests of other systems.
- M. Just prior to the final acceptance of a piece of equipment, the Contractor shall perform an infrared inspection to locate and correct all heating problems associated with electrical equipment. The infrared inspection shall apply to all new equipment and existing equipment that is in any way modified under this Contract. All heating problems detected with new equipment furnished and installed under the Scope of this Contract shall be corrected by the Contractor. All problems detected with portions of existing equipment modified under this Contract shall also be corrected by the Contractor. Any issues detected with portions of existing equipment that were not modified under this Contract are not the responsibility of the Contractor. Despite the Contractor not being held responsible for these problems, the Contractor shall report them to Owner and Engineer immediately for resolution. The infrared inspection report shall include both digital and IR pictures positioned side by side. Both the digital and IR pictures shall be clear and high quality. Fuzzy, grainy, or poorly illuminated pictures are not acceptable. The IR picture shall be provided with a temperature scale beside it, and an indication of the hot spot temperature in each picture. Reports shall be furnished in a 3-ring binder, with all pages printed in full color, with equipment assemblies separated by tabs.

1.10 DOCUMENTATION

- A. The work requirements of this Section are in addition to and do not supersede testing and adjusting specified in other portions of the Contract Documents. The Contractor shall submit to the Engineer test records and reports for all testing.

1.11 FIELD TEST OF EQUIPMENT

- A. The equipment to be tested shall include, but not be limited to, the following:
 - 1. Dry Type Distribution Transformers
 - 2. Panelboards
 - 3. Individual Motor Controllers
 - 4. Lighting Systems
 - 5. Variable Frequency Drives and Related Motor Control Equipment
 - 6. Conduit System
 - 7. Cable and Wire
 - 8. Grounding System
 - 9. Fire Alarm System
- B. Refer to each specific specification section for detailed field tests.

1.12 FINAL FIELD TEST OF SYSTEM

- A. The Contractor shall complete the installation and testing of the electrical installation at least two (2) months prior to the start-up and testing of all other equipment. During the period between the completion of electrical installation and the start-up and testing of all other equipment, the Contractor shall make all components of the Work available as it is completed for their use in performing Preliminary and Final Field Tests.
- B. Before each test commences, the Contractor shall submit a detailed test procedure, and also provide test engineer resume, manpower and scheduling information for the approval by the Engineer. In addition, the Contractor shall furnish detailed test procedures for any of his equipment required as part of the field tests of other systems.
- C. The Contractor shall perform an infrared inspection to locate and correct all heating problems associated with electrical equipment. The infrared inspection shall apply to all new equipment and existing equipment that is in any way modified under this Contract.

1.13 PROTECTIVE DEVICE SETTING AND TESTING

- A. The Contractor shall provide the services of a qualified, independent, third party testing company using N.E.T.A. certified technicians to adjust, set, calibrate and test all protective devices in the electrical system. The company shall not be a subsidiary of the electrical equipment manufacturer. The qualifications of the testing company and resumes of the technicians as well as all data forms to be used for the field testing shall be submitted.

- B. All protective devices in the electrical equipment shall be set, adjusted, calibrated and tested in accordance with the manufacturers' recommendations, the coordination study, and best industry practice.
- C. Proper operation of all equipment associated with the device under test and its compartment shall be verified, as well as complete resistance, continuity and polarity tests of power, protective and metering circuits. Any minor adjustments, repairs and/or lubrication necessary to achieve proper operation shall be considered part of this Contract.
- D. All solid state trip devices shall be checked and tested for setting and operation using manufacturers recommended test devices and procedures.
- E. Circuit breakers and/or contactors associated with the above devices shall be tested for trip and close functions with their protective device.
- F. When completed, the Contractor shall provide a comprehensive report for all equipment tested indicating condition, readings, faults and/or deficiencies in same. Inoperative or defective equipment shall be brought immediately to the attention of the Engineer.
- G. Prior to placing any equipment in service, correct operation of all protective devices associated with this equipment shall be demonstrated by field testing under simulated load conditions.

1.14 POWER SYSTEM STUDIES

A. General

- 1. The Contractor shall provide Power System studies, performed by a professional Engineer registered with the state of Florida, to the firm providing the protective device setting and testing services.
- 2. The studies shall include protective devices from all affected areas of the power distribution system.

B. Data Collection for the Studies

- 1. The Contractor shall provide the required data for preparation of the studies.
- 2. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to release of the equipment for manufacture.

C. Short Circuit Study and Protective Device Evaluation Study

- 1. A protective device evaluation study shall be performed to determine the adequacy of circuit breakers, molded case switches, automatic transfer switches, and fuses by tabulating and comparing the short circuit ratings of these devices with the calculated fault currents. Appropriate multiplying factors based on system X/R ratios and protective device rating standards shall be applied. Any problem areas or inadequacies in the equipment due to short circuit currents shall be promptly brought to the attention of the Engineer.

2. All equipment furnished shall meet the requirements of this study.

D. Protective Device Coordination Study

1. A protective device coordination study shall be performed to provide the necessary calculations and logic decisions required to select or to check the selection of power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated current transformers, and low voltage circuit breaker trip characteristics and settings.
2. The coordination study shall include circuit breakers of motor control center. The phase and ground overcurrent protection shall be included as well as settings of all other adjustable protective devices.
3. The time-current characteristics of the specified protective devices shall be drawn on log-log paper. The plots shall include complete titles, representative one-line diagram and legends, significant motor starting characteristics, complete parameters of transformers, complete operating bands of low voltage circuit breaker trip curves and fuses. The coordination plots shall indicate the types of protective devices selected, proposed relay taps, time dial and instantaneous trip settings, transformer magnetizing inrush and ANSI transformer withstand parameters, cable thermal overcurrent withstand limits and significant symmetrical and asymmetrical fault currents. All restrictions of the National Electrical Code shall be adhered to and proper coordination intervals and separation of characteristic curves shall be maintained. The coordination plots for phase and ground protective devices shall be provided on a system basis. A sufficient number of separate curves shall be used to clearly indicate the coordination achieved.
4. The selection and settings of the protective devices shall be provided separately in a tabulated form listing circuit identification, IEEE device number, current transformer ratios and connections, manufacturer and type, range of adjustment and recommended settings. A tabulation of the recommended power fuse selection shall be provided for the medium voltage fuses where applied in the system. Any discrepancies, problem areas, or inadequacies shall be promptly brought to the attention of the Engineer.

E. Arc Flash Hazard Analysis

1. An Arc Flash Hazard Analysis shall be performed with the aid of a digital computer program in accordance with IEEE Std. 1584, "IEEE Guide For Performing Arc Flash Hazard Calculations", NFPA 70E, and OSHA 29-CFR, Part 1910 Subpart S.
2. Arc Flash Warning Labels and Bus Detail Sheets shall be produced for each bus. Labels shall be printed in color on adhesive backed labels. Labels shall be attached to the doors of the equipment. Each label and detail sheet shall list the following:
 - a. Bus name
 - b. System operating voltage
 - c. Date of issue

- d. Flash hazard protection boundary
- e. Limited approach boundary
- f. Restricted boundary
- g. Prohibited boundary
- h. Incident energy level
- i. Required personal protective equipment class

In addition, each Bus Detail Sheet shall list the following:

- Upstream Protective Devices Names, Type and Settings

3. Arc Flash Evaluation Summary Sheets shall be produced. Summary sheets shall list the following:
 - a. Bus name
 - b. Upstream protective device name, type and settings
 - c. Bus line-to-line voltage
 - d. Bus bolted fault
 - e. Protective device bolted fault current
 - f. Arcing fault current
 - g. Protective device trip / delay time
 - h. Breaker opening time
 - i. Solidly grounded column
 - j. Equipment type
 - k. Gap
 - l. Arc flash boundary
 - m. Working distance
 - n. Incident energy
 - o. Required personal protective equipment class
4. Analyze the short circuit, protective device coordination, and arc flash calculations and highlight any equipment that is determined to be underrated or causes an abnormally high incident energy calculation. Propose approaches to reduce the

energy levels. Proposed major corrective modifications will be taken under advisement by the Engineer and the Contractor will be given further instructions.

F. Study Report

1. The results of the power system studies shall be summarized in a report. The report shall be submitted to the Engineer. The report shall be submitted for review and acceptance prior to submittals motor control centers, variable frequency drives, panelboards, and similar electrical equipment.
2. The report shall include the following sections:
 - a. Description, purpose, basis and scope of the study and a detailed single line diagram with "nodes" cross-referenced to the calculated values tabulated in the study report of that portion of the power system which is included within the scope of the study.
 - b. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties and commentary regarding same.
 - c. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.
 - d. Fault current calculations including a definition of terms and guide for interpretation of computer printout.
3. Prior to commencing the work, the preparer the studies shall meet with the testing firm that will do the relay field testing and Owner's representative at the site for a walk through of the facility to ensure that existing conditions are taken into account.
4. The study shall include a detailed explanation of all software programs and procedures used to arrive at the calculated values, settings, and drawings (e.g. single line diagrams) showing fault values at all busses.

1.15 SCHEDULES AND FACILITY OPERATIONS

- A. Since the testing required in Article 1.12 above shall require that certain pieces of equipment be taken out of service, all testing procedures and schedules must be submitted to the Engineer for review and approval one (1) month prior to any work beginning. When testing has been scheduled, the Engineer must be notified 48 hours prior to any work to allow time for load switching and/or alternation of equipment. In addition, all testing that requires temporary shutdown of equipment must be coordinated with Owner so as not to affect proper operations.
- B. At the end of the workday, all equipment shall be back in place and ready for immediate use should an emergency arise. In addition, should an emergency condition occur during testing, at the request of Owner, the equipment shall be placed back in service immediately and turned over to Owner personnel.
- C. In the event of accidental shutdown of equipment, the Contractor shall notify Owner personnel immediately to allow for an orderly restart of affected equipment.

1.16 MATERIALS HANDLING

- A. Materials arriving on the job site shall be stored in such a manner as to keep material free of rust and dirt and so as to keep material properly aligned and true to shape. Rusty, dirty, or misaligned material shall be rejected. Electrical conduit shall be stored to provide protection from the weather and accidental damage. Rigid non-metallic conduit shall be stored on even supports and in locations not subject to direct sun rays or excessive heat. Cables shall be sealed, stored, and handled carefully to avoid damage to the outer covering or insulation and damage from moisture and weather. Adequate protection shall be required at all times for electrical equipment and accessories until installed and accepted. Materials damaged during shipment, storage, installation, or testing shall be replaced or repaired in a manner meeting with the approval of the Engineer. The Contractor shall store equipment and materials in accordance with Section 01660 - Product Storage and Protection Requirements.

(Continued on Next Page)

(EXHIBIT A) TEST DATA - MEGOHMS TEST NO. _____							
Date:			Company:				
Time:			Location:				
Circuit:	Circuit Length:	Aerial:	Duct:	Buried:	No. of Conduc-tors	Size:	AMG MCM Shld:
Insulation Material:			Insulation Thickness:		Voltage Rating:		Age:
Type: _____Pothead _____Terminal					Location: Indoors_____		
					Outdoors_____		
Number and Type of Joints:							
Recent Operating History:							
Manufacturer:							
State if Potheads or Terminals were grounded during test:							
List associated equipment included in test:							
Miscellaneous Information:							

(EXHIBIT A)
TEST DATA - MEGOHMS
TEST NO. _____

Part Tested: _____ Test Made: _____
Hours/Days: _____
After Shutdown: _____

Grounding Time: _____ Dry Bulb Temperature: _____
Wet Bulb Temperature: _____

Test Voltage: _____

Equipment Temperature: _____
How Obtained: _____
Relative Humidity: _____
Absolute Humidity: _____
Dew Point: _____

Megohmmeter: Serial Number: _____ Range: _____
Voltage: _____ Calibration Date: _____

Test Connections	To Line To Earth To Ground	To Line To Earth To Ground	To Line To Earth To Ground	Test Connections	To Line To Earth To Ground	To Line To Earth To Ground	To Line To Earth To Ground
☐ Minute				5 Minutes			
☐ Minute				6 Minutes			
3/4 Minute				7 Minutes			
1 Minute				8 Minutes			
2 Minutes				9 Minutes			
3 Minutes				10 Minutes			
4 Minutes				10/1 Minutes			
				Ratio			

Remarks:

PART 2 - PRODUCTS

2.01 PRODUCT REQUIREMENTS

- A. Unless otherwise indicated, the materials to be provided under this Specification shall be the products of manufacturers regularly engaged in the production of all such items and shall be the manufacturer's latest design. The products shall conform to the applicable standards of UL and NEMA, unless specified otherwise. International Electrotechnical Commission (IEC) standards are not recognized. Equipment designed, manufactured, and labeled in compliance with IEC standards is not acceptable.
- B. All items of the same type or ratings shall be identical. This shall be further understood to include products with the accessories indicated.
- C. All equipment and materials shall be new, unless indicated or specified otherwise.
- D. The Contractor shall submit proof if requested by the Engineer that the materials, appliances, equipment, or devices that are provided under this Contract meet the requirements of Underwriters Laboratories, Inc., in regard to fire and casualty hazards. The label of or listing by the Underwriters Laboratories, Inc., will be accepted as conforming with this requirement.

2.02 SUBSTITUTIONS

- A. Any reference in the Specifications or on the Drawings to any article, service, product, material, fixture, or item of equipment by name, make, or catalog number shall be interpreted as establishing the type, function, and standard of quality and shall not be construed as limiting competition.

2.03 CONCRETE

- A. The Contractor shall furnish all concrete required for the installation of all electrical Work, Concrete shall be as specified. Concrete and reinforcing steel shall meet the appropriate requirements as indicated on the Contract Drawings.
- B. The Contractor shall provide concrete equipment pads for all freestanding electrical apparatus and equipment located on floors or slabs that exist or provided by others. The Contractor shall provide all necessary anchor bolts, channel iron sills, and other materials as required. The exact location and dimensions shall be coordinated for each piece of equipment well in advance of the scheduled placing of these pads. Equipment pads shall be 4 inches high unless otherwise indicated on the Drawings and shall conform to standard detail for equipment pads shown on the Contract Drawings. Equipment pads shall not have more than 3" excess concrete beyond the edges of the equipment.
- C. The Contractor shall provide concrete foundations for all free standing electrical apparatus and equipment located outdoors or where floors or slabs do not exist or provided by others. The Contractor shall provide all necessary anchor bolts, channel iron sills, and other materials as required. The location and dimensions shall be coordinated for each piece of equipment well in advance of the scheduled placing of the foundations. Equipment foundations shall be constructed as detailed on the Drawings or if not detailed on the Drawings shall be 6 inches thick minimum reinforced with #4 bars at 12-inch centers each

way placed mid-depth. Concrete shall extend 6 inches minimum beyond the extreme of the equipment base and be placed on a compacted stone bed (#57 stone) 6 inches thick minimum.

2.04 RUBBER MATS

- A. A three-foot-wide rubber mat shall be furnished and installed on the floor and in front of each piece of electrical equipment that is installed indoors. Rubber mats shall not be installed outdoors. The mat shall be long enough to cover the full length of the equipment. 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.
- B. Mats shall be provided for the following equipment:
 - 1. PLC/RTU Enclosures
 - 2. Main Circuit Breaker
 - 3. Automatic Transfer Switch
 - 4. Variable Frequency Drives
 - 5. Panelboards
 - 6. Transformers

PART 3 - EXECUTION

3.01 CUTTING AND PATCHING

- A. Coordination
 - 1. All cutting and patching shall be completed in accordance with the applicable requirements of Section 01045 – Execution of Work.
 - 2. The Work shall be coordinated between all trades to avoid delays and unnecessary cutting, channeling and drilling. Sleeves shall be placed in concrete for passage of conduit wherever possible.
- B. Damage
 - 1. The Contractor shall perform all chasing, channeling, drilling and patching necessary to the proper execution of his Contract. Any damage to the building, structure, or any equipment shall be repaired by qualified mechanics of the trades involved at the Contractor's expense. If, in the Engineer's judgment, the repair of damaged equipment would not be satisfactory, then the Contractor shall replace damaged equipment at his own expense.

3.02 EXCAVATION AND BACKFILLING

- A. The Contractor shall perform all excavation and backfill required for the installation of all electrical work. All excavation and backfilling shall be in complete accordance with the applicable requirements of Division 02.

3.03 CORROSION PROTECTION

- A. Wherever dissimilar metals, except conduit and conduit fittings, come into contact, the Contractor shall isolate these metals as required with neoprene washers, nine (9) mil polyethylene tape, or gaskets.

[END OF SECTION]

SECTION 16111

CONDUIT

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install conduits and conduit fittings to complete the installation of all electrically operated equipment as specified herein, indicated on the Drawings, and as required.
- B. Requirements for conduit clamps, support systems, and anchoring are not included in this Section. Reference Section 16190 - Supporting Devices, for these requirements.
- C. Reference Section 16000 - Basic Electrical Requirements.

1.02 CODES AND STANDARDS

- A. Conduits and conduit fittings shall be designed, manufactured, and/or listed to the following standards as applicable:
 - 1. American National Standards Institute (ANSI)
 - a. ANSI B1.20.1 – Pipe Threads, General Purpose
 - b. ANSI C80.1 – Electrical Rigid Steel Conduit
 - c. ANSI C80.3 – Steel Electrical Metallic Tubing
 - d. ANSI C80.5 – Electrical Rigid Aluminum Conduit
 - e. ANSI FB 1 – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
 - 2. Underwriters Laboratories (UL)
 - a. UL 1 – Standard for Flexible Metal Conduit
 - b. UL 6 - Electrical Rigid Metal Conduit-Steel
 - c. UL 6A – Electrical Rigid Metal Conduit-Aluminum, Red Brass, and Stainless Steel
 - d. UL 360 – Standard for Liquid-tight Flexible Metal Conduit
 - e. UL 467 – Grounding and Bonding Equipment
 - f. UL 514B – Conduit, Tubing, and Cable Fittings

- g. UL 651 – Standard for Schedule 40 and 80 Conduit and Fittings
 - h. UL 797 – Electrical Metallic Tubing-Steel
 - i. UL 1203 - Standard for Explosion-proof and Dust-ignition-proof Electrical Equipment for use in Hazardous (Classified) Locations
 - j. UL 1479 – Standard for Fire Tests of Penetration Fire Stops
 - k. UL 1660 – Liquid-tight Flexible Nonmetallic Conduit
- 3. National Electrical Manufacturer's Association (NEMA)
 - a. NEMA RN 1 – PVC Externally Coated Galvanized Rigid Steel Conduit
 - b. NEMA TC-2 – Electrical PVC Conduit
 - c. NEMA TC-3 – PVC Fittings for Use with Rigid PVC Conduit and Tubing
- B. Others
 - 1. ACI-318 – Building Code Requirements for Structural Concrete

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions, the Contractor shall obtain from the equipment manufacturer and submit the following:
 - 1. Shop Drawings
- B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets for conduits and fittings.
 - 2. Conduit identification methods and materials.
 - 3. Evidence of training for all personnel that will install PVC coated rigid metal conduit.

1.05 DEFINITIONS

- A. Conduits are categorized by the circuit type of the wiring to be installed inside. Conduits are defined as follows:
 - 1. Power Conduits – Conduits that carry AC or DC power wiring from a source to a load. Conduits that carry lighting and receptacle wiring.
 - 2. Control Conduits – Conduits that carry AC or DC discrete control wiring between devices and/or equipment. Conduits that carry fiber optic cables between devices and/or equipment.
 - 3. Instrumentation Conduits – Conduits that carry AC or DC analog signal wiring between devices and/or equipment.
- B. Conduit categories are indicated on the Drawings by the leading letter of the conduit tag. Conduit tag leading letters are defined as follows:
 - 1. P – Power Conduit
 - 2. C – Control Conduit
 - 3. I – Instrumentation Conduit

PART 2 – PRODUCTS

2.01 GENERAL

- A. Conduit and conduit fitting products are specified in the text that follows this article. Reference Part 3 herein for the application, uses and installation requirements of these conduits and conduit fittings.
- B. All metallic conduit fittings shall be UL 514B and UL 467 Listed, and constructed in accordance with ANSI FB 1. All metallic conduit fittings for use in Class I Division I hazardous areas shall be UL 1203 Listed. All non-metallic fittings shall be UL 651 Listed and constructed in accordance with NEMA TC-3.
- C. Flexible conduit couplings for use in Class I Division I hazardous areas shall have threaded stainless steel end fittings and a flexible braided core. Flexible braid shall be constructed of stainless steel where available in the conduit trade size required for the application. Where stainless steel braid is not available, the braid shall be provided with a PVC coating. No other braid types or materials are acceptable.
- D. Where threading is specified herein for conduit fitting connections, the fittings shall be manufactured to accept conduit that is threaded to ANSI B1.20.1 requirements.
- E. Conduit expansion fittings for all conduit materials of construction shall be capable of 4 inches of movement along the axis of the conduit for trade sizes 2 inches or less. Expansion fittings shall be capable of 8 inches of movement along the axis of the conduit for trade sizes greater than 2 inches.

- F. Conduit deflection fittings for all conduit materials of construction shall be provided with a flexible neoprene outer jacket that permits up to $\frac{3}{4}$ inch of expansion/contraction along the axis of the conduit as well as up to $\frac{3}{4}$ inch of parallel misalignment between the conduit axes. Outer jacket shall be secured to the conduit hubs by stainless steel clamps.
- G. Conduit seals shall either be Listed and labeled for 40% fill, or conduit reducing fittings and a trade size larger conduit seal shall be provided to achieve 25% or less fill within the seal. Percentage fill calculation shall be based on the conductors to be installed. Conduit seals shall be provided with breathers and/or drains where required by the NEC.
- H. Conduit insulating bushings shall be constructed of plastic and shall have internal threading.
- I. Additional conduit and conduit fitting requirements are specified in the articles that follow based on the specific conduit material of construction to be used.

2.02 PVC COATED RIGID ALUMINUM CONDUIT AND ASSOCIATED FITTINGS

A. General

- 1. Where an external coating of polyvinyl chloride (PVC) is specified for conduit and fittings, the coating shall be 40 mil (minimum) thickness. Where an internal coating of urethane is specified for conduit and fittings, the coating shall be 2 mil (minimum) thickness.
- 2. All conduit fittings shall have a sealing sleeve constructed of PVC which covers all connections to conduit. Sleeves shall be appropriately sized so that no conduit threads will be exposed after assembly.

B. Conduit

- 1. Conduit shall be hot dip galvanized on the inside and outside, and made of heavy wall high strength ductile steel. Conduit shall be manufactured in accordance with ANSI C80.1, and shall be UL 6 Listed.
- 2. Conduit shall be provided with factory-cut $\frac{3}{4}$ inch per foot tapered threads at each end in accordance with ANSI B1.20.1. Threads shall be cut prior to galvanizing to ensure corrosion protection adequately protects the threads. Conduit shall be provided with a matching coupling on one end and a color-coded thread protector on the other.
- 3. Conduit shall be coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Conduit shall be manufactured in accordance with NEMA RN-1.

C. Conduit Bodies for use with PVC Coated Rigid Galvanized Steel Conduit

- 1. Conduit bodies shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Conduit bodies shall have integral threaded conduit hubs.

2. Conduit bodies for Class I Division I hazardous areas shall be provided with integrally threaded covers constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane.
 3. Conduit bodies for all other areas shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Covers shall be affixed in place by stainless steel screws which thread directly into the conduit body and have a plastic encapsulated head. Covers that utilize wedge nuts or any other method of attachment to the conduit body are not acceptable. Covers shall be provided with matching gasket.
- D. Conduit Couplings, Nipples, and Unions for use with PVC Coated Rigid Galvanized Steel Conduit
1. Couplings and nipples shall be threaded and shall be constructed of hot dipped galvanized steel which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Split-type couplings that use compression to connect conduits are not acceptable.
 2. Unions shall be threaded, rain-tight, and constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane.
- E. Conduit Expansion and Deflection Fittings for use with PVC Coated Rigid Galvanized Steel Conduit
1. Conduit expansion fittings and conduit deflection fittings shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Expansion and deflection fittings shall have threaded conduit connections.
 2. Expansion fittings shall have an integral bonding jumper and deflection fittings shall have an external bonding jumper.
- F. Conduit Seals for use with PVC Coated Rigid Galvanized Steel Conduit
1. Conduit seals shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Conduit seals shall have threaded conduit connections.
- G. Conduit Termination Fittings for Use with PVC Coated Rigid Galvanized Steel Conduit
1. Conduit hubs shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Hubs shall have threaded connections to the conduit and enclosure. Hubs shall have a plastic insulated throat and shall be watertight when assembled to an enclosure.

2. Conduit bonding bushings shall be constructed of zinc plated malleable iron which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Bonding bushings shall have a threaded conduit connection. Bonding bushing shall be provided with properly sized set screw for connecting bonding conductor and an integral plastic insulator rated for 150 degrees C located in the throat.

2.03 RIGID ALUMINUM CONDUIT AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be made of heavy wall high strength 6063 alloy aluminum with temper designation T1. Conduit shall be manufactured in accordance with ANSI C80.5, and shall be UL 6A Listed.
2. Conduit shall be provided with factory-cut 3/4 inch per foot tapered threads at each end in accordance with ANSI B1.20.1. Threads shall be cut prior to galvanizing to ensure corrosion protection adequately protects the threads. Conduit shall be provided with a matching coupling on one end and a color-coded thread protector on the other.

B. Conduit Bodies for use with Rigid Aluminum Conduit

1. Conduit bodies shall be constructed of copper-free aluminum which is coated with an aluminum enamel finish. Conduit bodies shall have integral threaded conduit hubs.
2. Conduit bodies for Class I Division I hazardous areas shall be provided with integrally threaded covers constructed of copper-free aluminum which is coated with an aluminum enamel finish.
3. Conduit bodies for all other areas shall be provided with stamped copper-free aluminum covers that are affixed in place by stainless steel screws which thread directly into the conduit body. Covers that utilize wedge nuts or any other method of attachment to the conduit body are not acceptable. Covers shall be provided with matching gasket.

C. Conduit Couplings, Nipples, and Unions for use with Rigid Aluminum Conduit

1. Couplings and nipples shall be threaded and shall be constructed of heavy wall high strength 6063 alloy aluminum with temper designation T1. Split-type couplings that use compression to connect conduits are not acceptable.
2. Unions shall be threaded, rain-tight, and constructed of copper-free aluminum which is coated with an aluminum enamel finish.

D. Conduit Expansion and Deflection Fittings for use with Rigid Aluminum Conduit

1. Conduit expansion fittings and conduit deflection fittings shall be constructed of copper-free aluminum which is coated with an aluminum enamel finish. Expansion and deflection fittings shall have threaded conduit connections.

2. Expansion fittings shall have an integral bonding jumper and deflection fittings shall have an external bonding jumper.

E. Conduit Seals for use with Rigid Aluminum Conduit

1. Conduit seals shall be constructed of copper-free aluminum which is coated with an aluminum enamel finish. Conduit seals shall have threaded conduit connections.

F. Conduit Termination Fittings for use with Rigid Aluminum Conduit

1. Conduit hubs shall be constructed of copper-free aluminum and shall have threaded connections to the conduit and enclosure. Hubs shall have a plastic insulated throat and shall be watertight when assembled to an enclosure.
2. Conduit locknuts shall be constructed of copper-free aluminum. Locknuts shall have internal threading. Locknuts with integral gasket or seal are not acceptable. Locknuts shall have integral bonding screw where required for proper bonding.
3. Conduit bonding bushings shall be constructed of copper-free aluminum. Bonding bushings shall have a threaded conduit connection. Bonding bushing shall be provided with properly sized set screw for connecting bonding conductor and an integral plastic insulator rated for 150 degrees C located in the throat.

2.04 LIQUID TIGHT FLEXIBLE METAL CONDUIT (LFMC) AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be manufactured using a single strip of hot dip galvanized high strength steel alloy, helically formed into a continuously interlocked flexible metal conduit. Trade size 1-1/4 inch and smaller conduits shall be provided with an integrally woven copper bonding strip.
2. Conduit shall be covered with an outside PVC jacket that is UV resistant, moisture-proof, and oil-proof. Conduit shall be UL 360 Listed.

B. Conduit Termination Fittings for use with LFMC

1. Conduit termination fittings shall be constructed of either 304 stainless steel or an electro-galvanized malleable iron alloy which is coated on the exterior with a 40 mil (minimum) PVC jacket and coated on the interior with a 2 mil (minimum) layer of urethane. PVC coated fittings shall have a sealing sleeve constructed of PVC which covers the connection to conduit.
2. Termination fittings shall have a threaded end with matching locknut and sealing ring for termination to equipment, and shall have an integral external bonding lug where required for proper bonding. Termination fittings shall have a plastic insulated throat and shall be watertight when assembled to the conduit and equipment.

2.05 LIQUID TIGHT FLEXIBLE NONMETALLIC CONDUIT (LFNC) AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be constructed of rigid polyvinyl chloride (PVC), fabricated to provide flexibility. Conduit shall be covered with an outside PVC jacket that is UV resistant, moisture-proof, and oil-proof. Conduit shall be UL 1660 Listed.

B. Conduit Termination Fittings for use with LFNC

1. Conduit termination fittings shall be constructed PVC and shall have a threaded end with matching locknut and sealing ring for termination to equipment. Termination fittings shall be watertight when assembled to the conduit and equipment.

2.06 FLEXIBLE METAL CONDUIT (FMC) AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be manufactured using a single strip of hot dip galvanized high strength steel alloy, helically formed into a continuously interlocked flexible metal conduit. Conduit shall be UL 1 Listed.

B. Conduit Termination Fittings for use with FMC

1. Conduit termination fittings shall be constructed of an electro-galvanized malleable iron alloy. Fittings shall have a threaded end with matching locknut for termination to equipment, and a compression-style connection to the associated conduit.

2.07 ELECTRICAL METALLIC TUBING (EMT) AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be hot dipped galvanized on the inside and outside, and made of cold-rolled steel tubing. Conduit shall be manufactured in accordance with C80.3 and shall be UL 797 listed.

B. Conduit Bodies for use with EMT

1. Conduit bodies shall be constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish. Conduit bodies shall have integral threaded conduit hubs.
2. Conduit bodies shall be provided with galvanized sheet steel covers that are affixed in place by stainless steel screws which thread directly into the conduit body. Covers that utilize wedge nuts or any other method of attachment to the conduit body are not acceptable. Covers shall be provided with matching gasket.

C. Conduit Couplings and Nipples for use with EMT

1. Couplings and nipples shall have threaded compression connectors with associated gland and shall be constructed of electro-galvanized steel. Fittings utilizing a set screw or indenter tool to secure the associated conduit to the fitting are not acceptable. Couplings and nipples shall be rain-tight and have a plastic insulated throat.

D. Conduit Expansion and Deflection Fittings for use with EMT

1. Conduit expansion fittings and conduit deflection fittings shall be constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish. Expansion and deflection fittings shall have threaded conduit connections.
2. Expansion fittings shall have an integral bonding jumper and deflection fittings shall have an external bonding jumper.

E. Conduit Termination Fittings for use with EMT

1. Conduit termination fittings shall be constructed of electro-galvanized steel and have a plastic insulated throat. Termination fittings shall have a threaded compression connector with associated gland on one end and external threads on the other end. Termination fittings utilizing a set screw or indenter tool to secure the associated conduit to the fitting are not acceptable.
2. Conduit locknuts shall be constructed of zinc plated steel. Locknuts shall have internal threading. Locknuts shall have integral bonding screw where required for proper bonding.

2.08 CONDUIT BENDS

- A. Rigid conduit bends, both factory fabricated and field fabricated, shall meet the same requirements listed in the articles above for the respective conduit type and material of construction.

- B. Conduit bend radii for standard radius bends shall be no less than as follows:

TRADE SIZE (inches)	3/4	1	1-1/4	1-1/2	2	2-1/2	3	3-1/2	4	5	6
MIN. RADIUS (inches)	4-1/2	5-3/4	7-1/4	8-1/4	9-1/2	10-1/2	13	15	16	24	30

- C. Conduit bend radii for long radius bends shall be no less than as follows:

TRADE SIZE (inches)	3/4	1	1-1/4	1-1/2	2	2-1/2	3	3-1/2	4	5	6
MIN. RADIUS (inches)	N/A	12	18	24	30	30	36	36	48	48	60

2.09 MISCELLANEOUS

A. Conduit Periphery Sealing

1. The sealing of the exterior surface of conduits to prevent water and/or air from passing around the conduit periphery from one space to another (where required) shall be through the use of one of the following:
 - a. A conduit sleeve and pressure bushing sealing system. Acceptable products are FSK by OZ-GEDNEY, Link-Seal by Crouse-Hinds, or Engineer approved equal.
 - b. A conduit sleeve that is two trade sizes larger than the conduit being sealed, with 2-hour fire rated UL 1479 Listed caulk filling the entire void between the conduit and sleeve. This method is only suitable for penetrations in non-fire rated walls and floors between spaces within buildings. This method shall not be used for the sealing of conduits leaving a building and/or structure.
2. Conduit penetrations through fire-rated walls and floors shall be made with an approved UL 1479 Listed product specifically intended for the trade size of the conduit.

B. Primer and Cement

1. Nonmetallic conduit shall be cleaned with primer and connected to fittings with the manufacturer's recommended cement that is labeled Low VOC.

C. Galvanizing Compounds

1. Galvanizing compounds for field application shall be the cold-applied type, containing no less than 93% pure zinc.

D. Conduit Interior Sealing

1. The sealing of the inside of conduits against water ingress shall be achieved through the use of one of the following:
 - a. Two-part expanding polyurethane foam sealing compound, dispensed from a single tube which mixes the two parts as it is injected into the conduit. Expanding foam shall be compatible with the conduit material of construction as well as the outer jacket of the cables in the conduit. Acceptable products are Q-Pak 2000 by Chemque, FST by American Polywater Corporation, or Hydra-seal S-60 by Duraline.
 - b. Inflatable bag that provides seal around cables and around inside diameter of conduit. Provide appropriate quantity of additional fittings for applications with three or more cables in the conduit to be sealed. Acceptable products are Rayflate by Raychem, or Engineer approved

equal. This sealing method is only applicable to conduits trade size 2 inch and larger.

- c. Neoprene sealing ring provided with the required quantity and diameter of holes to accommodate the cables in each conduit. Sealing ring shall be compressed by two stainless steel pressure plates. Acceptable products are type CSB by OZ-GEDNEY, or Engineer approved equal. This sealing method is only applicable to metallic conduits containing 4 or less cables.
- 2. The use of aerosol-based expanding foam sealants or any other method of sealing against water ingress not listed above is not acceptable.

E. Pull Rope

- 1. Pull ropes for empty and/or spare conduits shall be woven polyester, 1/2 inch wide, with a minimum tensile strength of 1250 lbs.
- 2. Pull ropes for the Contractor's use in installing conductors shall be the size and strength required for the pull, and shall be made of a non-metallic material.

PART 3 – EXECUTION

3.01 GENERAL

- A. Minimum trade size for all rigid conduits shall be 3/4 inch in exposed applications and 1 inch in embedded applications. Conduits installed within ductbanks shall be allowed to be increased in size to trade size 2 inch, at the Contractor's option, to accommodate the saddle size of the ductbank spacers. However, no combining of circuits shall be allowed in the larger conduits.
- B. Minimum trade size for flexible conduits (where specifically allowed herein) shall be 1/2 inch in all applications.
- C. Conduit routing and/or homeruns within structures is not shown on the Drawings. Conduits shall be installed concealed wherever practical and within the limitations specified herein. All other conduits not capable of being installed concealed shall be installed exposed.
- D. Empty and/or spare conduits shall be provided with pull ropes which have no less than 12 inches of slack at each end.
- E. Nonmetallic conduits for installations requiring less than a factory length of conduit shall be field cut to the required length. The cut shall be made square, cleaned of debris, and primer shall be applied to ready each joint for fusing. Conduits shall then be fused together with the conduit manufacturer's approved cement compound.
- F. Metallic conduits for installations requiring less than a factory length of conduit shall be field cut to the required length. The cut shall be made square, be cleaned of all debris

and be de-burred, then threaded. Conduit threading performed in the field shall be $\frac{3}{4}$ inch per foot tapered threads in accordance with ANSI B1.20.1.

- G. Conduits shall be protected from moisture, corrosion, and physical damage during construction. Install dust-tight and water-tight conduit fittings on the ends of all conduits immediately after installation and do not remove until conductors are installed.
- H. Conduits shall be installed to provide no less than 12 inches clearance from pipes that have the potential to impart heat upon the conduit. Such pipes include, but are not limited to, hot water pipes, steam pipes, exhaust pipes, and blower air pipes. Clearance shall be maintained whether conduit is installed in parallel or in crossing of pipes.
- I. Where non-metallic instrumentation conduits are installed exposed, the following clearances to other conduit types shall be maintained:
 - 1. Instrumentation conduits installed parallel to conduits with conductors energized at 480V or above shall be 18 inches.
 - 2. Instrumentation conduits installed parallel to conduits with conductors energized at 240V and below shall be 12 inches.
 - 3. Instrumentation conduits installed at right angles to conductors energized at 480V and below shall be 6 inches.
 - 4. Instrumentation conduits installed at right angles to conductors energized at voltages above 480V shall be 12 inches.
- J. Where conduit fittings do not include an integral insulated bushing, an insulated bushing shall be installed at all conduit termination points.
- K. Conduits which serve multi-section equipment shall be terminated in the section where wiring terminations will be made.
- L. Conduits shall not penetrate the floors or walls inside liquid containment areas without specific written authorization from the Engineer. Liquid containment areas are indicated on the Drawings.
- M. In no case shall conduit be supported or fastened to another pipe or be installed in a manner that would prevent the removal of other pipes for repairs. Spring steel fasteners may only be used to affix conduits containing lighting branch circuits within EMT conduits to structural steel members.
- N. All field fabricated threads for rigid galvanized steel conduit shall be thoroughly coated with two coats of galvanizing compound, allowing at least two minutes to elapse between coats for proper drying.
- O. The appropriate specialized tools shall be used for the installation of PVC coated conduit and conduit fittings. No damage to the PVC coating shall occur during installation. Conduit and conduit fittings with damaged PVC coating shall be replaced at the Contractor's cost. The use of PVC coating touch-up compounds is not permitted.

- P. Conduits which emerge from within or below concrete encasement shall be PVC coated rigid galvanized steel where the conduit is not protected by an equipment enclosure that surrounds the conduit on all sides at the point where it emerges from the encasement.
- Q. Aluminum conduits shall not be installed in direct contact with concrete surfaces. Where aluminum conduits are routed along concrete surfaces, they shall be installed with one-hole electro-galvanized malleable iron alloy straps with matching clamp-backs to space the conduit ¼ inch away from concrete surface. Where aluminum conduit passes through concrete, CMU or brick walls, the penetration shall be made such that the aluminum conduit does not come in contact with concrete, CMU, brick or mortar.

3.02 CONCEALED AND EMBEDDED CONDUITS

- A. Conduits are permitted to be installed concealed and/or embedded with the following requirements:
 - 1. Conduits shall not be installed horizontally when concealed within CMU walls, only vertical installation is acceptable.
 - 2. Conduits installed embedded within concrete floors or walls shall be located so as not to affect the designed structural strength of the floor or wall. Embedded conduits shall be installed in accordance with ACI-318.
 - 3. Where conduit bends emerge from concrete embedment, none of the curved portion of the bend shall be visible. Only the straight portion of the bend shall be visible.
 - 4. Where multiple conduits emerge from concrete embedment or from concealment below a concrete floor, ample clear space shall be provided between conduits to allow for the appropriate and required conduit termination fittings to be installed.
 - 5. Conduits installed embedded within concrete encasement of any kind shall be installed such that conduit couplings for parallel conduits are staggered so that they are not side by side.
- B. Conduits are not permitted to be installed concealed and/or embedded for the following situations:
 - 1. Conduits shall not be installed embedded within any water-bearing floors or walls. Conduits shall not be installed embedded within any liquid containment area floors or walls.
 - 2. Conduits shall not be installed concealed within CMU walls or gypsum walls that are adjacent to Class I and II hazardous areas (Division I and Division II).
 - 3. Conduits shall not be installed concealed within CMU walls or gypsum walls that are adjacent to indoor Type 1 or Type 2 chemical storage/transfer areas.

3.03 CONDUIT USES AND APPLICATIONS

- A. Rigid Conduit

1. Rigid conduit for non-hazardous areas shall be furnished and installed in the materials of construction as follows:

RIGID CONDUIT FOR NON-HAZARDOUS AREAS		
<u>INSTALLATION AREA DESIGNATION/ SCENARIO</u>	<u>CONDUIT CATEGORY BY WIRING/CIRCUIT TYPE</u>	
	Power and Control	Instrumentation
Exposed in indoor wet process areas	Rigid aluminum conduit	Same as Power and Control
Exposed in indoor dry process areas	Rigid aluminum conduit	Same as Power and Control
Exposed in indoor dry non-process areas	Rigid aluminum conduit	Same as Power and Control
Exposed in indoor Type 1 chemical storage/transfer areas	Schedule 80 rigid non-metallic PVC conduit	Same as Power and Control
Exposed in indoor Type 2 chemical storage/transfer areas	PVC coated rigid galvanized steel conduit	Same as Power and Control
Exposed in outdoor areas	Rigid aluminum conduit	Same as Power and Control
Exposed within pre-fabricated electrical equipment center buildings	Electrical Metallic Tubing	Same as Power and Control
Concealed within underground direct-bury or concrete-encased ductbanks	Schedule 40 rigid non-metallic PVC conduit	PVC coated rigid galvanized steel conduit
Concealed within non-elevated (i.e. "slab-on-grade" construction) concrete slabs	Schedule 40 rigid non-metallic PVC conduit	Rigid galvanized steel conduit
Concealed within elevated concrete slabs	Rigid galvanized steel conduit	Same as Power and Control
Concealed below concrete slabs (within earth or fill material)	Schedule 40 rigid non-metallic PVC conduit	Rigid galvanized steel conduit
Concealed within concrete walls	Schedule 40 rigid non-metallic PVC conduit	Rigid galvanized steel conduit
Concealed within CMU walls	Schedule 40 rigid non-metallic PVC conduit or Electrical Metallic Tubing	Rigid galvanized steel conduit or Electrical Metallic Tubing
Concealed above suspended ceilings	Electrical Metallic Tubing	Same as Power and Control
Concealed within interior walls constructed of metal studs and gypsum wall board	Electrical Metallic Tubing	Same as Power and Control
Emerging from concealment within or below a concrete floor and transitioning to exposed conduit	PVC coated rigid aluminum conduit	Same as Power and Control

2. Rigid conduit for hazardous areas shall be furnished and installed in the materials of construction as follows:

RIGID CONDUIT FOR HAZARDOUS AREAS		
<u>INSTALLATION AREA HAZARD/SCENARIO</u>	<u>CONDUIT CATEGORY BY WIRING/CIRCUIT TYPE</u>	
	Power and Control	Instrumentation
Exposed in Class I and II areas (Division I and Division II)	Rigid aluminum conduit	Same as Power and Control
Concealed within concrete slabs in Class I and II areas (Division I and Division II)	Rigid galvanized steel conduit	Same as Power and Control
Concealed below concrete slabs (within earth or fill material) in Class I and II areas (Division I and Division II)	Rigid galvanized steel conduit	Same as Power and Control
Concealed within concrete walls in Class I and II areas (Division I and Division II)	Rigid galvanized steel conduit	Same as Power and Control
Concealed below concrete slabs encased in at least two inches of concrete and buried 24 inches below top of slab in Class I Division I areas	Schedule 40 rigid non-metallic PVC conduit	Rigid galvanized steel conduit
Concealed above suspended ceilings in Class I and II areas (Division I and Division II)	Rigid aluminum conduit	Same as Power and Control

3. The tables for the materials of construction for rigid conduits are intended to exhaustively cover all possible scenarios and installation areas under this Contract. However, if a scenario or installation area is found that is not explicitly governed by these tables, it shall be assumed for bid purposes that the conduit material of construction is to be rigid galvanized steel. This discrepancy shall be brought to the attention of the Engineer (in writing) immediately for resolution.

B. Conduit Bends

1. All conduit bends shall be the same material of construction as the rigid conduit listed in the tables above, with the following exceptions:
 - a. All 90 degree bends or combinations of adjacent bends that form a 90 degree bend where concealed within concrete or below a concrete slab shall be rigid galvanized steel.
2. Field fabricated bends of metallic conduit shall be made with a bending machine and shall have no kinks. Field fabricated standard radius and long radius bends shall have minimum bending radii in accordance with the associated tables in Part 2 herein.
3. Field bending of non-metallic conduits is not acceptable, factory fabricated bends shall be used.

4. Long radius bends shall be furnished and installed for the following specific applications, all other bends shall be standard radius:
 - a. All conduits containing medium voltage cable.
 - b. All conduits containing fiber optic cable.
 - c. All conduits containing shielded VFD cable.
 - d. Where specifically indicated on the Drawings.

C. Flexible Conduit

1. Flexible conduit shall only be installed for the limited applications specified herein. Flexible conduit shall not be installed in any other application without written authorization from the Engineer. Acceptable applications are as follows:
 - a. Connections to motors and engine-generator sets (and similar vibrating equipment)
 - b. Connections to solenoid valves and limit switches
 - c. Connections to lighting fixtures installed in suspended ceilings
 - d. Connections to lighting transformers
 - e. Connections to pre-fabricated equipment skids
 - f. Connections to HVAC equipment
 - g. Connections to instrument transmitters and elements
 - h. Where specifically indicated in the Standard Details
2. Flexible conduit length shall be limited to three (3) feet, maximum. Flexible conduit shall not be installed buried or embedded within any material.

3. Flexible conduit for non-hazardous areas shall be furnished and installed in the materials of construction as follows:

FLEXIBLE CONDUIT FOR NON-HAZARDOUS AREAS		
<u>INSTALLATION AREA DESIGNATION/SCENARIO</u>	<u>CONDUIT CATEGORY BY WIRING/CIRCUIT TYPE</u>	
	Power and Control	Instrumentation
Exposed in indoor wet process areas	Liquid-tight flexible metal conduit	Same as Power and Control
Exposed in indoor dry process areas	Flexible metal conduit	Same as Power and Control
Exposed in indoor dry non-process areas	Flexible metal conduit	Same as Power and Control
Exposed in indoor Type 1 chemical storage/transfer areas	Liquid-tight flexible non-metallic conduit	Same as Power and Control
Exposed in indoor Type 2 chemical storage/transfer areas	Liquid-tight flexible metal conduit	Same as Power and Control
Exposed in outdoor areas	Liquid-tight flexible metal conduit	Same as Power and Control
Concealed above suspended ceilings (all indoor areas)	Same material as exposed conduit in same area	Same as Power and Control

4. For Class I Division I hazardous areas, the NEC does not permit the installation of flexible conduit. In lieu of flexible conduit in these areas, flexible conduit couplings shall be installed as specified in Part 2 herein. Flexible conduit for all other hazardous areas shall be furnished and installed in the materials of construction as follows:

FLEXIBLE CONDUIT FOR HAZARDOUS AREAS		
<u>INSTALLATION AREA HAZARD/SCENARIO</u>	<u>CONDUIT CATEGORY BY WIRING/CIRCUIT TYPE</u>	
	Power and Control	Instrumentation
Exposed in Class I Division II areas	Liquid-tight flexible metal conduit	Same as Power and Control
Exposed in Class II (Division I and Division II) areas	Liquid-tight flexible metal conduit	Same as Power and Control
Concealed above suspended ceilings in Class I and II (Division I and Division II) areas	Same material as exposed conduit in same area	Same as Power and Control

3.04 CONDUIT FITTING USES AND APPLICATIONS

A. General

1. Conduit fittings shall be furnished and installed in the materials of construction as indicated in Part 2, herein. Conduit fitting materials of construction are dependent on the material of construction used for the associated conduit.
2. Conduit fittings shall be provided in the trade size and configuration required to suit the application.

B. Conduit Bodies

1. Conduit bodies shall be installed where wire pulling points are desired or required, or where changes in conduit direction or breaking around beams is required.
2. Where conduit bodies larger than trade size 2 inches are intended to be used as a pull-through fitting during wire installation, oversized or elongated conduit bodies shall be used. Oversized or elongated conduit bodies shall not be required if the conduit body is intended to be used as a pull-out point during wire installation.

C. Conduit Nipples and Unions

1. Conduits with running threads shall not be used in place of 3-piece couplings (unions) or close nipples. After installation of a conduit fitting of any kind, there shall be no more than ¼ inch of exposed threads visible. Factory fabricated all-thread nipples may be used between adjacent enclosures, however, the same restriction applies regarding the length of exposed threads that are visible.

D. Conduit Expansion and Deflection Fittings

1. Conduit expansion fittings shall be installed where required by the NEC and where indicated on the Drawings. Expansion fittings shall also be installed for exposed straight metallic conduit runs of more than 75 feet, in both indoor and outdoor locations. Expansion fittings for runs of non-metallic conduit shall be installed in accordance with the NEC.
2. Conduit deflection fittings shall be installed where required by the NEC and where conduits are installed (exposed and concealed) across structural expansion joints.

E. Conduit Seals

1. Conduit seals shall be installed for conduits installed within or associated with hazardous areas and other areas as required by the NEC. In addition, conduit seals shall also be furnished and installed as follows:
 - a. All conduits entering or leaving enclosed areas which store or distribute chlorine gas.
 - b. All conduits entering or leaving enclosed areas which store or distribute sulfur dioxide gas.

F. Conduit Termination Fittings

1. Where conduits terminate at enclosures with a NEMA 4, 4X, or 3R rating and the enclosure does not have integral conduit hubs, an appropriately sized watertight conduit hub shall be installed to maintain the integrity of the enclosure. The use of locknuts with integral gasket in lieu of watertight conduit hubs is not acceptable.
2. Where conduits terminate at enclosures that do not require conduit hubs, a two-locknut system shall be used to secure the conduit to the enclosure. One locknut shall be installed on the outside of the enclosure, and the other inside, drawn tight against the enclosure wall. The locknut on the interior of the enclosure shall be the type with integral bonding lug, or a conduit bonding bushing may be used in place of the locknut.
3. Conduits shall not be installed such that conduit fittings penetrate the top of any enclosure located outdoors, except in cases where specifically required by the serving electric utility. Conduits which serve outdoor equipment or an enclosure from above shall instead be routed into the side of the enclosure at the bottom. The conduit termination fitting shall be provided with a conduit drain to divert moisture from the raceway away from the enclosure.

3.05 MISCELLANEOUS

A. Conduit Periphery Sealing

1. All conduit penetrations through exterior walls shall be sealed around the periphery using the appropriate products specified in Part 2 herein to prevent air and/or water entry into the structure.
2. All conduit penetrations through interior walls and floors shall be sealed through the use of with conduit sleeves and caulk as specified in Part 2 herein. Alternatively, mortar may be used to seal around the conduit periphery.
3. Conduit penetrations through fire-rated walls as floors shall be made with the appropriate fire rated penetration product.

B. Conduit Interior Sealing

1. All conduits (including spares) entering a structure below grade shall be sealed on the interior of the conduit against water ingress. Sealing shall be at an accessible location in the conduit system located within the building structure and shall be via one of the methods specified in Part 2 herein. If conduit sealing cannot be achieved at an accessible location within the building structure, sealing shall be placed in the conduits in the nearest manhole or handhole outside the structure.

3.06 CONDUIT IDENTIFICATION

- A. The identification system for the conduits furnished and installed under this Contract shall match the existing identification system used at the project location.

- B. Exposed conduits shall be identified at the source, load, and all intermediate components of the raceway system. Examples of intermediate components include but are not limited to junction boxes, pull boxes, and disconnect switches. Identification shall be by means of an adhesive label with the following requirements:
1. Labels shall consist of an orange background with black text. Text for the label shall be the conduit number as indicated in the conduit and wire schedules.
 2. In addition, at the source end of the conduit, a second line of text shall be included to indicate the load equipment name. This second line shall consist of the word "TO:" and the text in the 'TO' column of the conduit and wire schedule (e.g. TO: Pump No. 1). At the load end of the conduit, a second line of text shall be included to indicate the source equipment name. This second line shall consist of the word "FROM:" and the text in the 'FROM' column of the conduit and wire schedule (e.g. FROM: MCC-SPS). This requirement applies only to the source and load ends of the conduit, and not anywhere in between.
 3. For conduits trade sizes 3/4 inch through 1-1/2 inch, the text shall be a minimum 18 point font. For conduits trade size 2 inch and larger, the text shall be a minimum 24 point font.
 4. Label height shall be 3/4 inch minimum, and length shall be as required to fit required text. The label shall be installed such that the text is parallel with the axis of the conduit. The label shall be oriented such that the text can be read without the use of any special tools or removal of equipment.
 5. Labels shall be installed after each conduit is installed and, if applicable, after painting. Labels shall be printed in the field via the use of a portable label printing system. Handwritten labels are not acceptable.
 6. Labels shall be made of permanent vinyl with adhesive backing. Labels made of any other material are not acceptable.
- C. Conduits that are not exposed but installed beneath free standing equipment enclosures shall be identified by means of a plastic tag with the following requirements:
1. The tag shall be made of white Tyvek material, and have an orange label with black text, as described above, adhered to it. Text for the label shall be the conduit number as indicated in the conduit and wire schedules.
 2. The tag shall be affixed to the conduit by means of a nylon cable tie. The tag shall be of suitable dimensions to achieve a minimum text size of 18 points.
- D. Conduits for lighting and receptacle circuits shall not require identification.
- E. Any problems or conflicts with meeting the requirements above shall immediately be brought to the attention of the Engineer for a decision.

3.07 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:
 - 1. All conduit installed below grade or concrete encased shall be tested to ensure continuity and the absence of obstructions by pulling through each conduit a swab followed by a mandrel 85% of the conduit inside diameter. After testing, all conduits shall be capped after installation of a suitable pulling rope.

3.08 TRAINING OF INSTALLATION PERSONNEL

- A. All Contractor personnel that install PVC coated RGS conduit shall be trained by the PVC coated RGS conduit manufacturer. Training shall include proper conduit system assembly techniques, use of tools appropriate for coated conduit systems, and field bending/cutting/threading of coated conduit. Training shall have been completed within the past 24 months prior to the Notice to Proceed on this Contract to be considered valid. Contractor personnel not trained within this timeframe shall not be allowed to install coated conduit, or shall be trained/re-trained as required prior to commencement of conduit installation.

[END OF SECTION]

SECTION 16123

WIRE AND CABLE

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, connect, test, and place in satisfactory operating condition, ready for service, all cables and wires indicated on the Drawings and as specified herein or required for proper operation of the installation, with the exception of internal wiring provided by electrical equipment manufacturers. The work of connecting cables to equipment, machinery, and devices shall be considered a part of this Section. All hardware, junction boxes, bolts, clamps, insulators, and fittings required for the installation of cable and wire systems shall be furnished and installed by the Contractor.
- B. The wire and cable to be furnished and installed for this project shall be the product of manufacturers who have been in the business of manufacturing wire and cable for a minimum of ten (10) years.
- C. Reference Section 16000 - Basic Electrical Requirements.

1.02 TESTING

- A. All testing shall be performed in accordance with the requirements of the General Conditions, Division 01, and Section 16000 – Basic Electrical Requirements. The following tests are required:
 - 1. Witness Shop Tests
 - a. Not required.
 - 2. Shop Test
 - a. Cable and wiring shall be tested in accordance with the applicable ICEA Standards. Wire and cable shall be physically and electrically tested in accordance with the manufacturer's standards.
 - 3. Field Tests
 - a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 01, and NETA acceptance testing specifications referenced in Section 16000 - Basic Electrical Requirements.
 - b. After installation, all wires and cables shall be tested for continuity. Testing for continuity shall be "test light" or "buzzer" style.
 - c. After installation, all wires and cables shall be tested for insulation levels. Insulation resistance between conductors of the same circuit and between

conductor and ground shall be tested. Testing for insulation levels shall be as follows:

- i. For 600V power and control cable, apply 1,000 VDC from a Megaohmmeter for one (1) minute for all 600V wires and cables installed in lighting, control, power, indication, alarm and motor feeder circuits. Resistance shall be no less than 100 Megaohms.
 - ii. 600V instrumentation signal cable shall be tested from conductor to conductor, conductor to shield, and conductor to ground using a Simpson No. 260 volt-ohmmeter, or approved equal. The resistance value shall be 200 Megaohms or greater.
- B. Low voltage wires and cables shall be tested before being connected to motors, devices or terminal blocks.
- C. Voltage tests shall be made successively between each conductor of a circuit and all other conductors of the circuit grounded.
- D. If tests reveal defects or deficiencies, the Contractor shall make the necessary repairs or shall replace the cable as directed by the Engineer, without additional cost to Owner.
- E. All tests shall be made by and at the expense of the Contractor who shall supply all testing equipment. Test reports shall be submitted to the Engineer.

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions, the Contractor shall obtain from the wire and cable manufacturer and submit the following:
1. Shop Drawings
 2. Reports of Field Tests
 3. Wiring Identification Methods
- B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed material's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible Submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
1. Product data sheets.
 2. Cable pulling calculations (if required).

3. Wiring identification methods and materials.

1.05 IDENTIFICATION

- A. Each cable shall be identified as specified in Part 3, Execution, of this Specification.

1.06 CABLE PULLING CALCULATIONS

- A. The Contractor shall submit cable pulling calculations. These calculations, to be performed by a currently registered professional engineer in the State of Florida, shall define pulling tension and sidewall loading (sidewall bearing pressure values) for all installations of 600VAC, #1/0 conductors and larger greater than 200 feet in length. Calculations for straight horizontal installations of 600VAC, #1/0 conductors and larger greater than 200 feet are not required.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. The wire and cable covered by this Specification is intended to be standard equipment of proven performance. Wire and cable shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and indicated on the Drawings. Only one (1) manufacturer for each wire and cable type shall be permitted.
- B. The wire and cable manufacturer shall be ISO 9000 registered.

2.02 600 VOLT POWER WIRE AND CABLE

- A. 600 volt cable and wire shall consist of stranded, copper conductor with insulation rated THHN, 90°C for dry locations and THWN, 75°C for wet locations.
- B. Conductors shall be stranded copper per ASTM-B8 and B-33, and Class B or C stranding contingent on the size unless otherwise specified. Minimum size wire shall be No. 12 AWG.
- C. 600 volt individual power wire and cable shall be Okoseal-N as manufactured by the Okonite Company, Cerro Wire and Cable equivalent, Southwire Company equivalent with SIMPull jacket, or equal. Multi-conductor power cables shall be Okoseal-N Type TC Cable as manufactured by the Okonite Company, Cerro Wire and Cable equivalent, Southwire Company equivalent, or equal.
- D. For a motor controlled by a Variable Frequency Drives (VFD) provide VFD power cables. The cable shall be shielded, flexible motor supplied cable for variable speed drives, subject to non-linear power distortion. The VFD cable shall be used to interconnect the AC VFD to the AC motor. The VFD cable shall be 1000V rated UL flexible motor supply cable, with 3 stranded tinned copper conductors with XLPE insulation, 1 stranded tinned copper ground wire with PVC insulation, overall combination tinned copper braid shield

and foil shield, and black PVC jacket. The cable shall be Belden VFD cable, or approved equal.

2.03 600 VOLT CONTROL CABLE

- A. 600 volt control cable shall consist of stranded, copper conductor with insulation rated THHN, 90°C for dry locations and XHHW, 75°C for below grade and wet locations. The individual conductors of the multiple conductor cable shall be color coded for proper identification. Color coding shall be equal to ICEA S-68-514, Method 1, E2. Cables shall meet requirements of IEEE-383.
- B. Conductors shall be stranded copper per ASTM B-8 and B-33, and Class B or C stranding contingent on the size unless otherwise specified. Minimum wire size shall be No. 14 AWG.
- C. 600 volt individual conductor control wire shall be Okoseal-N as manufactured by the Okonite Company, Cerro Wire and Cable equivalent, Southwire Company equivalent with SIMPull jacket, or equal. Multi-conductor control cable shall be Okoseal-N Type TC Cable as manufactured by the Okonite Company, Cerro Wire and Cable equivalent, Southwire Company equivalent, or equal.

2.04 LIGHTING AND RECEPTACLE WIRE AND CABLE

- A. The lighting and receptacle branch circuit wire shall consist of solid, copper conductors with insulation rated THHN, 90°C for dry locations and THWN, 75°C for wet locations.
- B. Conductors shall be solid copper per ASTM- B-33. Minimum size wire shall be No. 12 AWG.
- C. Lighting and receptacle cables and wire shall be Okoseal-N as manufactured by the Okonite Company, Cerro Wire and Cable equivalent, Southwire Company equivalent with SIMPull jacket, or equal.

2.05 INSTRUMENTATION CABLE

- A. Single Twisted Pair Instrument Cable
 - 1. The cable shall be single, shielded, twisted pairs or triads with 600 volt insulation and shall have a 90°C insulation rating.
 - 2. Conductors shall be tin or alloy coated (if available), soft, annealed copper, stranded per ASTM-B8, Class B stranding unless otherwise specified. Minimum size wire shall be No. 16 AWG.
 - 3. Conductors shall be with foil and braided shield.
- B. Multi-conductor Twisted Pair Instrument Cable
 - 1. The cable shall be insulated stranded conductors, twisted pairs or triads with foil shield over each pair, a common overall foil and braided shield, 600 volt insulation, and 90°C insulation rating.

2. Conductors shall be tin or alloy coated (if available), soft, annealed copper, stranded per ASTM-B8, Class B stranding unless otherwise specified. Minimum size wire shall be No. 20 AWG.
- C. The instrumentation cable for analog signals shall be Okoseal-N Type P-OS for single pair or triad applications and Okoseal-N Type SP-OS for multiple pair or triad applications as manufactured by the Okonite Company, Cerro Wire and Cable equivalent, Southwire Company equivalent, or equal.

2.06 CABLE PULLING LUBRICANTS

- A. Cable pulling lubricants shall be non-hardening type and approved for use on the type of cable installed. Lubricant shall be Yellow #77 by Ideal, Cable Gel by Greenlee, Poly-Gel by Gardner Bender, or equal.

PART 3 - EXECUTION

3.01 600V CABLE INSTALLATION

- A. The cable and wires shall be installed as specified herein and indicated on the Drawings.
- B. The cables shall be terminated in accordance with the cable and/or termination product manufacturer's instructions for the particular type of cable.
- C. To minimize oxidation and corrosion, wire and cable shall be terminated using an oxide-inhibiting joint compound recommended for "copper-to-copper" connections. The compound shall be Penetrox E as manufactured by Burndy Electrical, or equal.
- D. Splices shall not be allowed in the underground manhole and handhole systems. If splices are required, the Contractor shall obtain approval in writing from the Engineer prior to splicing. Splicing materials shall be barrel type butt splice connectors and heat shrink tubing as manufactured by 3M, Ideal, or equal. No splicing of instrumentation cable is allowed. The use of screw-on wire connectors (wire nuts) shall only be permitted for lighting and receptacle circuits. Reference Section 16130 - Boxes for additional requirements regarding control wiring.
- E. Wire and Cable Sizes
 1. The sizes of wire and cable shall be as indicated on the Drawings, or if not shown, as approved by the Engineer. If required due to field routing, the size of conductors and respective conduit shall be increased so that the voltage drop measured at the load does not exceed 2-1/2%.
 2. Minimum wire size within control panels, motor control centers, switchboards and similar equipment shall be No. 12 AWG for power and No. 14 AWG for control.
- F. Number of Wires

1. The number of wires indicated on the Drawings for the various control, indication, and metering circuits were determined for general schemes of control and for particular indication and metering systems.
2. The actual number of wires installed for each circuit shall, in no case, be less than the number required; however, the Contractor shall add as many wires as may be required for control and indication of the actual equipment selected for installation at no additional cost to Owner. The addition of conductors shall be coordinated with and approved by the Engineer to avoid violations of the NEC regarding conduit fill.
3. All spare conductors shall be terminated on the terminal blocks mounted within the equipment.

G. Wiring Identification

1. In addition to color coding, all wiring shall be identified at each point of termination. This includes but is not limited to identification at the source, load, and in any intermediate junction boxes where a termination is made. The Contractor shall meet with Owner and Engineer to come to an agreement regarding a wire identification system prior to installation of any wiring. Wire numbers shall not be duplicated.
2. Wire identification shall be by means of a heat shrinkable sleeve. Sleeves shall have a white background with black text. Wire sizes #14 AWG through #10 AWG shall have a minimum text size of 7 points. Wire sizes #8 AWG and larger shall have a minimum text size of 10 points. Sleeves shall be of appropriate length to fit the required text. The use of handwritten text for wire identification shall not be permitted.
3. Sleeves shall be suitable for the size of wire on which they are installed. When installation is complete, sleeves shall be tightly affixed to the wire and shall not move. Sleeves shall be heat shrunk onto wiring with a heat gun approved for the application. Sleeves shall not be heated by any means which employs the use of an open flame. The Contractor shall take special care to ensure that the wiring insulation is not damaged during the heating process.
4. Sleeves shall be installed prior to the completion of the wiring terminations and shall be oriented so that they can be easily read.
5. Sleeves shall be white polyolefin as manufactured by Brady, Seton equivalent, Panduit equivalent, or equal.
6. Where sleeves are not available in the size required for the wire, the Contractor shall use an adhesive label with a white background and black text. Text size shall be in accordance with the requirements listed above.
7. Adhesive labels, for the case when sleeves are not suitable for the wire size, shall be white permanent vinyl as manufactured by Brady, Seton equivalent, Panduit equivalent, or equal.
8. Wire identification in manholes, handholes, pull boxes, and other accessible components in the raceway system where the wiring is continuous shall be accomplished by means of a tag installed around the bundled group of conductors.

Identification shall utilize a FROM-TO system. Each group of conductors shall consist of all of the individual conductors in a single conduit or duct. The tag shall have text that identifies the bundle in accordance with the 'FROM' and 'TO' column for that particular conduit number in the conduit and wire schedule. Minimum text size shall be 10 point. The tag shall be affixed to the wire bundle by the use of nylon wire ties, and shall be made of polyethylene as manufactured by Brady, Seton equivalent, Panduit equivalent, or equal.

H. Cable Installation

1. All interior cable not protected by a compartment enclosure shall be installed in conduit.

I. Wiring Supplies

1. Only electrical wiring supplies manufactured under high standards of production and meeting the approval of the Engineer shall be used.
2. Rubber insulating tape shall be in accordance with ASTM Des. D119. Friction tape shall be in accordance with ASTM Des. D69.

J. Training of Cable

1. The Contractor shall furnish all labor and material required to train cables around cable vaults within buildings and in manholes and handholes in the outdoor underground duct system. Sufficient length of cable shall be provided in each handhole, manhole, and vault so that the cable can be trained and racked in an approved manner. Instrumentation cable shall be racked separate from all other AC and DC wiring to maintain the required separation specified herein. In training or racking, the radius of bend of any cable shall be not less than the manufacturer's recommendation. The training shall be done in such a manner as to minimize chaffing.

K. Connections at Control Panels, Limit Switches, and Similar Devices

1. Where stranded wires are terminated at panels, and/or devices, connections shall be made by solderless lug, crimp type ferrule, or solder dipped.
2. Where enclosure sizes and sizes of terminals at limit switches, solenoid valves, float switches, pressure switches, temperature switches, and other devices make 7-strand, No. 12 AWG, wire terminations impractical, the Contractor shall terminate external circuits in an adjacent junction box of proper size complete with terminal strips and shall install No. 14 AWG stranded wires from the device to the junction box in a conduit. The #12 AWG field wiring shall also be terminated in the same junction box to complete the circuit.

L. Pulling Temperature

1. Cable shall not be flexed or pulled when the temperature of the jacket is such that damage will occur due to low temperature embrittlement. When cable will be pulled with an ambient temperature of 40°F or less within a three (3) day period prior to

pulling the cable reels shall be stored three (3) days prior to pulling in a protected storage area with an ambient temperature of 55°F or more. Cable pulling shall be completed during the work day for which the cable is removed from the protected storage. Any remaining cable reels shall be returned to storage at the completion of the workday.

M. Color Coding

1. Conductor insulation shall be color coded as follows:

a. 480/277V AC Power

Phase A - BROWN
Phase B - ORANGE
Phase C - YELLOW
Neutral WHITE

b. 120/208V or 120/240V AC Power

Phase A - BLACK
Phase B - RED
Phase C ORANGE
Neutral - WHITE

c. DC Power

Positive Lead - RED
Negative Lead - BLACK

d. DC Control

All wiring - BLUE

e. 120VAC Control

Single conductor 120 VAC control wire shall be RED except for a wire entering a motor control center compartment or control panel which is an interlock. This conductor shall be color coded YELLOW.

f. 24VAC Control

All wiring – ORANGE

g. Equipment Grounding Conductor

All wiring - GREEN

2. Conductors No. 2 AWG and smaller shall be factory color coded with a separate color for each phase and neutral, which shall be used consistently throughout the

system. Larger cables shall be coded by the use of colored tape in accordance with the requirements listed above.

3. Low voltage feeder and branch circuit conductors shall be identified in accordance with the NEC. The method utilized for conductor identification for each nominal voltage system shall be permanently posted at each feeder or branch circuit distribution equipment assembly. Reference Articles 200, 210, and 215 of the NEC.

3.02 INSTRUMENTATION CABLE INSTALLATION

- A. The Contractor shall install all cable or conductors used for instrumentation wiring (4-20 mA DC, etc.) in rigid galvanized steel or PVC coated rigid galvanized steel conduit. The use of asbestos cement or PVC conduit shall not be permitted. Analog signal wires shall exclusively occupy these conduits. No other wiring for AC or discrete DC circuits shall be installed in these conduits.
- B. All shielding shall be continuous and shall be grounded at one point only, or in accordance with the instrumentation equipment manufacturer's recommendations.
- C. Where instrumentation cables are installed in panels, manholes, handholes, and other locations, the Contractor shall arrange wiring to provide maximum clearance between these cables and other conductors. Instrumentation cables shall not be installed in same bundle with conductors of other circuits.
- D. Additional pullboxes shall be furnished and installed for ease of cable pulling and the cable manufacturer's recommended conduit fill factor shall be followed. Where required or specifically directed by the Engineer, the Contractor shall moisture seal the cables at all connections with OZ Gedney Type "CSB", or equal, sealing bushings.
- E. Special instrument cable shall be as specified or recommended by the manufacturer of the equipment or instruments requiring such wiring. Installation, storage, terminations, etc., shall be per manufacturer's recommendations.
- F. All cable insulation and jackets shall have adequate strength for it to be pulled through the conduit systems. All conductors shall be color coded and all wires shall be suitably tagged with permanent markers as specified herein.

[END OF SECTION]

SECTION 16130

BOXES

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The scope of work under this Section includes furnishing and installing all pull boxes, junction boxes, and outlet boxes.
- B. Requirements for other boxes and enclosures are not included in this Section. Reference each specific Division 16 equipment Section for requirements related to that equipment's respective enclosure.
- C. Reference Section 16000 - Basic Electrical Requirements, and Section 161111 - Conduit.

1.02 CODES AND STANDARDS

- A. Boxes shall be designed, manufactured, and/or listed to the following standards as applicable:
 - 1. UL 514A - Metallic Outlet Boxes
 - 2. UL 514C - Standard for Non-metallic Outlet Boxes, Flush Device Boxes, and Covers
 - 3. UL 50 – Enclosures for Electrical Equipment, Non-environmental Considerations
 - 4. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations
 - 5. UL 1203 - Standard for Explosion-proof and Dust-ignition-proof Electrical Equipment for use in Hazardous (Classified) Locations.
 - 6. NEMA 250 – Enclosures for Electrical Equipment

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions, the Contractor shall obtain from the equipment manufacturer(s) and submit the following:
 - 1. Shop Drawings
- B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

- B. Partial, incomplete or illegible Submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets for boxes, terminal strips, and all accessories

1.05 OPERATION AND MAINTENANCE MANUALS

- A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 01.
- B. As-built drawings showing dimensions, internal box layout, terminal strip information, and terminal strip identification information shall be provided for all junction boxes. As-built drawings are not required for pull boxes or outlet boxes.

1.06 IDENTIFICATION

- A. Each pull and junction box shall be identified with the box name as indicated on the Contract Drawings (e.g. PPB-XXX, CJB-YYY) or as directed by the Engineer. A nameplate shall be securely affixed in a conspicuous place on each box. Nameplates shall be as specified in Section 16195 - Electrical Identification.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 PULL AND JUNCTION BOXES

- A. General
 - 1. All pull and junction boxes shall be UL listed and labeled.
 - 2. Pull and junction boxes shall not be provided with eccentric or concentric knockouts.
 - 3. Pull and junction boxes mounted embedded in concrete shall be UL listed for embedment.
 - 4. Where metallic boxes are used they shall be of cast type or all welded construction as specified herein. Tack welded boxes are not acceptable.
- B. Pull Boxes
 - 1. All pull boxes shall be provided with a matching gasketed cover. For covers with dimensions of 24 inches by 24 inches or less, the cover shall be held in place by

machine screws. Other screw types are not acceptable. For covers with dimensions greater than 24 inches by 24 inches, the cover shall be hinged and held in place by screw-operated clamp mechanisms. Hinge pins shall be removable. Clamp mechanism material of construction shall match that of the associated box.

2. Pull boxes shall not have any wire terminations inside, other than those for grounding/bonding. A ground bar shall be provided with the necessary number of screw type terminals. Twenty (20) percent of the total amount of terminals otherwise required for the pull box (minimum of two) shall be provided as spare terminations. Boxes requiring any other wire terminations shall be furnished and installed in accordance with the requirements for junction boxes herein.
3. Pull boxes shall be 6 inches wide by 6 inches tall by 4 inches deep, minimum. For applications requiring larger boxes, the box shall be sized in accordance with the fill requirements and dimensional requirements of the NEC.
4. Barriers shall be provided in pull boxes to isolate conductors of different voltages, types, and functions. Barrier material of construction shall match that of the box. Isolation shall be provided between the following groups:
 - a. Power wiring
 - b. AC control wiring
 - c. DC control wiring
 - d. Instrumentation wiring

C. Junction Boxes

1. Junction boxes used for lighting and receptacle circuits only shall be provided with a matching gasketed cover held in place by machine screws. Other screw types are not acceptable.
2. Junction boxes for all uses other than lighting and receptacle circuits shall be provided with a hinged, gasketed cover. Hinge pins shall be removable. Cover shall be held in place by screw-operated clamp mechanisms. Clamp mechanism material of construction shall match that of the associated box.
3. Barriers shall be provided in junction boxes to isolate conductors and terminal blocks of different voltages, types, and functions. Barrier material of construction shall match that of the box. Isolation shall be provided between the following groups:
 - a. Power wiring
 - b. AC control wiring
 - c. DC control wiring
 - d. Instrumentation wiring

4. Junction boxes used for lighting and receptacle circuits only shall be allowed to have screw-on (wire nut) type connectors for wire terminations/junctions.
5. Junction boxes for all uses other than lighting and receptacle circuits shall be provided with terminal strips, consisting the necessary number of screw type terminals. Current carrying parts of the terminal blocks shall be of ample capacity to carry the full load current of the circuits connected, with a 10A minimum capacity. Terminal strips shall be rated for the voltage of the circuits connected. A separate ground bar shall be provided with the necessary number of screw type terminals. Twenty (20) percent of the total amount of terminals otherwise required for the junction box (minimum of two) shall be provided as spare terminations. When barriers are provided within the box, separate terminal strips shall be provided in each barrier area. Terminals shall be lettered and/or numbered to conform to the wiring labeling scheme in place on the project.
6. Junction boxes shall be 6 inches wide by 6 inches tall by 4 inches deep, minimum. For applications requiring larger boxes, the box shall be sized in accordance with the fill requirements and dimensional requirements of the NEC. Terminal blocks (including spare terminals) shall be considered when sizing the junction box.

D. Enclosure Types and Materials

1. In non-hazardous locations, pull and junction boxes shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

AREA DESIGNATION	ENCLOSURE TYPE AND MATERIAL
Indoor Wet Process Area	NEMA 4X, Aluminum Construction
Indoor Dry Process Area	NEMA 12, Galvanized Steel
Indoor Dry Non-process Area	NEMA 1, Galvanized Steel
Indoor Type 1 Chemical Storage/Transfer Area	NEMA 4X, Fiberglass or PVC
Indoor Type 2 Chemical Storage/Transfer Area	NEMA 4X, Type 316 Stainless Steel
All Outdoor Areas	NEMA 4X, UV-resistant, Sch.80 PVC

2. In hazardous locations, pull and junction boxes shall be furnished with the following enclosure type and material of construction, dependent upon the classification of the area in which they are to be installed. Area classifications are indicated on the Drawings.

AREA CLASSIFICATION	ENCLOSURE TYPE AND MATERIAL
Class 1, Division 1, Group D	NEMA 7, Die Cast Aluminum
Class 1, Division 2, Group D	NEMA 4X, Cast Aluminum
Class 2, Division 1, Group F	NEMA 9, Die Cast Aluminum
Class 2, Division 2, Group F	NEMA 4X, Cast Aluminum

3. Non-metallic enclosures, NEMA 7 enclosures, and NEMA 9 enclosures shall be provided with threaded integral conduit hubs.

2.03 OUTLET BOXES

A. General

1. Outlet boxes shall be provided with a trim appropriate for the wiring device installed inside. Reference Section 16141, Wiring Devices, for outlet box trim requirements. An appropriate outlet box trim is required to achieve the NEMA rating of the outlet boxes as specified herein.

B. Surface Mount Outlet Boxes

1. Outlet boxes shall be the deep type, no less than 2.5 inches deep.
2. Outlet boxes shall be provided in single or multi-gang configuration as required, sized in accordance with the requirements of the NEC.
3. In non-hazardous locations, outlet boxes shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

AREA DESIGNATION	ENCLOSURE TYPE AND MATERIAL
Indoor Wet Process Area	NEMA 4X, Cast Aluminum
Indoor Dry Process Area	NEMA 1, Cast Aluminum
Indoor Dry Non-process Area	NEMA 1, Cast Aluminum
Indoor Type 1 Chemical Storage/Transfer Area	NEMA 4X, PVC
Indoor Type 2 Chemical Storage/Transfer Area	NEMA 4X, Cast Aluminum
All Outdoor Areas	NEMA 4X, Cast Aluminum

4. In hazardous locations, outlet boxes shall be furnished with the following enclosure type and material of construction, dependent upon the classification of the area in which they are to be installed. Area classifications are indicated on the Drawings.

AREA CLASSIFICATION	ENCLOSURE TYPE AND MATERIAL
Class 1, Division 1, Group D	NEMA 7, Die Cast Aluminum
Class 1, Division 2, Group D	NEMA 4X, Cast Aluminum
Class 2, Division 1, Group F	NEMA 9, Die Cast Aluminum
Class 2, Division 2, Group F	NEMA 4X, Cast Aluminum

5. Outlet boxes shall be provided with integral threaded conduit hubs mounted external to the box. Boxes with threaded conduit hubs mounted internal to the box or as a part of the box wall are not acceptable.

C. Flush Mount Outlet Boxes

1. Outlet boxes shall be no less than 2-1/8 inches deep, and 4-11/16 inches square. Boxes shall be UL listed and labeled. Pre-punched single diameter conduit knockouts are acceptable, however, concentric and eccentric knockouts are not acceptable.
2. Outlet boxes mounted flush in CMU walls shall be made of galvanized, tack welded steel, and suitable for installation in masonry walls. Sectional type boxes are not acceptable for this application.
3. Outlet boxes mounted flush in gypsum walls shall be made of galvanized pressed steel. Tack welded boxes are not acceptable for this application. Sectional type boxes are not acceptable for this application.
4. Outlet boxes mounted cast into concrete shall be concrete tight, and shall be made of galvanized steel or PVC.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Pull and Junction Boxes

1. Pull boxes and junction boxes shall be solidly attached to structural members prior to installation of conduit and set true and plumb. Boxes shall not be supported by their associated conduits.
2. Wooden plugs are not permitted for securing boxes to concrete. Appropriately rated anchors specifically suited for use in concrete shall be used.
3. Box penetrations for conduits shall be made with a punch tool, and penetrations shall be of the size required for the conduit entry and/or hub. Oversized penetrations in boxes are not acceptable.
4. Watertight conduit hubs shall be provided for boxes where a NEMA 4X enclosure rating is specified. Reference Section 16111 - Conduit, for conduit hub requirements.
5. Pull and junction boxes may be installed flush mounted in gypsum, concrete or CMU walls where appropriate provided that covers are easily removed or opened.
6. Pull and junction boxes shall be provided in the enclosure type and material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.

B. Outlet Boxes

1. Outlet boxes shall be solidly attached to structural members prior to installation of conduit and set true and plumb. Boxes shall not be supported by their associated conduits.
2. Wooden plugs are not permitted for securing boxes to concrete. Appropriately rated anchors specifically suited for use in concrete shall be used.
3. Flush mounted outlet boxes shall be arranged and located so that tile and grout lines fit closely around the boxes, and so placed that the cover or device plate shall fit flush to the finished wall surface.
4. Outlet boxes shall be flush mounted in finished areas and other areas where practical. Flush mounted outlet boxes shall not be installed in hazardous areas and type 1 or 2 chemical storage/transfer areas.
5. For the below-named items, mounting heights from finished floor, or finished grade to top is applicable, depending on the type of wiring device to be installed in the outlet box. Mounting heights for outlet boxes shall be as follows, unless otherwise specified herein, indicated on the Drawings, or required by the Americans with Disability Act (ADA):
 - a. Light switches and wall mounted occupancy sensors, 48 inches
 - b. Receptacles in indoor dry process/non-process areas, 16 inches
 - c. Receptacles in indoor wet process areas and all indoor chemical storage/transfer areas, 48 inches
 - d. Receptacles in outdoor locations, 24 inches
6. Outlet boxes shall be provided in the material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.

[END OF SECTION]

SECTION 16141

WIRING DEVICES

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install all switches and receptacles for lighting and miscellaneous power applications of the type and at the locations as specified herein and as shown on the Drawings.
- B. All switches and receptacles shall be furnished and installed in outlet boxes as specified in Section 16130 - Boxes.
- C. Reference Section 16000 - Basic Electrical Requirements.

1.02 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions, the Contractor shall obtain from the equipment manufacturer and submit shop drawings. Each submittal shall be identified by the applicable specification section.

1.03 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include, but not be limited to:
 - 1. Product data sheets.

1.04 SUPPLIES AND SPARE PARTS

- A. The Contractor shall furnish 10% (minimum of 1) spare of each receptacle, switch, and plug furnished and installed for this project.
- B. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.
- C. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size shall have the same parts number.

1.05 IDENTIFICATION

- A. Each switch and receptacle shall be identified with the equipment item number, manufacturer's name or trademark, and such other information as the manufacturer may consider necessary, or as specified, for complete identification.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. The equipment covered by these Specifications is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.
- B. The Contractor shall use the products of a single manufacturer for each type of wiring device.
- C. The Contractor shall use the products of a single manufacturer for all device plates. Plate variations are allowed for the following devices:
 - 1. Where the selected plate manufacturer does not manufacture a suitable finish plate.
 - 2. For heavy-duty receptacles rated at more than 30A.
 - 3. Where non-standard plates are required, specified, or shown.
- D. The Contractor shall furnish and install all wiring devices and device plates. Wiring devices as listed herein are intended to indicate type, function, and quality of the products.
- E. The receptacles, switches, device plates, and other appurtenances shall comply with the requirements of these Specifications. Receptacles installed in toilet, locker, and bathrooms shall be of ground fault interrupter type to meet the minimum NEC requirements. Ground fault circuit interrupter receptacles shall also be furnished and installed as specified herein, indicated on the Drawings, and required by the NEC.
- F. Wiring devices shall be approved for use with stranded conductors, if stranded conductors are to be used with the device. Reference Section 16123 - Wire and Cable.
- G. The Contractor shall provide specification grade devices which shall be as manufactured by Appleton, Crouse-Hinds, Leviton, Harvey Hubbell Co., Bryant Electric Company, Pass & Seymour, or equal.

2.02 WIRING DEVICES

- A. Wiring devices shall be in accordance with the following for nonhazardous areas:
 - 1. Wall Switches, Single Pole, 20 A, 120-277V equivalent to Hubbell No. 1221, Pass & Seymour No. 20AC1, Leviton equivalent, or equal. Switches rated 30 A, 120-277V shall be Leviton 3031, Hubbell equivalent, Pass & Seymour equivalent, or equal.

2. Wall Switches, Double Pole, 20 A, 120-277V equivalent to Hubbell No. 1222, Pass & Seymour No. 20AC2, Leviton equivalent, or equal. Switches rated 30 A, 120-277V shall be Leviton 3032, Hubbell equivalent, Pass & Seymour equivalent, or equal.
 3. Wall Switches, Three-Way, 20 A, 120-277V equivalent to Hubbell No. 1223, Pass & Seymour No. 20AC3, Leviton equivalent, or equal. Switches rated 30 A, 120-277V shall be Leviton 3033, Hubbell equivalent, Pass & Seymour equivalent, or equal.
 4. Wall Switches, Four-Way, 20 A, 120-277V equivalent to Hubbell No. 1224, Pass & Seymour No. 20AC4, Leviton equivalent, or equal.
 5. Convenience Receptacles 20 A, 125V, duplex polarized with grounding connection equivalent to Hubbell No. 5362, Pass & Seymour equivalent, Leviton equivalent, or equal.
 6. Hubbell Cat. No. GF-5362, Pass & Seymour equivalent, Leviton equivalent, or equal, for 20A, 120V, duplex, ground fault circuit interrupting type.
- B. Special Purpose Receptacles shall be rated to carry, at least where required the full load amperes and voltage of the unit connected thereto. These receptacles shall be provided with grounding poles and shall be equivalent to the following:
1. Hubbell Cat. No. HBL-5661, Pass & Seymour No. 5871, Leviton equivalent, or equal, for 20A, 250VAC, 1-phase service.
 2. Hubbell Cat. No. HBL-9330, Pass & Seymour No. 3801, Leviton equivalent, or equal, for 30A, 250VAC, 1-phase service.
 3. Hubbell Cat. No. 9430, Pass & Seymour No. 5740, Leviton equivalent, or equal, for 30A, 208/120V, 3-phase service.
 4. Hubbell Cat. No. 9450, Pass & Seymour No. 5750, Leviton equivalent, or equal, for 50A, 208/120V, 3-phase service.
 5. Hubbell Cat. No. 9460, Pass & Seymour No. 5760, Leviton equivalent, or equal, for 60A, 208/120V, 3-phase service.
 6. Hubbell Cat. No. 9330, Pass & Seymour No. 5930, Leviton equivalent, or equal, for 30A, 208V, single-phase service.
 7. Hubbell Cat. No. 9315, Pass & Seymour equivalent, Leviton equivalent, or equal, for 30A, 277V, single-phase service.
 8. Hubbell Cat. No. 23CM10, Pass & Seymour equivalent, Leviton equivalent, or equal, for 20A, single, 125V, polarized with grounding connection, twist lock type. Matching plug shall be Hubbell Cat. No. 23CM11, Pass & Seymour equivalent, Leviton equivalent, or equal.
 9. Crouse-Hinds "Arktite" Series, Appleton equivalent, Killark equivalent, or equal, 30A, 3P, 600 Volt, twist lock, weatherproof, power receptacle and box with matching plug.
- C. For hazardous areas the following shall be provided:

1. Wall Switches, single pole, 20 A, 120 V equivalent to Crouse Hinds Cat. No. EFD3591 or EFDC3591 (as required); Appleton No. EDS175F1 or EDSC175F1, Killark equivalent, or equal.
 2. Convenience Receptacles 20 A, 120-250 VAC, 2 wire, 3 pole equivalent to Crouse Hinds Cat. No. CPS152-201, Appleton No. CPE1-2375, Killark equivalent, or equal.
- D. Plugs for hazardous and non-hazardous receptacles shall be provided:
1. Plugs and respective cable shall be provided for equipment furnished under other Divisions (steam cleaners, welders, etc.) as necessary.

2.03 DEVICE PLATES

- A. Wall plates with gaskets for flush-mounted receptacles and switches shall be made of Type 304 stainless steel, not less than 0.032 of an inch thick, with beveled edges and milled on the rear so as to lie flat against the wall. Wall plates shall be equivalent to Hubbell Series 9600, Pass & Seymour series 93000, Leviton equivalent, or equal.
- B. Device plates for outdoor installations and indoor wet process area installations shall be Appleton Type FSK, Crouse-Hinds #DS185, or equal for wall switches. Device plates for receptacles shall be "in-use" style. "In-use" weatherproof covers shall be rugged, minimum 3 ¼" depth, die-cast aluminum as manufactured by Thomas & Betts "Red Dot," Intermatic International, Inc., or equal.
- C. Device plates for indoor dry process areas with surface mounted boxes shall be Crouse-Hinds DS32, or equal for switches, and Crouse-Hinds DS23 or equal for receptacles.

2.04 PLUGS

- A. The Contractor shall furnish suitable plugs with equipment furnished under the respective Contract. Plugs shall be black rubber or plastic. For waterproof receptacles, the plugs shall be similar in construction to the receptacles and shall be encased in corrosion resistant yellow housing provided with clamping nuts and stuffing gland cable outlets.

2.05 PROCESS INSTRUMENTS

- A. The Contractor shall furnish and install a local disconnect switch at each process instrument (e.g., level transmitter, flow transmitter, analytical instrument etc.,) to disconnect the 120VAC power supply to the instrument. The device shall be a NSSC series manual motor starting switch without overload protection as manufactured by Crouse-Hinds, Appleton equivalent, or equal. For hazardous locations, the device shall be a front operated general use snap switch mounted in an EFS enclosure as manufactured by Crouse-Hinds, Appleton equivalent, or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Switch boxes shall be of unit construction and of sizes as required to adequately house the number of switches required. No sectional type switch boxes shall be permitted.
- B. Where more than one (1) switch occurs at one (1) point, gang plates shall be used.
- C. All device plates shall be set true and plumb, and shall fit tightly against the finished wall surfaces and outlet boxes.
- D. All devices shall be flush-mounted in finished areas, unless otherwise noted. The Contractor shall determine the proper position of every outlet, and relocate any outlet without additional cost to Owner if same is incorrectly or improperly located. The Engineer reserves the right to change the location of any outlet or connecting equipment up to the time of roughing in without additional cost to Owner, provided conduit runs are not increased by more than ten (10) feet.
- E. In all areas where thermal or acoustic insulation is applied to the ceiling or walls, outlet boxes shall be set to finish flush with the finished surface of the insulation.
- F. When indicated height would place any of the equipment at an unsuitable location such as at a molding or break in wall finish, the contractor shall bring it to the attention of the Engineer for a decision.
- G. For the below-named items, mounting heights from finish floor, or finish grade to top is applicable. Mounting heights shall be as follows, unless otherwise specified herein, indicated on the Drawings, or required by the Americans with Disability Act (ADA):
 - 1. Single-pole light switches, 48 inches.
 - 2. Duplex receptacles in dry areas, 16 inches
 - 3. Duplex receptacles in pump rooms, 48 inches
- H. The Contractor shall furnish and install switches as indicated on the Drawings. Switches shall be single pole, double pole, 3-way, or 4-way as indicated on the Drawings and as required. Switches located outdoors or in wet indoor locations shall be installed in cast boxes complete with yellow, fiberglass weatherproof covers. Reference Section 16141 - Wiring Devices.
- I. All receptacles shall have a self-adhesive label installed on the top at the respective device plate that indicates which panel and which circuit number the receptacle is supplied from. Labels shall have a white background and black lettering in 14 point font.

3.02 CIRCUITING

- A. Convenience receptacles shall be grouped on circuits separate from the lighting circuits. A maximum of eight (8) convenience receptacles are permitted per 20A, 120V circuit.

[END OF SECTION]

SECTION 16170

GROUNDING AND BONDING

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install grounding systems complete in accordance with the minimum requirements established by Article 250 of the NEC. Article 250 of the NEC shall be considered a minimum requirement for compliance with this Specification.
- B. Grounding of all instrumentation and control systems shall be furnished and installed in accordance with the manufacturer/system requirements and IEEE 1100-92, Powering and Grounding of Sensitive Electronic Equipment. Conflicts shall be promptly brought to the attention of the Engineer.
- C. In addition to the NEC requirements, building structural steel columns shall be permanently and effectively grounded:
- D. Reference Section 16000 - Basic Electrical Requirements.

1.02 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions, the Contractor shall obtain from the equipment manufacturer and submit the following:
 - 1. Shop Drawings
 - 2. Reports of certified field tests.
- B. Each submittal shall be identified by the applicable specification section.

1.03 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets.
 - 2. Drawings and written description of how the Contractor intends to furnish and install the grounding system.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. The equipment covered by these specifications shall be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 GROUND RODS AND GRID

- A. Ground rods shall be rolled to a commercially round shape from a welded copper-clad steel manufactured by the molten-welding process or by the electro-formed process (molecularly bonded). They shall have an ultimate tensile strength of 75,000 pounds per square inch (psi) and an elastic limit of 49,000 psi. The rods shall be not less than 3/4 inch in diameter by 10 feet in length; and the proportion of copper shall be uniform throughout the length of the rod. The copper shall have a minimum wall thickness of 0.010 inch at any point on the rod. Ground rods shall be UL 467 listed. The ground rods shall be manufactured by Erico Products, Blackburn, or equal.
- B. Except where specifically indicated otherwise, all exposed non current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductors in nonmetallic raceways and neutral conductors of wiring systems shall be grounded.
- C. The ground connection shall be made at the main service equipment and shall be extended to the ground grid surrounding the structure. The ground grid shall also be connected to the point of entrance of the metallic water service. Connection to the water pipe shall be made by a suitable ground clamp or lug connection to a plugged tee. If flanged pipes are encountered, connection shall be made with the lug bolted to the street side of the flanged connection.
- D. Where ground fault protection is employed, care shall be taken so that the connection of the ground and neutral does not interfere with the correct operation of the ground fault protection system.

2.03 FITTINGS

- A. Grounding connections to equipment shall be bolted. Cable end connections shall be made by hydraulic crimp or exothermically welded. Split bolt type connectors are not acceptable. Fittings shall be UL 467 listed.

2.04 BARE GROUND CABLE

- A. Bare ground cable shall be soft-drawn, bare copper stranded cable complying with ASTM B8. No. 4/0 AWG minimum size unless otherwise shown or indicated on the Drawings.

2.05 EQUIPMENT GROUNDING CONDUCTORS

- A. An insulated equipment grounding conductor, which shall be separate from the electrical system neutral conductor, shall be furnished and installed for all circuits. Insulation shall be of the same type as the underground conductors in the raceway and shall be green in color.

Equipment grounding conductors shall be furnished and installed in all conduits. Use of conduits as the NEC required equipment grounding conductor is not acceptable.

2.06 EQUIPMENT GROUNDS

- A. Equipment grounds shall be solid and continuous from a connection at earth to all distribution panel boards. Ground connections at panelboards, outlets, equipment, and apparatus shall be made in an approved and permanent manner.

2.07 EXOTHERMIC WELDS

- A. All exothermic welding shall be completed per welding kit manufacturer's instructions. Exothermic welds shall be CadWeld by Erico or ThermoWeld.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Metal surfaces where grounding connections are to be made shall be clean and dry. Steel surfaces shall be ground or filed to remove all scale, rust, grease, and dirt. Copper and galvanized steel shall be cleaned with emery cloth to remove oxide before making connections.
- B. Ground Grid
 - 1. A main ground grid shall be provided for each structure and interconnecting structure grids consisting of driven ground rods as shown on the Drawings. The ground rods shall be interconnected by the use of copper cable exothermically welded to the rods. The grounding cables shall be installed after the excavations for the building have been completed and prior to the pouring of concrete for the footings, mats, etc. Copper "pigtailes" shall be exothermically welded to the ground grid and shall enter the buildings and structure from the outside and shall be connected to steel structures, and equipment as described in this Section and as required to provide a complete grounding system.
 - 2. Grounding conductors shall be continuous between points of connection; splices shall not be permitted.
 - 3. Where conductors are exposed and subject to damage from personnel, traffic, etc., conductors shall be installed in metal raceway. The raceway shall be bonded to the grounding system.
 - 4. Where subsurface conditions do not permit use of driven ground rods to obtain proper ground resistance, rods shall be installed in a trench or plate electrodes shall be provided, as applicable and necessary to obtain proper values of resistance.
 - 5. Buried exothermic welds and ground ring shall not be backfilled until inspected by Engineer.

C. Raceways

1. Conduit which enters equipment such as switchgear, motor control centers, transformers, panelboards, variable frequency drives, instrument and control panels, and similar equipment shall be bonded to the ground bus or ground lug, where provided, and as otherwise required by the NEC.

3.02 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 01. The following tests are required:

1. Witnessed Shop Tests

- a. None required.

2. Field Tests

- a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 01, and NETA acceptance testing specifications referenced in Section 16000 - Basic Electrical Requirements.
- b. Fall of potential tests shall be performed on the ground grid per IEEE81 recommendations by a third party, independent testing firm. A fall of potential plot shall be submitted at the conclusion of testing for Engineer review. Documentation indicating the location of the rod and grounding system as well as the resistance and soil conditions at the time the measurements were made shall be submitted. Testing shall show that the ground grid has 5 ohms resistance or less. Due to soil conditions and/or unforeseen field conditions, ground resistances greater than 5 ohms may be acceptable if specifically approved in writing by the Engineer. Ground resistance measurements shall be made in normally dry weather not less than 48 hours after rainfall and with the ground grid under test isolated from other grounds.
- c. Continuity tests for the grounding electrode conductor shall also be performed. Test will be accepted when a resistance of less than 1 ohm is shown for this conductor.

[END OF SECTION]

SECTION 16190
SUPPORTING DEVICES

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install structural supports for mounting and installing all conduit, electrical equipment, lighting, alarm systems, instrumentation, and communications equipment furnished under this Contract.
- B. Equipment shall be installed strictly in accordance with recommendations of the manufacturer and best practices of the trade resulting in a complete, operable, and safe installation. The Contractor shall obtain written installation manuals from the equipment manufacturer prior to installation.
- C. Reference Section 16000 - Basic Electrical Requirements.

1.02 CODES AND STANDARDS

- A. Equipment and materials covered under this Section shall be designed, manufactured, and/or listed to the following standards as applicable:
 - 1. ASTM A123 – Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.
 - 2. ASTM A153 – Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware.
 - 3. ASTM A240 – Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - 4. ASTM A276 – Standard Specification for Steel Bars and Shapes
 - 5. ASTM B783 – Standard Specification for Materials for Ferrous Powder Metallurgy Structural Parts

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions, the Contractor shall obtain from the equipment manufacturer and submit the following:
 - 1. Shop drawings
 - 2. Structural support calculations (if required)
- B. Each submittal shall be identified by the applicable Specification section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets.
 - 2. Complete assembly, layout, installation, and foundation drawings with clearly marked dimensions.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 MATERIALS

- A. Support channel shall be 1-5/8" by 1-5/8" minimum, with 12 gage material thickness.
- B. Support channel, support channel fittings, and threaded rod shall be furnished with the following material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

AREA DESIGNATION	MATERIAL OF CONSTRUCTION
Indoor Wet Process Area	Type 316 Stainless Steel
Indoor Dry Process Area	Aluminum
Indoor Dry Non-process Area	Aluminum
All Outdoor Areas	Type 316 Stainless Steel
All Hazardous Areas	Type 316 Stainless Steel

- C. Fastening hardware (bolts, nuts, washers, and screws) shall be furnished with the following material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

AREA DESIGNATION	MATERIAL OF CONSTRUCTION
Indoor Wet Process Area	Type 316 Stainless Steel
Indoor Dry Process Area	Type 316 Stainless Steel
Indoor Dry Non-process Area	Type 316 Stainless Steel
All Outdoor Areas	Type 316 Stainless Steel
All Hazardous Areas	Type 316 Stainless Steel

PART 3 - EXECUTION

3.01 INSTALLATION

A. Concrete or Masonry Inserts

1. The Contractor shall be responsible for the furnishing and installation of all anchor bolts, masonry inserts, and similar devices required for installation of equipment furnished under this Contract.
2. If a time delay for the arrival of any special inserts or equipment drawings, etc. occurs, the Contractor may, if permitted by the Engineer, make arrangements for providing approved recesses and openings in the concrete or masonry and, upon subsequent installation, the Contractor shall be responsible for filling in such recesses and openings. Any additional costs that may be incurred by this procedure shall be borne by the Contractor.
3. The Contractor shall furnish leveling channels for all switchgear, switchboards, motor control centers, and similar floor mounted equipment. The leveling channels shall be provided for embedment in the equipment housekeeping pads. Coordination of the installation of these channels with the concrete pad is essential and required. Pad height shall be as required to maintain concrete coverage of the reinforcement bars while not causing associated equipment to exceed the maximum mounting height requirements of the NEC.

B. Support Fastening and Locations

1. All equipment fastenings to columns, steel beams, and trusses shall be by beam clamps or welded. No holes shall be drilled in the steel.
2. Unless otherwise indicated on the Drawings or in the Specifications, handrails/guardrails shall not be utilized as supports for electrical equipment, devices, or appurtenances. Handrails/guardrails shall not be cut, drilled, or otherwise modified in order to accommodate electrical supports without written approval from the Engineer.
3. All holes made in reflected ceilings for support rods, conduits, and other equipment shall be made adjacent to ceiling grid bars where possible, to facilitate removal of ceiling panels.

4. Support channel shall be provided wherever required for the support of starters, switches, panels, and miscellaneous equipment.
 5. All equipment, devices, and raceways that are installed on the dry side of a water bearing wall shall not be installed directly onto the wall. Support channel shall be used to allow ventilation air to pass behind the equipment, devices, or raceway.
 6. All supports shall be rigidly bolted together and braced to make a substantial supporting framework. Where possible, control equipment shall be grouped together and mounted on a single framework.
 7. Aluminum support members shall not be installed in direct contact with concrete. Stainless steel or non-metallic "spacers" shall be used to prevent contact of aluminum with concrete.
 8. Actual designs for supporting framework should take the nature of a picture frame of support channels and bracket with a plate for mounting the components. The Contractor is responsible for the design of supporting structure; Contractor shall submit design details to the Engineer for acceptance before proceeding with the fabrication.
 9. Wherever dissimilar metals come into contact, the Contractor shall isolate these metals as required with neoprene washers, nine (9) mil polyethylene tape, or gaskets.
 10. For all installations where fiberglass supporting materials are required, the Contractor shall submit structural calculations and the details of the proposed system of support. Structural calculations shall be signed and sealed by a registered professional engineer in the state in which the project is located.
 11. For the following installations where conduits are provided with a support system suspended from the above or attached to a vertical structure, the Contractor shall submit structural calculations and details of the proposed system of support. Structural calculations shall be signed and sealed by a registered professional engineer in the state in which the project is located.
 - a. A quantity of twelve (12) or more conduits trade size 1" and smaller are proposed for a conduit support rack.
 - b. A quantity of eight (8) or more conduits trade sizes 1 1/2" to 2 1/2" are proposed for a conduit support rack.
 - c. A quantity of four (4) or more conduits trade sizes 3" and larger are proposed for a conduit support rack.
 12. Single conduits installed exposed along walls and ceilings shall be secured to the wall or ceiling with a one-hole conduit clamp and clamp-back. Where multiple conduits are installed exposed together, support channel and conduit clamps shall be used.
- C. Equipment, boxes, and enclosures which are factory-constructed with integral mounting provisions (such as brackets, mounting feet, bolt holes, etc.) shall be installed/supported utilizing those mounting provisions. Equipment, boxes and enclosures shall not be field

modified to enable mounting by any other means. Equipment, boxes, and enclosures that are field-modified by any means which compromises the UL Listing or NEMA rating of the enclosure/assembly shall be removed and replaced by the Contractor at no additional cost to Owner.

[END OF SECTION]

SECTION 16195

ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. All electrical equipment shall be properly identified in accordance with these Specifications and the Contract Drawings. All switchgear, switchboards, motor control centers, variable frequency drives, lighting and distribution panelboards, combination starters, control panels, pull and junction boxes, enclosures, disconnect switches, control stations, and similar equipment shall be identified in the manner described, or in an equally approved manner.
- B. The types of electrical identification specified in this section include, but are not limited to, the following:
 - 1. Operational instructions and warnings.
 - 2. Danger signs.
 - 3. Equipment/system identification signs.
 - 4. Nameplates.

1.02 SIGNS

- A. "DANGER-HIGH-VOLTAGE" signs shall be securely mounted on the entry doors of all electrical rooms.

1.03 LETTERING AND GRAPHICS

- A. The Contractor shall coordinate names, abbreviations, and other designations used in the electrical identification work with the corresponding designations shown, specified or scheduled. Provide numbers, lettering, and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of the electrical systems and equipment.

1.04 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions, the Contractor shall obtain from the equipment manufacturer and submit shop drawings. Each submittal shall be identified by the applicable specification section.

1.05 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. The material covered by these Specifications is intended to be standard material of proven performance as manufactured by reputable concerns. Material shall be fabricated, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and shown on the Drawings.

2.02 NAMEPLATES

- A. Nameplates shall be engraved, high pressure plastic laminate, white with black lettering.
- B. Nameplates shall be attached to NEMA 4X enclosures utilizing UL-recognized mounting kits designed to maintain the overall UL Type rating of the enclosure. Mounting kit fasteners shall be stainless steel Type AHK10324X as manufactured by Hoffman, or equal.

2.03 HIGH VOLTAGE SIGNS

- A. Standard "DANGER" signs shall be of baked enamel finish on 20 gage steel; of standard red, black and white graphics; 14 inches by 10 inches size except where 10 inches by 7 inches is the largest size which can be applied where needed, and except where a larger size is needed for adequate identification.

2.04 CONDUIT IDENTIFICATION

- A. Conduit identification shall be as specified in Section 16111 - Conduit.

2.05 WIRE AND CABLE IDENTIFICATION

- A. Field installed wire and cable identification shall be as specified in Section 16123 - Wire and Cable.
- B. A plastic laminate nameplate shall be provided at each panelboard, motor control center, switchgear assembly, and switchboard assembly. This nameplate shall be used to clearly convey the conductor identification means used at that piece of equipment (i.e., Phase A=Brown, Phase B=Orange, C = Yellow).
- C. Wiring identification for factory installed wiring in equipment enclosures shall be as specified in the respective section.

2.06 BOX IDENTIFICATION

- A. Pull, junction and device box identification shall be as specified in Section 16130 – Boxes.

PART 3 - EXECUTION

3.01 NAMEPLATES

- A. Nameplates shall be attached to the equipment enclosures with (2) two stainless steel sheet metal screws for nameplates up to 2-inches wide. For nameplates over 2-inches wide, four (4) stainless steel sheet metal screws shall be used, one (1) in each corner of the nameplate. The utilization of adhesives is not permitted.

3.02 OPERATIONAL IDENTIFICATION AND WARNINGS

- A. Wherever reasonably required to ensure safe and efficient operation and maintenance of the electrical systems and electrically connected mechanical systems and general systems and equipment, including prevention of misuse of electrical facilities by unauthorized personnel, install plastic signs or similar equivalent identification, instruction, or warnings on switches, outlets, and other controls, devices, and covers or electrical enclosures. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for the intended purposes. Signs shall be attached as specified above for nameplates.

3.03 POWER SOURCE IDENTIFICATION

- A. After installation of all field equipment (i.e. valves, motors, fans, unit heaters, instruments, etc) install nameplates at each power termination for the field equipment. Nameplate data shall include equipment designation (tag number), power source (MCC number, panelboard, etc), circuit number, conduit number from schedule and voltage/phase.
- B. Contractor to coordinate with the Engineer and Owner regarding exact nameplate placement during construction.
- C. Nameplates shall be as specified herein.

[END OF SECTION]

SECTION 16440

DISCONNECT SWITCHES

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install separately mounted, individual disconnect switches as specified herein and indicated on the Drawings.
- B. Disconnect switches for process instruments are not included in the scope of this Section and shall be as specified in Section 16141 – Wiring Devices.

1.02 CODES AND STANDARDS

- A. Disconnect switches shall be designed, manufactured, and/or listed to the following standards as applicable:
 - 1. UL 98 – Enclosed and Dead-Front Switches
 - 2. UL 1203 – Standard for Explosion-proof and Dust-ignition-proof Electrical Equipment for use in Hazardous (Classified) Locations.
 - 3. NEMA 250 – Enclosures for Electrical Equipment
 - 4. NEMA KS 1 – Heavy Duty Enclosed and Dead-Front Switches

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions, the Contractor shall obtain from the equipment manufacturer and submit the following:
 - 1. Shop Drawings
 - 2. Spare Parts List
- B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:

1. Product data sheets.
 2. Complete layout and installation drawings with clearly marked dimensions for each type/size/rating of disconnect switch.
 3. Assembled weight of each unit.
- D. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items that the Contractor intends to provide are acceptable and shall be submitted.

1.05 SPARE PARTS

- A. The equipment shall be furnished with all spare parts as recommended by the equipment manufacturer.
- B. One (1) complete set of spare fuses for each ampere rating installed shall be furnished and delivered to Owner at the time of final inspection.
- C. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.
- D. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.

1.05 IDENTIFICATION

- A. Each equipment item shall be identified with a nameplate. The nameplate shall be engraved indicating the circuit number and equipment name with which it is associated. Equipment identification shall be in accordance with Section 16195 - Electrical Identification.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.
- B. Switches shall be manufactured by the Square D Company, Eaton, the General Electric Company, Siemens Energy and Automation, Inc or approved equal.

2.02 DISCONNECT SWITCHES

- A. Disconnect switches shall be heavy-duty type and/or as specified in these Specifications. Switches shall be furnished and installed as shown on the Drawings and as required by the NEC. Handles shall be lockable.
- B. Disconnect switches for non-hazardous areas shall be UL 98 Listed. Disconnect switches for hazardous areas shall be UL 1203 Listed.
- C. Switches shall meet NEMA Standard KS 1 type HD requirements, be, single-throw, be externally operated, and be fused or non-fused as indicated on the Drawings. Switches shall have the number of the poles, voltage, and ampere ratings as shown on the Drawings.
- D. In non-hazardous locations, disconnect switches shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

AREA DESIGNATION	ENCLOSURE TYPE AND MATERIAL
Indoor Wet Process Area	NEMA 4X, Type 316 Stainless Steel
Indoor Dry Process Area	NEMA 12, Painted Steel
Indoor Dry Non-process Area	NEMA 1, Painted Steel
Indoor Type 1 Chemical Storage/Transfer Area	NEMA 4X, Fiberglass
Indoor Type 2 Chemical Storage/Transfer Area	NEMA 4X, Type 316 Stainless Steel
All Outdoor Areas	NEMA 4X, Type 316Stainless Steel

- E. In hazardous locations, disconnect switches shall be furnished with the following enclosure type and material of construction, dependent upon the classification of the area in which they are to be installed. Area classifications are indicated on the Drawings.

AREA CLASSIFICATION	ENCLOSURE TYPE AND MATERIAL
Class 1, Division 1, Group D	NEMA 7, Die Cast Aluminum
Class 1, Division 2, Group D	NEMA 7, Die Cast Aluminum
Class 2, Division 1, Group F	NEMA 9, Die Cast Aluminum
Class 2, Division 2, Group F	NEMA 9, Die Cast Aluminum

- F. Disconnect switches shall be quick-make, quick-break and with an interlocked cover which cannot be opened when switch is in the "ON" position and capable of being locked in the "OPEN" position.
- G. A complete set of fuses for all switches shall be furnished and installed as required. Time-current characteristic curves of fuses serving motors or connected in series with circuit breakers shall be coordinated for proper operation. Fuses shall have voltage rating not less than the circuit voltage.
- H. Disconnect switches shall be furnished with a factory installed internal barrier kit that helps prevent accidental contact with live parts and provides "finger-safe" protection when the door of the enclosed switch is open.

- I. Disconnect switches shall be furnished with a manufacturer-supplied ground lug kit for termination of equipment grounding conductors. Where a grounded (neutral) conductor is shown on the Drawings in the conduits connected to the disconnect switch, a manufacturer-supplied neutral bar shall be furnished for termination of the grounded conductors. Third party ground lug and neutral lug kits not supplied by the disconnect switch manufacturer are not acceptable.
- J. Fused disconnect switches shall be furnished for motor operated valve and gate actuators where shown on the Drawings. The Contractor shall coordinate the supply of these fused switches with the specific requirements of the actuator. Fuses with fast fault clearing times may be required for modulating valve actuators.
- K. Disconnect switches for all motors connected to variable frequency drives (VFDs) and other pump starters, where indicated on drawings, shall be furnished with a factory installed electrical interlock kit that includes one (1) early-break auxiliary contact rated for 5A (minimum) at 120 VAC to be used to open the control circuit before the main switch blades break.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. All disconnect switches shall be mounted five (5) feet above the floor or finished grade, at the equipment height where appropriate, or where shown otherwise.
- B. Disconnect switches shall be provided in the enclosure type and material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.

3.02 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 01. The following tests are required:
 - 1. Field Tests
 - a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 01, and NETA Acceptance Testing Specifications, latest edition.

[END OF SECTION]

SECTION 16500

LIGHTING

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install all lighting fixtures, labor, and material, in accordance with the preceding Specifications, the requirements of this Section, and as shown on the Drawings.
- B. Lighting shall be in accordance with the latest requirements of the Illuminating Engineering Society, and all lighting fixtures shall have the Underwriters Laboratories, Inc. label of approval.
- C. All wiring shall be placed in conduit and shall comply with the Specifications for conduit, outlet boxes, pull and junction boxes, wires and cables, grounding, and other Sections as set forth in these Specifications and as noted herein.
- D. Reference Section 16000 - Basic Electrical Requirements, and Section 16170 - Grounding and Bonding.

1.02 CODES AND STANDARDS

- A. The equipment specified herein shall comply with the following codes and standards, where applicable.
 - 1. Underwriter's Laboratories, Inc. (UL):
 - a. UL 924 – Emergency Lighting and Power Equipment
 - b. UL 935 – Fluorescent Lamp Ballasts
 - c. UL 844 – Luminaires for Use in Hazardous (Classified) Locations
 - d. UL 1029 – High Intensity Discharge Lamp Ballasts
 - e. UL 1598 – Luminaires
 - 2. American National Standards Institute (ANSI):
 - a. ANSI C82.11 – High Frequency Fluorescent Lamp Ballasts
 - b. ANSI C62.41 – Guide for Surge Voltages in Low-Voltage AC Power Circuits
 - 3. National Electrical Code (NEC), latest edition.

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings
 2. Operation and Maintenance Manuals
 3. Spare Parts Lists
- B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete or illegible submittals will be returned to the Contractor for resubmittal without review.
- C. Shop drawings shall include but not be limited to:
1. Product data sheets.
 2. Catalog cuts for each fixture type showing performance and construction details of standard fixtures, and complete working drawings showing all proposed construction details of special or modified standard fixtures.
 3. Photometric curves.
 4. Lamp and LED data including efficiency (Efficacy lumens/watt) information.
 5. LED Driver information.
 6. Catalog data including applicable coefficients of utilization tables, isolux chart of illumination on a horizontal plane, beam efficiency, horizontal and vertical beam spread, and beam lumens.
 7. System (entire fixture assembly) efficiency data.
 8. Pole calculations.
- D. Shop drawings shall be submitted to the Engineer for review and acceptance for all fixtures before fixtures and poles are manufactured. Substitutions will be permitted only if acceptable to the Engineer.
- E. Manufacturer's catalog number and description in the fixture schedule on the Contract Documents establishes a level of quality, style, finish, etc. The use of a catalog number describing the various types of fixtures shall be used as a guide only, and does not exclude all the required accessories or hardware that may be required for a complete installation.

1.05 OPERATION AND MAINTENANCE MANUALS

- A. The Contractor shall submit Operation and Maintenance Manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 01.

1.06 SPARE PARTS

- A. All spare parts as recommended by the equipment manufacturer shall be furnished to Owner by the Contractor. The following minimum spare parts shall be furnished:
 - 1. One (1) spare bulb.
 - 2. One (1) spare LED driver.
- B. The spare parts shall be packed in labeled containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.
- C. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the work, at which time they shall be delivered to Owner.

1.07 LIGHTING CONTROLS

- A. The lighting systems shall be controlled as specified under control panels in Division 17 interfacing with integral photocells.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 FIXTURES

- A. Each fixture shall bear the Underwriters Laboratories, Inc. label. All lighting fixtures shall be furnished complete with lamps of the size and type as indicated on the Drawings and all fittings and hardware necessary for a complete installation. Lighting fixtures shall have all parts and fittings necessary to completely and properly install the fixtures.
- B. Fixture leads shall be as required by NEC and shall be grounded by the equipment grounding conductor in the conduit.
- C. All glassware shall be high quality, homogeneous in texture, uniform in quality, free from defects, of uniform thickness throughout, and properly annealed. Edges shall be well rounded and free from chips or rough edges.
- D. Fixtures shall be 115W, Pole-mounted, 120-277 VAC, LED light fixture, color temperature of 4000K, 20LEDs, IESNA roadway Type 4 distribution, gray die cast aluminum housing,

1050mA driver 6250 lumen minimum, full-cutoff optics, integral photocell, wet location listed. Pole shall be round gray, base mounted, tapered, 12ft. anodized aluminum pole. Fixture shall be AEL Autobahn ATB0 Series, GE Evolve LED EASC, or Gardco Radiant RL Series.

2.03 LED DRIVERS

- A. Drivers shall have a voltage range of (120-277) +/- 10% at a frequency 60Hz.
- B. All drivers shall be designed to a power factor >90% with a total harmonic distortion THD <20% at full load.
- C. Case temperature shall be rated for -40°C through +80°C.
- D. Drivers shall have overheat protection, self-limited short circuit protection and overload protected.
- E. Drivers shall be furnished with a fused primary.
- F. Drivers shall have an output current ripple <30%
- G. Drivers shall have a five year (100,000 hour) warranty.
- H. Drivers shall be manufactured by Advance, Universal or equal.
- I. Drivers shall be UL Listed for damp location, UL1012, UL935, ROHS.
- J. Drivers shall meet FCC 47 Sub Part 15.
- K. All drivers shall be provided with ANSI/IEEE C62.41 Category C (10kV/5kA) surge protection.

2.04 LEDs

- A. Luminaires provided with LED technology shall utilize high brightness LEDs with a group binning code of P and/or Q.
- B. Color Temperature: as specified in fixture schedule.
- C. Junction point shall be designed and manufactured to allow adequate heat dissipation.
- D. LEDs shall be rated for 100,000 hours of life, minimum (based on IESNA L70).

2.05 POLES

- A. Poles shall be designed to withstand calculated wind force based on wind velocity in accordance with the provisions of the Florida Building Code.
- B. Pole mounted fixtures shall be mounted on poles as designated in the fixture schedule or as indicated on the Drawings. Poles shall have adequate handholes and weatherproof receptacles where indicated. All anchor bolts and nuts shall be stainless steel.

- C. The Contractor shall furnish and install a concrete foundation for the pole mounted fixtures located in the yard (i.e. site lighting) as indicated on the Drawings and as required, and shall provide anchorage to new and existing structures for pole mounted fixtures located on structures.
- D. Foundation shall be designed and approved by a professional structural engineer currently registered in the State of Florida. The wind design shall be in accordance with the Florida Building Code and local requirements. Pole structure/foundation shall be designed for the most critical load combinations as defined by the Building Code.
- E. Signed and sealed calculations and drawings of lighting foundations and structural anchorage shall be submitted to the Engineer for the purpose of verifying the design criteria and to verify compatibility of anchorage forces with supporting structures not designed by the Contractor's Engineer.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. The Contractor shall protect all fixtures at all times from damage, dirt, dust, and the like. Before final acceptance, all fixtures and devices shall be cleaned of all dust, dirt or other material to the satisfaction of the Engineer.
- B. Relamping access of fixtures shall require no special tools. All optical control surfaces such as lenses and reflectors shall be safely and securely attached to fixtures and shall be easily and quickly removed and replaced for cleaning without the use of special tools. No fixture part that may be removed, for maintenance, shall be held in place by metal tabs that must be bent to remove said part.
- C. The Contractor shall furnish and install a concrete foundation for the pole mounted fixtures as indicated on the Drawings and as required. Foundation shall be designed and approved by a professional structural engineer currently registered in the State of Florida. The wind design shall be in accordance with ASCE 7 and the Florida Building Code. Pole structure/foundation shall be able to handle fixture/pole weight and withstand design wind velocity and gust factor. Provide calculations signed and sealed by a Professional Structural Engineer for review.
- D. One (1), 3/4" diameter, 10'-0" long ground rod, furnish in accordance with Section 16170 – Grounding and Bonding, shall be driven adjacent to each pole. The pole, anchor bolts, steel reinforcement bar in the base, and equipment grounding conductor shall all be bonded to the ground rod as indicated in the standard details. Top of pole shall be fitted with a lightning dissipating aerial.

[END OF SECTION]

SECTION 17000

INSTRUMENTATION AND CONTROL - GENERAL

PART 1 – GENERAL

1.01 SCOPE

- A. The Contractor shall provide, through the services of the Instrumentation and Control System Subcontractor, all components, system installation services, as well as all required and specified ancillary services in connection with the Instrumentation, Control and Information System. The System includes all materials, labor, tools, fees, charges and documentation required to furnish, install, test and place in operation a complete and operable instrumentation, control and information system as shown and/or specified. The system shall include all measuring elements, signal converters, transmitters, control panels, cabinets, digital hardware, signal and data transmission systems, interconnecting wiring, brackets, supports, piping, tubing, valves, mounting hardware, and such accessories as shown, specified, and/or required to provide the functions indicated.
- B. The Contractor shall take note of any specific construction sequencing restrictions that may impact the performance of the Work. The Contractor shall coordinate sequence requirements between its various Project subcontractors as necessary to meet all requirements as specified in the contract documents.
- C. The general scope of work to be performed under this Division includes, but is not limited to, the following:
 - 1. The Contractor shall retain overall responsibility for the instrumentation and control system as specified herein.
 - 2. Furnish and install control equipment, operator interfaces, field panels, and associated cabinets and control panels as shown on the Drawings and specified in this Division.
 - 3. Provide basic software configuration, network equipment configuration, factory testing, and field testing for all control panels furnished by instrumentation and controls subcontractor under this Contract. Basic configuration of the PLCs shall consist of assigning PLC tags to the physical IOs, setting up communications protocol links where required, and assigning IP addresses in accordance the Owner's standards.
 - 4. Coordinate with Owners operations, Environmental Services, and IT departments.
 - 5. Furnish and install process instrumentation, and associated taps, nipples, valves, tubing, pipe stands, sunshields, and supports as scheduled or shown on the Drawings, unless otherwise noted or supplied by equipment vendors.
 - 6. Perform termination and testing of all Instrumentation and Control System signal wiring and power supply wiring at equipment furnished under this Division.
 - 7. Final termination and testing of all Instrumentation and Control System signal wiring and power supply wiring at equipment furnished under this Division.
 - 8. Furnish and install transient voltage surge suppression systems for all digital equipment, data communications equipment, local control panels, and field instruments provided under this Division, including connections to grounding system(s) provided under Division 16.

9. Coordinate grounding requirements with the electrical subcontractor for all digital equipment, local control panels, and field instrumentation provided under this Division. Terminate grounding system cables at all equipment provided under this Division.
 10. Provide system factory acceptance testing, field testing, calibration, operator/maintenance personnel training, and startup services as specified herein and as required to make all systems fully operational.
 11. The Contractor shall furnish and install embedded supports, instrument stands, brackets, mounting hardware, piping, tubing, isolation valves and related items required for instrumentation and equipment furnished under Division 17.
- D. The Contractor shall coordinate all work specified herein with related work specified in other Divisions, and shall schedule the work to minimize downtime of equipment and controls. The Contractor shall provide temporary equipment and interconnecting cables as described herein and as shown on the Drawings.
- E. It is the intent of the Contract Documents to construct a complete and working installation. Items of equipment or materials that may reasonably be assumed as necessary to accomplish this end shall be supplied whether or not they are specifically stated herein.

1.02 RELATED ITEMS

- A. Field mounted switches, limit switches, valve and gate operator position transmitters, sump pump controls, and other instrumentation and controls furnished with mechanical or electrical equipment not listed in the instrument schedule shall be furnished, installed, tested, and calibrated as specified under other Divisions and contract drawings.
- B. Additional and related work performed under Division 16 includes the following:
1. Conduit and raceways for all instrumentation and control system signal wiring, grounding systems, copper and fiber optic communication cables, and special cables.
 2. Instrumentation and control system signal wiring.
 3. Installation of (pull in conduit system) copper and fiber optic data communications cables.
 4. Grounding systems for all digital equipment, local control panels, and field instrumentation provided under Division 17. Grounding systems shall be complete to the equipment provided under Division 17, ready for termination by the instrumentation and controls subcontractor.
 5. Termination of all instrumentation and control system grounding, signal and data communications cables, wiring and surge suppression devices at the equipment end of all equipment furnished under other Divisions of the Specifications. Wiring systems shall be installed complete to the equipment provided under Division 17, ready for termination by the instrumentation and controls subcontractor.

1.03 GENERAL INFORMATION AND DESCRIPTION

- A. Where manufacturers are named for a particular item of equipment, it is intended as a guide to acceptable quality and performance and does not exempt such equipment from the requirements of these Specifications or Drawings.

- B. In order to centralize responsibility, it is required that all equipment (including field instrumentation and control system hardware) offered under this Division shall be furnished and installed by the instrumentation and controls subcontractor, or under the supervision of the instrumentation and controls subcontractor, who shall assume complete responsibility for proper operation of the instrumentation and control system equipment, including that of coordinating all signals, and furnishing all appurtenant equipment.
- C. The Contractor shall retain total responsibility for the proper detailed design, fabrication, inspection, test, delivery, assembly, installation, activation, checkout, adjustment, and operation of the entire instrumentation and control system as well as equipment and controls furnished under other Divisions of the Specifications. The Contractor shall be responsible for the delivery of all detailed drawings, manuals, and other documentation required for the complete coordination, installation, activation, and operation of mechanical equipment, equipment control panels, local control panels, field instrumentation, control systems, and related equipment and/or systems and shall provide for the services of a qualified installation engineer to supervise all activities required to place the completed facility in stable operation under full digital control.
- D. The instrumentation and control system shall be capable of simultaneously implementing all real-time control and information system functions, and servicing all operator service requests as specified, without degrading the data handling and processing capability of any system component.
- E. The Drawings indicate the approximate locations of field instruments, control panels, systems, and equipment as well as field-mounted equipment provided by others. The instrumentation subcontractor shall examine the Drawings to determine actual size and locations of process connections and wiring requirements for instrumentation and controls furnished under this Contract. The instrumentation and controls subcontractor shall inspect all equipment, panels, instrumentation, controls, and appurtenances either existing or furnished under other Divisions of the Specifications to determine all requirements to interface with the control and information system. The Contractor shall coordinate the completion of any required modifications with the associated supplier of the item furnished.
- F. The instrumentation and controls subcontractor shall review and approve the size and routing of all instrumentation and control cable and conduit systems furnished by the electrical subcontractor for suitability for use with the associated cable system.
- G. The Contractor shall coordinate the efforts of each supplier to aid in interfacing all systems. This effort shall include, but shall not be limited to, the distribution of approved shop drawings to the electrical subcontractor and to the instrumentation and controls subcontractor furnishing the equipment under this Division.
- H. The Contractor shall be responsible for providing a signal transmission system free from electrical interference that would be detrimental to the proper functioning of the instrumentation and control system equipment.
- I. The Owner shall have the right of access to the instrumentation and controls subcontractor's facility and the facilities of its equipment suppliers to inspect materials and parts; witness inspections, tests, and work in progress; and examine applicable design documents, records, and certifications during any stage of design, fabrication, and tests. The instrumentation subcontractor and its equipment suppliers shall furnish office space, supplies, and services required for these surveillance activities.
- J. The terms "Instrumentation", "Instrumentation and Control System", and "Instrumentation, Control, and Information System" shall hereinafter be defined as all equipment, labor, services and documents necessary to meet the intent of the Specifications.

1.04 INSTRUMENTATION AND CONTROL SYSTEM SUBCONTRACTOR QUALIFICATIONS

- A. Instrumentation and control system subcontractor shall be regularly engaged in the detailed design, fabrication, installation, and startup of instrumentation and control systems for municipal facilities. Instrumentation and control system subcontractor shall have a minimum of five years of such experience, and shall have completed a minimum of three projects of similar type and size as that specified herein. As used herein, the term “completed” shall mean that a project has been brought to final completion and final payment has been made.
- B. The instrumentation and controls subcontractor’s staff shall meet the following requirements:
 - 1. Programmers:
 - a. As a minimum, all programmers shall have a minimum of 5 years of experience in industrial PLC and HMI programming.
 - 2. Field Service Technicians:
 - a. All service technicians shall have a minimum of five years of experience in PLC systems and HMIs.
 - b. All service technicians shall be capable of programming minor edits in the project PLC’s and uploading or downloading PLC applications.
 - c. All service technicians shall have experience troubleshooting: motor starters, PLC’s, computers, HMI systems, and basic electrical controls.
 - d. Service technicians shall show proficiency in using the following equipment: volt meters, PLC programming software, HMI configuration tools.

1.05 DEFINITIONS

- A. Solid State: Wherever the term solid state is used to describe circuitry or components in the Specifications, it is intended that the circuitry or components shall be of the type that convey electrons by means of solid materials such as crystals or that work on magnetic principles such as ferrite cores. Vacuum tubes, gas tubes, slide wires, mechanical relays, stepping motors or other devices will not be considered as satisfying the requirements for solid state components of circuitry.
- B. Bit or Data Bit: Whenever the terms bit or data bit are used in the Specification, it is intended that one bit shall be equivalent to one binary digit of information. In specifying data transmission rate, the bit rate or data bit rate shall be the number of binary digits transmitted per second and shall not necessarily be equal to either the maximum pulse rate or average pulse rate.
- C. Integrated Circuit: Integrated circuit shall mean the physical realization of a number of circuit elements inseparably associated on or within a continuous body to perform the function of a circuit.
- D. Mean Time Between Failures (MTBF): The MTBF shall be calculated by taking the number of system operating hours logged during an arbitrary period of not less than six months and dividing by the number of failures experienced during this period plus one.
- E. Mean Time to Repair (MTTR): The MTTR shall be calculated by taking the total system down time for repair over an arbitrary period of not less than six months coinciding with that used for calculation of MTBF and dividing by the number of failures causing down time during the period.

- F. Availability: The availability of a non-redundant device or system shall be related to its MTBF and MTTR by the following formula:

$$A=100 \times (\text{MTBF}/(\text{MTBF} + \text{MTTR})) \text{ Percent}$$

The availability of a device or system provided with an automatically switched backup device or system shall be determined by the following formula:

$$A=A2 + 1 ((1 A1) \times (1 A1))$$

where:

A1=availability of non-redundant device or system

A2=availability of device or system provided with an automatically switched backup device or system

- G. Abbreviations: Specification abbreviations include the following:

A	Availability
ADC	Analog to Digital Converter
AVAIL	Available
ATA	Advanced Technology Attachment
BCD	Binary Coded Decimal
CSMA/CD	Carrier Sense Multiple Access/Collision Detect
CPU	Central Processing Unit
CRC	Cyclic Redundancy Check
CRT	Cathode Ray Tube
CS	Control Strategy
DAC	Digital to Analog Converter
DBMS	Data Base Management System
DDR	Double Data Rate
DIMM	Dual In-line Memory Module
DMA	Direct Memory Access
DPDT	Double Pole, Double Throw
DVD	Digital Video Disc
DVE	Digital to Video Electronics
ECC	Error Correction Coding
EPROM	Erasable Programmable Read Only Memory
FDM	Frequency Division Multiplexing
FSK	Frequency Shift Keyed
GB	Gigabyte
Gbps	Gigabits per second
HMI	Human Machine Interface
I/O	Input/Output
LAN	Local Area Network

LCD	Liquid Crystal Display
LED	Light Emitting Diode
MB	Megabyte
Mbps	Megabits per second
MCC	Motor Control Center
MTBF	Mean Time Between Failures
MTTR	Mean Time To Repair
OS	Operating System
OIT	Operator Interface Terminal
PCB	Printed Circuit Board
PLC	Programmable Logic Controller
RAID	Redundant Array of Inexpensive Discs
PROM	Programmable Read Only Memory
RAM	Random Access Memory
RMSS	Root Mean Square Summation
ROM	Read Only Memory
RTU	Remote Telemetry Unit
SATA	Serial ATA
SCADA	Supervisory Control and Data Acquisition
SDRAM	Synchronous Dynamic Random-Access Memory
SIMM	Single In-line Memory Module
SPDT	Single Pole, Double Throw
TB	Terabyte
TDM	Time Division Multiplexing
TFT	Thin Film Transistor
USB	Universal Serial Bus
UPS	Uninterruptible Power Supply
WAN	Wide Area Network

- H. To minimize the number of characters in words used in textual descriptions on displays, printouts, and nameplates, abbreviations may be used subject to Engineer approval. If a specified abbreviation does not exist for a particular word, an abbreviation may be generated using the principles of masking and or vowel deletion. Masking involves retaining the first and last letters in a word and deleting one or more characters (usually vowels) from the interior of the word.

1.06 ENVIRONMENTAL CONDITIONS

- A. Instrumentation equipment and enclosures shall be suitable for ambient conditions specified. All system elements shall operate properly in the presence of telephone lines, power lines, and electrical equipment.
- B. Inside control rooms and climate-controlled electrical rooms, the temperature will normally be 20 to 25 degrees Celsius; relative humidity 40 to 80 percent without condensation and the air will be essentially free of corrosive contaminants and moisture. Appropriate air filtering shall be provided to meet environmental conditions (i.e., dust).
- C. Other indoor areas may not be air conditioned/heated; temperatures may range between 0 and 40 degrees Celsius with relative humidity between 40 and 95 percent.

- D. Outdoor equipment including instrumentation and panels may be subjected to wind, rain, lightning, and corrosives in the environment, with ambient temperatures from 0 to 48 degrees Celsius and relative humidity from 10 to 100 percent. All supports, brackets and interconnecting hardware shall be aluminum or Type 316 stainless steel as shown on the Drawings or indicated by the individual specifications.

1.07 INSTRUMENT AND HARDWARE SUBMITTALS

- A. Submit in accordance with submittal requirements of the Contract Documents.
- B. Submit information for all new hardware including, but not limited to, the following:
 - 1. Product (item) name and tag number.
 - 2. Catalog cut sheets.
 - 3. Manufacturer's complete model number.
 - 4. Location of the device.
 - 5. Input - output characteristics.
 - 6. Range, size, and graduations.
 - 7. Physical size with dimensions, NEMA enclosure classification and mounting details.
 - 8. Materials of construction of all enclosures, wetted parts, and major components.
 - 9. Instrument or control device sizing calculations where applicable.
 - 10. Certified calibration data on all flow metering devices.
 - 11. Environmental requirements during storage and operation.
 - 12. Associated surge protection devices.
 - 13. Mounting requirements.
 - 14. Environmental requirements during storage and operation.
 - 15. Complete panel fabrication shop drawings including panel layouts and wiring diagrams.
 - 16. Complete network diagram showing all network communications to PLCs, UPSs, network switches, and communication cables and protocols used between all connected devices.

1.08 SOFTWARE SUBMITTALS

- A. Submit in accordance with submittal requirements of the Contract Documents.
- B. Software submittals shall include the following as a minimum:
 - 1. PLC input/output schedules for interface with values being sent to and received from the existing and new field I/O and internal data registers. List complete addresses and tagnames for each data register.

2. Written control strategy documentation to describe the proposed control logic interface with the I/O.
4. Upon approval of PLC input/output schedules and written control strategy documentation, submit a complete hard copy of fully commented PLC ladder logic programming and a complete hard copy of proposed display screen modifications.

1.09 OPERATION AND MAINTENANCE MANUALS

- A. Submit in accordance with submittal requirements of the Contract Documents.
- B. Provide equipment operation and maintenance manuals for new instruments. The manuals shall contain all illustrations, detailed drawings, wiring diagrams, and instructions necessary for installing, operating, and maintaining the equipment. The illustrated parts shall be numbered for identification. All modifications to manufacturer standard equipment and/or components shall be clearly identified and shown on the drawings and schematics. All information contained therein shall apply specifically to the equipment furnished and shall only include instructions that are applicable. All such illustrations shall be incorporated within the printing of the page to form a durable and permanent reference book.
- C. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance personnel unfamiliar with such equipment. The maintenance instructions shall include trouble shooting data and full preventive maintenance schedules. The instructions shall be bound in locking 3-D-ring binders with bindings no larger than 3.5 inches and external hard drives with PDF files shall be provided. The manuals shall include 15% spare space for the addition of future material. The instructions shall include Drawings reduced or folded and shall provide at least the following as a minimum.

1.10 FINAL SYSTEM DOCUMENTATION

- A. Provide two copies on external hard drive/flash drive for all software (actual program files and pdf copies). PLC files shall include all comments. Provide complete control panel as-installed panel fabrication and wiring diagrams for new panels in .dwg and .pdf format on flash drive.

1.11 SHIPPING, HANDLING, AND STORAGE

- A. In addition to shipping, handling, and storage requirements specified under Division 01, air conditioning/heating shall be provided for storage of all new field instrumentation and ancillary devices to maintain temperatures between 20 and 25 degrees C and relative humidity between 40 to 60 percent without condensation. The air shall be filtered and free of corrosive contaminants and moisture.

1.12 GUARANTEE

- A. The instrumentation and control system subcontractor through the Contractor shall install, maintain, and guarantee the Instrumentation, Control and Information System as specified under the General Conditions and Division 01 of the Specifications.
- B. Maintenance personnel provided by the instrumentation and control system subcontractor shall instruct the Owner's personnel in the operation, adjustment, calibration, and repair of the equipment being serviced. All preventive and corrective activities shall be documented with

service reports, which shall identify the equipment being serviced, state the condition of the equipment, describe all work performed, and list materials used. A copy of all service reports shall be delivered to the Owner on the day the work is performed.

- C. The instrumentation and control system subcontractor shall provide the services of factory-trained service technician(s) at least twice during the guarantee period, for the purpose of performing preventive hardware maintenance.
- D. Corrective hardware and software maintenance during the guarantee period shall be performed in accordance with the requirements of Division 01 and, in addition, shall meet the following requirements:
 - 1. Corrective hardware maintenance shall be performed by factory-trained service technician(s) specifically trained to service the digital equipment provided. Technicians possessing suitable training and experience shall be provided to perform corrective maintenance on all other equipment. The hardware service technician(s) shall be available on-site within 24 working hours after notification by the Owner.
 - 2. Corrective software maintenance shall be performed for software provided by the instrumentation subcontractor and incorporated into the system prior to the completion of system commissioning. Software service programmer(s) shall be available for consultation within four business hours and, if required, on-site within 16 business hours after notification by the Owner. Corrective software maintenance shall include the supply, installation and startup of all application software upgrades released during the guarantee period.
 - 3. Corrective hardware and software maintenance performed during the guarantee period shall be performed at no cost to the Owner.
 - 4. As used herein, the term "working hours" shall be defined as those of the treatment facility (seven days per week, 24 hours per day). The term "business hours" shall be defined as the hours between 8:00 a.m. and 5:00 p.m., local time, Monday through Friday; excluding holidays.
 - 5. The guarantee period shall commence upon final acceptance of the completed treatment facility in accordance with the provisions of the Contract Documents.

PART 2 – PRODUCTS

2.01 NAMEPLATES

- A. All instruments, control panels, and all items of digital hardware shall be identified with nameplates. Each nameplate shall be located so that it is legible from the normal observation position and is clearly associated with the device or devices it identifies. Nameplates shall be positioned so that removal of the device for maintenance and repair shall not disturb the nameplate. Nameplates shall include the equipment identification number and description. Abbreviations of the description shall be subject to Engineer approval.
- B. Nameplates shall be made of 1/16-inch thick machine engraved laminated phenolic plastic having white numbers and letters not less than 3/16-inch high on a black background.
- C. Nameplates shall be attached to metal equipment by stainless steel screws and to other surfaces by an epoxy-based adhesive that is resistant to oil and moisture. In cases where the label cannot be attached by the above methods, it shall be drilled and attached to the associated device by means of stainless steel wire.

PART 3 – EXECUTION

3.01 CLEANING

- A. The Contractor shall thoroughly clean all soiled surfaces of installed equipment and materials.
- B. Upon completion of the instrumentation and control work, the Contractor shall remove all surplus materials, rubbish, and debris that has accumulated during the construction work. The entire area shall be left neat, clean, and acceptable to the Owner.

3.02 TESTING REQUIREMENTS

- A. The Contractor shall provide the services of experienced factory trained technicians, tools, and equipment to field calibrate, test, inspect, and adjust all equipment in accordance with manufacturer's specifications and instructions.
- B. The proper control of all final control elements shall be verified by tests conducted in accordance with the requirements specified herein.
- C. All modulating final control elements shall be tested for appropriate speed or position response by applying power and input demand signals, and observing the equipment for proper direction and level of reaction. Each final control element shall be tested at 0, 25, 50, 75, and 100 percent of signal input level and the results checked against specified accuracy tolerances. Final control elements which require turndown limits such as VFD's shall be initially set during this test.
- D. Prior to control system startup and testing, each monitoring and control loop shall be tested on an individual basis from the primary element to the final element, including the operator work station or loop controller level, for continuity and for proper operation and calibration.
- E. Signals from transducers, sensors, and transmitters shall be utilized to verify control responses. Simulated input data signals may be used subject to prior written approval by the Engineer. All modes of control shall be exercised and checked for proper operation.
- F. Control system startup and testing shall be performed to demonstrate complete compliance with all specified functional and operational requirements. Testing activities shall include the simulation of both normal and abnormal operating conditions.
- G. Each loop and control strategy test shall be witnessed and signed off by both the Contractor (or designee) and the Engineer upon satisfactory completion.
- H. Upon completion of the startup tests and prior to final system acceptance, the new controls shall be tested under normal operating conditions, initiated either automatically or manually, over a 30-day test period to demonstrate continuous reliable operation as intended.
- I. If the system fails the 30-day availability test, unless the failure is related to programming, the 30-day test period shall be restarted after the failed component is repaired / replaced and full operation is restored.

3.03 FINAL ACCEPTANCE

- A. Final acceptance of the Instrumentation, Control and Information System will be determined as complete by the Engineer, and shall be based upon the following:
 - 1. Receipt and acceptance of all control panel completion reports, control panel test reports, and other documentation as required by the Contract Documents.
 - 2. Completion of the Final Acceptance Test (FAT). Final sign off of the FAT shall include endorsement of test results from Owner.
 - 3. Completion of all punch-list items that are significant in the opinion of the Engineer.
 - 4. Completion of all specified control system training requirements.
- B. Final acceptance of the Control and Information System in its entirety shall be required to achieve Substantial Completion. Substantial Completion establishes the commencement date of the warranty period and all warranty period services.
- C. All equipment in service, operational, and in use by the Owner prior to the commencement of the one (1) year warranty period shall be warranted and maintained by the Contractor at no additional cost to the Owner.
- D. Refer to the General Conditions for additional project closeout requirements.

[END OF SECTION]

SECTION 17500

CONTROL PANEL

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install, and place into satisfactory operation the control panel(s), with all spare parts, accessories, and appurtenances as specified herein and as shown on the Drawings.
- B. Control panel shall be assembled, wired, and tested in the instrumentation and control system subcontractor's own facilities, unless specified otherwise. All components and all necessary accessories such as power supplies, conditioning equipment, mounting hardware, signal input and output terminal blocks, and plug strips that may be required to complete the system shall be provided.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Instrumentation and Control, General
- B. Section 17650 – Pressure Gauges
- C. Section 17701 – Electromagnetic Flow Meters
- D. Section 17749 – Submersible Level (Pressure) Sensors
- E. Division 16 sections.

1.03 GENERAL INFORMATION AND DESCRIPTION

- A. The panel itself and all interior and exterior equipment shall be identified with nameplates. The equipment shall be mounted such that service can occur without removal of other equipment. Face mounted equipment shall be flush or semi-flush mounted with flat black escutcheons. All equipment shall be accessible such that adjustments can be made while the equipment is in service and operating. All enclosures shall fit within the allocated space as shown on the Drawings.

1.04 TOOLS, SUPPLIES AND SPARE PARTS

- A. Tools, supplies and spare parts shall be provided as specified in Section 17000 – Instrumentation and Control, General.
- B. Provide 10 percent spare fuses of each type furnished, but not less than two of each type.
- C. Provide 10 percent spare terminal blocks (pre-installed).
- D. Provide 10 percent spare bulbs for indicators furnished, but not less than four.

PART 2 - PRODUCTS

2.01 CONTROL PANEL

- A. General: The control panel electrical service shall be as indicated on the Drawings. The specifically panel shall be designed for the equipment supplied. The panel shall perform the following functions:
1. Power to and control of the pumping equipment.
 2. Interface with emergency generator through a panel mounted receptacle.
 3. Interface with a local audible and visual alarm for critical alarms.
 4. Provide level indication and historical digital recording.
 5. Provide phase fail and surge protection for incoming power and input/outputs.
 6. Provide power distribution to pumping equipment, station lighting, and instruments, as shown on the Drawings.
- B. Control Panel Construction
1. Panel enclosure shall be rack-mounted, constructed in accordance with UL 508 requirements for enclosed industrial control panels and shall bear the serialized UL label.
 2. Enclosures shall be NEMA 4X Type 316 stainless steel enclosures, minimum 14 gauge, suitable for enclosures mounted outdoors in corrosive environments, including hinges, pins, latches, and fasteners.
 3. Exterior of the outdoor panels shall be coated with a UV-resistant, white laminate baked enamel powder coating to reduce temperature inside the panel.
 4. The enclosures shall have a continuous hinged outer door with suitable, single handle lockable, 3-point latching mechanism that maintains the NEMA rating and continuous gaskets to keep ambient corrosive gasses from entering the panel when closed.
 5. The enclosures shall have a 12-ga steel, formed, removable subpanel and an aluminum dead-front panel door behind the main panel door.
 6. The subpanel shall be degreased, cleaned, treated with a phosphatizing process, then primed and painted with white industrial grade baked enamel.
 7. The enclosures and mounting systems shall be designed to withstand wind loads as required by applicable building codes.
 8. Enclosures shall be of formed or welded construction, reinforced with slotted channels, or equal, to facilitate mounting of internal components or equipment.

9. Panels shall be prefabricated enclosures as manufactured by Hoffman, Saginaw Control and Engineering (SCE), or approved equal.

C. Control Panel Mounting

1. The Contractor shall fabricate and install a suitable mounting rack for the control panel as indicated on the Drawings. Support shall be adequate to provide a rigid support for the supplied panel and be designed to withstand structure wind loadings.

D. Panel Fabrication:

1. Enclosures shall provide mounting for power supplies, control equipment, input/output subsystems, panel mounted equipment, and appurtenances. Ample space shall be provided between equipment to facilitate servicing and cooling.
2. Enclosures shall be constructed so that no screws or bolt heads are visible when viewed from the front. Penetrations for instruments and other devices shall be clean and smoothly finished with rounded edges.
3. The temperature inside the enclosure shall be continuously monitored and shall generate an alarm to the PLC if the temperature rises to an adjustable, preset high temperature.
4. Ventilation of Heat: Panels shall be equipped with internal ventilation and heat sink components to adequately dissipate heat generated by equipment mounted inside the panel while maintaining the NEMA 4X rating.
5. Intrusion alarm switches, wired fail-safe, shall be provided on all enclosures containing digital hardware and shall generate an alarm to the panel PLC when enclosure door is opened.
6. All wiring shall be bundled with nylon cable ties when exposed (leaving in conduits, at bends, etc.) but otherwise shall be routed and enclosed in vented plastic wireway as required. Wireways shall be oversized by a minimum of 10%; overfilled wireways shall not be acceptable. DC power, analog signal and discrete signals shall be run in separate wireways from AC signal and power wiring.
7. Spare field wiring shall be bundled, tied, and labeled as specified above, and shall be neatly coiled in the bottom of the cabinet.
8. All installed spare I/O hardware shall be wired along with live I/O wiring to the field wiring terminal blocks within the cabinet. Where space for spare I/O modules has been provided with the PLC backplane or DIN-rail mounting system, corresponding space for wiring, surge protection, and terminations shall be furnished within the cabinet.
9. A copper ground bus shall be installed in each cabinet and shall be connected to the station's power ground.
10. Interior panel wiring shall be tagged at all terminations with machine-printed self-laminating labels. Labeling system shall be Brady TLS 2200 Printer with TLS

2200®/TLS PC Link™ labels, or equivalent system by Seton or Panduit. The wire numbering system and identification tags shall be coordinated with field wire numbering system used by the electrician under Division 16.

11. Main breaker and branch breaker sizes shall be coordinated such that an overload in a branch circuit will trip only the branch breaker but not the main breaker.
12. Enclosure shall be provided with a 120-volt, 20A duplex receptacle and LED service lights. Power to these devices shall be independent from the PLC power supply and its associated uninterruptible power system. Panel light shall be manually activated by an ON/OFF switch on the light as well as automatically come on when the panel is opened if left in the ON position.

E. Control Panel Components:

1. Manual main breaker handle mounted on the panel dead-front door to disconnect power to the panel and prevent the door from being opened when in the ON position unless manually bypassed. Main breaker shall be Allen Bradley 1489-M1C200, or approved equal.
2. NEMA Rated Motor Starters: The panel shall include motor starters for each pump motor for constant speed pump stations, if noted on the contract drawings. The motor starters shall be FVNR (full voltage non-reversing), with overload relays and reset buttons. The contactors shall feature double break silver cadmium oxide contacts, pressure type terminals, arc barriers, free floating armature magnet frame, molded continuous duty coil and stainless steel springs. Starter overload heater coils shall be sized to protect installed motor at full load AMP rating. The motor starters shall be Square D, or approved equal.
3. Branch Circuit Breakers: Circuit breakers shall be quick-make, quick-brake and trip free. The thermal and magnetic elements shall operate independently and be designed with a common trip bar breaking all poles when a fault is received on any pole. The circuit breakers shall be as manufactured by Allen Bradley for 120V and 460V (if required per the contract drawings) service, or approved equals. Provide breakers for the following:
 - a. Breakers for each motor power circuit.
 - b. 2-Pole breaker for the panel control power step-down transformer.
 - c. 120V breaker for the panel lighting and receptacle.
 - d. 120V breaker for the panel control circuit to the panel UPS.
 - e. Branch circuit breakers off of the UPS output power for the panel's 24Vdc power supply and for each PLC input/output module.
13. Programmable Controller (PLC): The panel shall include a PLC for all control logic. The PLC shall be Allen-Bradley MicroLogix 1400, or as noted on the contract drawings.

- a. PLC hardware and software shall be provided to allow operators to make changes to setpoints and control settings within the PLC. Software ladder programming shall be set up to allow modifications to the programming through direct laptop connection at the PLC.
 - b. Provide input/output modules in sufficient quantities specified herein and as required to meet functional requirements of the Specification. PLC hardware and power supplies shall be provided with all necessary cabling, mounting hardware, racks, and connectors for a fully functional system. I/O terminal strips shall be removable without disturbing field wiring.
 - c. Provide a minimum of 20% spare slot capacity in the card rack for future expansion and 15% spare I/O capacity for each type of input (rounded up to the next whole number of required points or channels). Provide 25% spare memory on the PLC CPU after the PLC has been programmed for full operation.
 - d. Input/Output Circuit Arrangement: Signal and control circuitry to individual input/output modules shall be arranged such that board failure shall not disable both pumps.
14. Operator Interface: An operator interface shall be provided that gives operators full control parameter and monitoring capabilities for the station. The interface shall be a minimum 7-inch display screen. Graphics are to be color display, primarily in tabular format. Operator input is to be available through touch screen interface. Operator Interface shall be 24Vdc powered, mounted on the panel front door, and shall be Panelview 800 series, or approved equal.
15. Uninterrupted Power Supply (UPS): The PLC shall operate on 24 VDC input power from a UPS securely mounted on a din rail inside the panel (loose installation at bottom of panel not acceptable). The UPS shall be as manufactured by Phoenix Contact or approved equal, with outputs to the PLC to indicate battery life low, running on battery status, UPS fault. UPS shall be sized, and panel shall be wired, to power all PLC components, telemetry communications equipment, and station control functions within the panel. Panel shall be sized to dissipate the heat generated by the UPS when running on battery, full load.
16. Telemetry Interface: The panel PLC shall communicate with the City's SCADA network via telemetry communications using a cellular modem. Model shall be Prosoft, or approved equal.
17. Surge Suppression: Provide a surge arrestor installed on the line side of the main breaker in accordance with manufacturer's instructions. Provide surge suppression devices on all signal and power leads on all circuits that have any part of the control or power circuit that extends past the limits of the control panel. Surge devices shall be as manufactured by Phoenix Contact, or approved equal:
- a. for 120VAC Power use Phoenix Contact 2859479
 - b. for 2-channel 2 wire 24 VDC Signal use Phoenix Contact 2800980

- c. for 4-channel 24 VDC signals use Phoenix Contact 2800983
 - d. for Ethernet use Phoenix Contact 2881007
 - e. for Coaxial Antenna use Phoenix Contact 2800021
18. As-built Drawings: A laminated "As Built" copy of the panel wiring diagrams shall be provided and placed in the panel print pocket for all panels that include PLCs. All panel drawings shall be developed using AutoCad®. The drawings shall have a complete Bill of Materials, panel exterior and interior layouts, and show all electrical wiring. As-built drawings shall be submitted with the O&M materials on a CD in both AutoCad® (.dwg) and Adobe Acrobat® (.pdf).
19. Panel shall be provided with a drawing pocket for as-built panel drawings. One laminated copy of the appropriate panel as-built drawings shall be furnished and left in the pocket.
20. Panel shall be provided with a folding laptop programmer shelf on the inside of the door. When deployed, the laptop shelf shall not be greater than 48 inches above finished floor. Laptop shelf shall be fitted to door with factory applied weld-studs. Weld discoloration and enclosure penetrations will not be accepted.
21. Terminals: Terminal blocks shall be as follows:
- a. Terminal blocks shall be assembled on non-current carrying galvanized steel DIN mounting rails securely bolted to the cabinet subpanel. Terminals shall be of the screw down pressure plate type as manufactured by Phoenix Contact, or approved equal.
 - b. Power terminal blocks for both 120 VAC and 24 VDC power shall be single tier with a minimum rating of 600 volts, 30 amps.
 - c. Discrete signal terminal blocks shall be 2-tier with a minimum rating of 600 volts, 20 amps. One terminal block shall be used for each signal. The positive wire shall be installed on the top or left-most terminal.
 - d. Analog signal terminal blocks shall be 3-tier with a minimum rating of 600 volts, 20 amps. One terminal block shall be used for each signal. The positive wire shall be installed on the top or left-most terminal and the shield/drain wire shall be installed on the bottom or right-most terminal.
 - e. Only one wire shall be terminated under a single wire clamp or screw.
 - f. Terminal blocks for field wire connections shall be added as needed in 10-pole increments. Terminal blocks shall be mounted with a minimum of 2" from both enclosure sides and from the bottom of the enclosure for easy access to terminal screws.
 - g. Terminals shall be marked with a permanent, continuous marking strip. One side of each terminal shall be reserved exclusively for field incoming conductors. Common connections and jumpers required for internal wiring shall not be made on the field side of the terminal.

- h. Separate terminal strips shall be provided for each type of power and signal used within each cabinet. Where applicable, terminal strips for different voltages of discrete signal wiring shall also be separated. Terminal strips shall be labeled as to voltage and function.
22. Wiring: All wiring shall be color-coded using tinned copper MTW #14 AWG minimum for power and control wiring and #16 twisted pair for analog signal wiring. Wiring and cables shall be numbered at each end. Wire numbers shall be printed on non-removable heat-shrink tags. Wires shall be color coded as follows:
- Equipment Ground - GREEN
 - 480V Power - BLACK
 - 120 VAC Power - BLACK
 - 120 VAC Power Neutral - WHITE
 - 120 VAC Control (Internally Powered) - RED
 - 120 VAC Control (Externally Powered) - YELLOW
 - 24 VAC Control - ORANGE
 - DC Power/analog – BLUE for (+) and BLUE/WHITE for (-)
23. Component Labels: All interior panel components shall be individually labeled on the back plate with a custom engraved plastic tag with adhesive back (see Section 17000 for nameplates). The tags shall be white with black letters and match the nomenclature indicated on the as-built wiring diagrams.
24. Mounting Hardware: All mounting hardware such as screws or bolts used in the manufacturing of the control panel shall be Type 316 stainless steel. All holes in the back plate and dead front shall be drilled and tapped. No self-tapping screws, adhesive tapes, or Velcro will be accepted for the mounting of any hardware.
25. Interposing relays shall be provided on all discrete outputs on the PLC and shall be DIN rail mounting type, DPDT, minimum 10 amp, 120 VAC contact rating. Relay coils shall be 120 VAC or 24 VDC as required. Relays shall have a flag indicator to show relay status, a pushbutton to allow manual operation of the relay, and an internal pilot light to indicate power to the coil. Relays shall be as manufactured by Phoenix Contact.
26. Corrosion Protection: Panel interior components shall be treated with a corrosion inhibiting spray on all exposed metallic surfaces, particularly terminations, contacts, and wire ends. After installation, furnish corrosion inhibiting capsules that emit molecular level coating on metallic surfaces throughout the panel that provide specific corrosion barrier toward hydrogen sulfide and/or subsequent formation of sulfuric acid when combined with ambient moisture.
27. Panel Conduit Seals: All conduits entering the panel shall be sealed at the conduit entry point with a removable, expandable conduit seal material to prohibit outside air from entering the panel. Provide seal-off fittings below the panel with permanent epoxy seal material for all conduits from the wet well. Provide a NEMA 4X Type 316

stainless steel terminal junction box between the seal offs and the wet well to terminate all cables and wires with conduits to the wet wells sealed using the removable, expandable conduit seal material.

- F. System Operation Controls – The station equipment shall be controlled by the panel PLC. The PLC shall control all components of the system through a combination of direct wires to field devices, remote I/O interface to field devices, and through control and setpoint registers adjustable at the panel operator interface. Controls shall be as follows:

1. Lift Station Control:

- a. Provide HAND/OFF/AUTO switches, one for each pump. In HAND, power is applied directly to the pump motor with no interlocks. In OFF, power is removed from the pump motor. In AUTO, the pump is controlled by the PLC and pump protection circuits.
- b. For constant speed lift stations, in AUTO, the pumps shall be controlled by adjustable level control LEAD ON, LAG ON, and PUMPS OFF setpoints based on the level signal input from the level transmitter. The LEAD pump shall start when the level rises above the LEAD ON setpoint and stops when the level falls below the PUMPS OFF setpoint. If the level continues to rise above the LAG ON setpoint, the LAG pump shall start and both pumps shall remain on until the level falls below the PUMPS OFF setpoint.
- c. For variable speed pump stations, provide similar lead/lag level setpoints but once running, the pump VFD(s) shall vary the speed of the pump to maintain an adjustable level setpoint. Outputs to pumps running at the same time shall match.
- d. Provide a 1-ALT-2, PUMP SELECT selector switch for duty selection of the pumps. In position "1", pump 1 shall be LEAD each time the system calls for a pump and pump 2 shall be the LAG. In position "2", pump 2 shall be LEAD each time the system calls for a pump and pump 1 shall be the LAG. In ALT, the pumps shall alternate LEAD/LAG duty when the LEAD pump is called to run.
- e. Provide an auxiliary switch on each pump motor starter to activate a RUNNING indicator light and advance an Elapsed Time Meter for each pump whenever the pump is running (AUTO or HAND). PLC internal register counters shall also keep a record of each pump's runtime on a continuous basis and on a daily basis that resets at midnight.
- f. In AUTO, the pumps shall be disabled if an adjustable Low Level Lockout Alarm conditions exists in the wet well.
- g. In AUTO, provide an adjustable Delay Power On Timer (initially set at 30 seconds) to assure that only one pump starts at any point, particularly while the system first starts powering up.

2. Panel Power: Provide a CONTROL POWER ON/OFF selector switch on the 120V control power input to the UPS. Provide a POWER ON indicator light to indicate that control power has been applied to the UPS input.

3. Pump Protection Relay: The enclosure shall provide space for mounting the temperature/moisture monitoring relay provided by the pump manufacturer (referred to by Flygt as the "MiniCAS" relay). Mounting, wiring, and interface with the pump manufacturer's relay shall be furnished by the panel manufacturer and be in accordance with the pump manufacturer's recommendations. Relay shall interface with local control devices as noted herein for motor high temperature and moisture seal leak. Power and signal wiring to and from the relay shall be verified and approved by the pump manufacturer as to the correct voltage, wire size and type, and circuit design. If the pump manufacturer recommends a relay other than the specified MiniCAS relay, all required cabling and connections shall be provided at no additional cost to the Owner.
4. Motor Protection Circuits – Each pump motor shall have motor temperature switches. In HAND or AUTO, if a motor temperature rises above setpoint, the motor shall stop and require manual reset before restarting in any mode. The motor temperature circuit shall be a hard-wired circuit to the starter. Manual reset shall be through the reset pushbutton on the panel front door and through a reset output from the PLC that can be sent remotely. Provide an indicator light on the front panel door and a SCADA alarm for this condition.
5. Moisture Seal Alarm – Each pump motor shall have motor moisture leak sensors. If either sensor in a motor detects moisture, a latched alarm shall be generated to alert operators to this condition (requires manual reset). Provide an indicator light on the front panel door for this condition.
6. Motor Fault – A motor fault shall register if the any starter overload is tripped, a load monitor detects a high load, or the motor starter run contact is not received within a preset time after the motor is called to run. For any of these conditions, the fault shall latch until manually reset, an alarm shall be sent to alert operators, and the pump shall stop. Upon reset, all settings shall be re-initiated so that the pump can resume normal operation. Manual reset shall be through the reset pushbutton on the panel front door. Provide an indicator light on the front panel door and a SCADA alarm for this condition.
7. System Alarms – Provide adjustable setpoints and an indicator light on the dead-front panel door as well as a SCADA alarm for each of the following conditions:
 - a. LOW LOW LEVEL ALARM - Indicates that wet well level has dropped below setpoint and pumps have been shut off.
 - b. HIGH WARNING LEVEL ALARM - Indicates that the wet well level has reached an adjustable high warning level condition.
 - c. HIGH LEVEL ALARM - Indicates that the wet well level has reached a maximum high level condition as determined by the level transducer starting both pumps. Condition shall latch as alarm requiring manual reset (locally or from SCADA) and automatically reset after an adjustable time delay once the high level alarm input goes away.
8. Exterior Alarm/Beacon

- a. Provide an exterior mounted alarm horn and beacon assembly on the panel exterior to be activated (horn sounds and beacon lights) upon High Level Alarm.
 - b. If required and shown on the contract drawings, Provide SILENCE, TEST, and RESET pushbuttons on the panel front door. The SILENCE pushbutton acknowledges the alarm (input to PLC) and stops the horn but the beacon remains lit if the condition remains. The TEST button activates both the horn and the beacon (no input to PLC). The RESET button stops the horn and turns off the latched beacon if the condition has cleared.
 - c. Provide a remote silence output from the PLC.
 - d. Alarm horn shall rated NEMA4X, with a pitch at 2900HZ and 80-95dB at a fast pulse, 24VAC powered. Horn shall be a Federal Signal 450E-24-31 W/WB or approved equal.
 - e. Alarm beacon shall be a red LED signal device, strobe type and shall be 24VAC powered and be a Federal Signal 1412T-24R or approved equal.
9. Alarm Reset: If required and shown on the contract drawings, provide an alarm reset pushbutton on the panel dead-front door to reset any latched alarm.
 10. Station Intrusion: Provide a Square D 9007 or approved equal, proximity type door switch mounted on the station's entrance door (active leaf) to indicate the door has been opened. Switch shall be rated NEMA4X.
- G. SCADA Control Interface – SCADA control interface shall be via communications between the panel PLC and the City's SCADA network over the telemetry link. Provide interface signals as follows:
1. Run status signal for each motor
 2. Alarm condition signals for each individual alarm condition
 - Starter overload for each constant speed motor
 - High current load for each motor
 - Failed to start for each pump
 - High motor temperature for each pump
 - Moisture seal leak for each pump
 - Low Level shutoff
 - High warning level
 - High level alarm
 - UPS fault
 - Power Loss, UPS running on battery
 - Station intrusion
 - Phase monitor alarm
 3. Alarm RESET output from SCADA
 4. In AUTO status for each motor
 5. Continuous and Daily Runtime calculation value (in hours and tenths of hours) for each motor

6. Daily Runtime calculation value for the duration of time both pumps are running at the same time.
 7. Daily Starts value for each motor
 8. Delay Power On Timer setpoint from SCADA
 9. Pump LEAD ON, LAG ON, and PUMPS OFF setpoints from SCADA
 10. Low level, High warning level, and High level alarm setpoints from SCADA
 11. Station flow signal
 12. Wet well level signal
 13. Station communication loss signal
- H. Panel Control and Power Interface: Provide terminals to interface with local control devices, instruments, motors, and other devices located outside the control panel. Separate 480V power terminals from 120V terminals and separate 24Vdc signal terminals from other power terminals.

PART 3 - EXECUTION

3.01 CONTROL PANEL PROGRAMMING

- A. Programming shall be furnished to perform all functions described, making use of the various IEC languages as appropriate to the specific task and shall be performed in a modular style making extensive use of program blocks (subroutines) and program variables to be passed to the program blocks for specific equipment. It is the intent of this requirement to allow for enhanced readability and ease of modification of the program code through the elimination of multiple instances of repeated code for the same function in a “hard-coded” style.
- B. Extensive, clear and concise program documentation comments shall be placed in the program code to describe the functions of all elements of the program code. PLC code that does not contain comments shall be rejected.
- C. Programming shall adhere to minimum PLC standards, including:
 - 1. Discrete data corresponding to a single digital I/O point as either a hardwired I/O point or an internal bit in the PLC data memory file.
 - 2. Analog values registered in PLC memory in a binary data format either as a floating-point register or an integer register
 - 3. PLC programs shall be configured to provide bump less output control when transitioning from PLC auto to PLC manual control. Process control of equipment shall be performed in the PLC not from SCADA or field devices
 - 4. All PLC registers shall be identified with an appropriate address symbol that corresponds to the adopted tagging and naming conventions. All PLC logic and subroutines shall include ladder-rung descriptions/comments that explains the control logic and identifies its purpose in an English descriptive format. Rung comments will be provided for each set of controls. At the beginning of each process routine a process description explaining the entire process will be provided. At each rung that performs a crucial code a rung description will be provided to explain the PLC code.
 - 5. IO Faults for Local Modules and Ethernet connected devices shall not cause a major fault on the PLC processor. A processor fault shall provide an alarm to SCADA.
 - 6. PLC communications shall be monitored in the PLC code and mapped to SCADA I/O database to indicate communications status. Status indication in SCADA shall report OK for a valid communications path or FAULTED for an invalid path.

[END OF SECTION]

SECTION 17650
PRESSURE GAUGES

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install, and place in satisfactory operation the pressure gauges, with all spare parts, accessories, and appurtenances as herein specified, and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Instrumentation and Control, General

PART 2 - PRODUCTS

2.01 PRESSURE GAUGES

- A. All gauges shall be designed in accordance with the ASME B40.1 entitled, "Gauges, Pressure, Indicating Dial Type - Elastic Element".
- B. All gauges shall be direct reading type. Snubbers shall be provided on all gauges. Gauge full-scale pressure range shall be selected such that the maximum operating pressure shall not exceed the approximately 75% of the full-scale range.
- C. Gauge increments shall not exceed 2 psi, unless approved by Engineer.
- D. Features
 - 1. Mounting: ½" NPT, lower stem mount type.
 - 2. Accuracy: 0.5% full scale.
 - 3. Case: Solid front, black phenolic material.
 - 4. Dial: White background and black letters.
 - 5. Glass: Shatterproof.
 - 6. Blow-out protection: Back.
 - 7. Pressure element: stainless steel bourdon tube.
 - 8. Movement: Stainless steel, Teflon coated pinion gear and segment.
 - 9. Gaskets: Buna-N.
- E. Liquid-filled or equivalent mechanically-damped gauges shall be used if the gauges are installed with pumps, or where gauges are subjected to vibrations or pulsation. Filling fluid shall be silicone unless oxidizing agents such as sodium hypochlorite are present, where halocarbon shall be used.
- F. Gauge size shall be 2" for line sizes up to 3" and 4½" for line sizes of 4" or greater.
- G. Diaphragm seals and isolating ring seals shall be furnished for each pressure gauge.

- H. The complete gauge assembly and appurtenances shall be fully assembled and tested prior to field mounting. A ½" isolation stainless steel ball valve shall be provided for each gauge assembly.
- I. Pressure and vacuum gauges shall be Ashcroft Duragauge Model 1279, Ametek-U.S. Gauge Division, H.O. Trerice Co., WIKA Instrument Corporation, Rosemount or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's recommendations.

[END OF SECTION]

SECTION 17701

ELECTROMAGNETIC FLOW METERS

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the magnetic flow meters, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Instrumentation and Control, General.

PART 2 - PRODUCTS

2.01 ELECTROMAGNETIC FLOW METER

- A. Electromagnetic flow meter systems shall include a electromagnetic flow tube and a microprocessor-based "smart" transmitter that is capable of converting and transmitting a signal from the flow tube for wastewater-liftstation applications and environment. Electromagnetic flow meters shall utilize the characterized field principle of electromagnetic induction and shall produce DC signals directly proportional to the liquid flow rate.
- B. Each meter shall be furnished with a stainless steel metering tube and carbon steel flanges with a hard rubber (NBR or ebonite) liner as required by the application and/or as specified herein. Liner shall have a minimum thickness of 0.125 inches. The inside diameter of the liner shall be within 0.125 inches of the inside diameter of the adjoining pipe. Liner protectors shall be provided on all flow tubes.
- C. The flow tube shall be provided with bullet nose electrodes.
- D. The sensor shall house two measuring electrodes, a grounding electrode, and one for physical empty pipe detection. The electrodes shall be made of 316L stainless steel.
- E. Grounding rings shall be minimum 316 stainless steel, and shall be compatible with the process fluid.
- F. All materials of construction for metallic wetted parts (electrodes, grounding rings, etc.) shall be minimum 316 stainless steel, but shall be compatible with the process fluid for each meter in accordance with the recommendations of the manufacturer. Verify with the manufacturer that the selected electrode material for the electromagnetic flow meters is the least likely material to be affected by either corrosion or erosion.

- G. Flow tube shall be rated for pressures up to 2.0 times the flange rating of adjacent piping. System shall be rated for ambient temperatures of -30 to +65°C.
- H. Unless otherwise required by the Contract Documents, transmitter shall be remote, not integral to, the flow meter body.
- I. Meter and transmitter housings shall meet NEMA 4X requirements as a minimum. Non-metallic transmitter housings shall not be acceptable.
- J. The transmitter shall provide pulsed DC coil drive current to the flow tube and shall convert the returning signal to a linear, isolated 4-20 mA DC signal. The transmitter shall utilize "smart" electronics and shall contain automatic, continuous zero correction, signal processing routines for noise rejection, and an integral LCD readout capable of displaying flow rate and totalized flow. The transmitter shall continuously run self-diagnostic routines and report errors via English language messages.
- K. Transmitter shall be capable of generating an electronic flow meter calibration verification (E+H Heartbeat Verification or equal) document.
- L. The transmitter shall be equipped with an RJ45 port capable of communicating with the PLC via Profinet. A password-based security lockout feature shall be provided to prevent unauthorized modification of configuration parameters.
- M. The transmitter's preamplifier input impedance shall be a minimum of 10^9 - 10^{11} ohms which shall make the system suited for the amplification of low-level input signals and capable of operation with a material build up on the electrodes.
- N. The transmitter shall provide an automatic low flow cutoff below a user configurable low flow condition (0-10%). The transmitter's outputs shall also be capable of being forced to zero by an external contact operation.
- O. Each flow tube shall be factory calibrated and assigned a calibration constant or factor to be entered into the associated transmitter as part of the meter configuration parameters. Manual calibration of the flow meter shall not be required. Meter configuration parameters shall be stored in non-volatile memory in the transmitter. An output hold feature shall be provided to maintain a constant output during configuration changes.
- P. Accuracy shall be a minimum of 0.20% of rate over the flow velocity range of 1.0 to 33.0 fps. Repeatability shall be 0.1% of rate; minimum turndown shall be 100:1. Maximum response time shall be adjustable between 5 and 200 milliseconds as a minimum. Transmitter ambient temperature operating limits shall be -40 to +60°C.
- Q. Power supply shall be 24 V DC OR 120 VAC if required by manufacturer
- R. Flow tubes shall be 150-lb flange mounted unless otherwise noted. The cables for interconnecting the meter and transmitter shall be furnished by the manufacturer. Transmitter shall be a remote wall mounted display/transmitter.
- S. The display/transmitter shall be protected from the sun by a pipe stand mounted 316 stainless steel or aluminum sunshield.

- T. Magnetic flow meter systems shall be Endress + Hauser Proline Promag W 500 or approved equal.

PART 3 - EXECUTION

3.01 REQUIREMENTS

- A. Install instruments in accordance with Section 17000, Instrumentation – General.
- B. Ground electromagnetic flow meter flow tubes and grounding rings in strict accordance with the manufacturer's recommendations.

[END OF SECTION]

SECTION 17749

SUBMERSIBLE LEVEL (PRESSURE) SENSORS

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install, and place in satisfactory operation the submersible level (pressure) sensors, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Instrumentation - General.

PART 2 - PRODUCTS

2.01 SUBMERSIBLE LEVEL (PRESSURE) SENSORS

- A. Submersible level (pressure) sensors shall consist of a pressure-sensing probe assembly with a depth cable molded directly to the probe body. Sensing probe housing shall be fabricated of type 316 stainless steel. The depth support cable shall be polyethylene (PE), polyurethane (PUR), or fluorinated ethylene propylene (FEP) and shall contain a strength relief member constructed of high-strength PE fibers, a vent tube, and conductors for electrical power and signal.
- B. The sensor shall contain an encapsulated pressure sensing element which is electrically and physically isolated from the media via a ceramic isolation diaphragm. The pressure sensing connection shall be protected from damage by a removable acetal nose cone or equivalent guard.
- C. Each submersible level transducer shall be provided with a NEMA 4X termination/junction box and PTFE filter to prevent moisture from entering the vent tube.
- D. Sensor specifications shall be as follows:
 - 1. Sensor Rating: NEMA 7, loop-powered
 - 2. Output Signal: 4-20 mA HART, 2-wire design
 - 3. Accuracy: $\pm 0.20\%$, F.S. (full scale)
 - 4. Long Term Stability: $\pm 0.1\%$ F.S./year
 - 5. Zero Offset and Span Setting: $\pm 0.25\%$ F.S., max.
 - 6. Operating Temperature: -10 to +70 degrees C
 - 7. Compensated Temperature: 0 to +70 degrees C
 - 8. Overpressure Limits: At least 2x full scale range
 - 9. Cable Length: As required
 - 10. Electrical Area Classification: Class 1, Division 1
- E. Submersible level (pressure) sensors shall be WaterPilot Model FMX 21 by Endress & Hauser, equivalent by Druck, KPSI, or approved equal.

PART 3 - EXECUTION

3.01 REQUIREMENTS

- A. Install in accordance with manufacturer's recommendations and Section 17000, Instrumentation – General.

[END OF SECTION]

SECTION 17760

PRESSURE INDICATING TRANSMITTERS

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install, and place in satisfactory operation the pressure indicating transmitters, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000, Instrumentation - General.

PART 2 - PRODUCTS

2.01 PRESSURE INDICATING TRANSMITTERS, GENERAL

- A. Pressure indicating transmitters shall consist of a piezoresistive silicon pressure transducer with a process-isolated diaphragm, silicone oil fill, and microprocessor-based electronics. The pressure transducer shall be mechanically, electrically, and thermally isolated from the process and the environment, and shall have an integral temperature compensation sensor. Factory set correction coefficients and diagnostic data shall be stored in the transmitter's non-volatile memory, for correction and linearization of the output. Span and zero shall be continuously adjustable, externally, over the entire range. Span and zero adjustments shall be capable of being disabled internally. The maximum zero elevation and maximum zero suppression shall be adjustable to anywhere within sensor limits.
- B. Provide a wall, pipe, or strut mounted 316 stainless steel (or aluminum) sunshield to protect the pressure indicating transmitter from direct sunlight.
- C. Each transmitter shall be furnished with an integral LCD indicator capable of displaying engineering units and/or milliamps, and mounting hardware as required. Each transmitter shall have a stainless steel tag with calibration data attached to body. Transmitters shall satisfy the performance criteria in Table 1, below.

Table 1. Pressure Indicating Transmitter Performance Criteria	
Accuracy ⁽¹⁾	± 0.06% of calibrated span, zero-based

Table 1. Pressure Indicating Transmitter Performance Criteria	
Calibration Stability	± 0.15% of upper range limit (URL) over fifteen years
Field-Adjustable Rangeability	200:1 input range
Enclosure Type	NEMA 4X, Weather and Corrosion-Resistant
Enclosure Materials	Low-Copper Aluminum, with epoxy or powder coating
Process Wetted Materials	316 Stainless Steel, or better as scheduled or required for process compatibility
Ambient Environment Limits	-40 to 85 degrees Celsius at 0-100% relative humidity
Hazardous Environment Approval	Factory Mutual (FM) Approved for Class I, Division 1, Groups C and D
Overload Capacity	25 MPa (3,600 psi), or higher
Power Supply	24 VDC, two-wire design
Output	Linear isolated 4-20 mA 24 VDC with HART
Output Damping	Adjustable, 0-36 seconds

Notes:

⁽¹⁾ Including nonlinearity, hysteresis, and repeatability errors

2.02 GAUGE PRESSURE INDICATING TRANSMITTERS

- A. Gauge pressure indicating transmitters shall satisfy all requirements of Article 2.01.
- B. Where scheduled, gauge pressure indicating transmitters shall be calibrated in feet of liquid for liquid level service.
- C. Where scheduled, gauge pressure indicating transmitters with ranges in inches water column (in. w.c.) shall achieve the scheduled range with a turndown ratio not to exceed 1:5. As an example, a gauge pressure indicating transmitter scheduled for 0-20" w.c. shall have an uncalibrated range of -50 to +50" w.c. or 0 to 100" w.c., or less.
- D. Gauge pressure indicating transmitters shall be Emerson Process Management (Rosemount) Model 3051S1TG, or approved equal.

2.03 VALVE MANIFOLDS

- A. Gauge and differential pressure indicating transmitters shall be furnished and installed with a valve manifold. Valve manifolds shall satisfy the criteria in Table 2, below.

Table 2. Valve Manifold Criteria	
Materials	316L Stainless Steel, or better to match transmitter wetted parts
Construction Type	Milled
Valve Type	Needle Valve with non-rotating plug, T-bar handle
Packing Material	Polytetrafluoroethylene (PTFE) ⁽¹⁾
Rated Pressure	4,000 psi at 200 degrees Celsius

Notes:

⁽¹⁾ Alternative packing materials shall be furnished as scheduled herein, shown on the drawings, and for applications where temperature may exceed 200 degrees Celsius

- B. Dust caps shall be installed on all manifold connections during shipping, and remain installed until connection of the transmitter and process piping. Dust caps on vent and purge connections shall be 316 stainless steel, minimum.
- C. All manifolds shall be configured to allow isolation, venting, removal, and calibration of the transmitter without disassembly of process piping.
- D. Gauge pressure indicating transmitters shall be furnished with a two-valve manifold. Valve functions shall be isolate and vent. Two-valve manifolds shall be Ashcroft V02 Series, Hoke GP Series, or approved equal.

2.04 FLANGE MOUNTED LEVEL INDICATING TRANSMITTERS

- A. Flange-mounted tank liquid level indicating transmitters shall satisfy all requirements of Article 2.01.
- B. The flange-mounted sensor shall consist of a special non-corrosive isolating diaphragm with fill fluid in a sealed capillary system to transmit liquid pressure to the sensing element. A second isolating diaphragm shall transmit pressure through the fill fluid to the sensing diaphragm in the center of the capacitance cell. An isolating diaphragm and fluid fill shall also be provided on the opposite side of the sensing diaphragm to convey atmospheric or reference pressure.
- C. All mounting flanges, diaphragms, O-rings and materials used in construction shall be non-corroding, compatible with each other, and compatible with the liquid being measured.
- D. Flange-mounted liquid level transmitters shall be Emerson Process Management (Rosemount) Model 3051L, or approved equal.

2.05 REMOTE DISPLAYS

- A. Where specified or indicated on the Drawings remote display units shall be furnished to display the pressure or level signal received from the pressure indicating transmitter 4-20mA output. Remote displays shall be powered from the same loop at the pressure transmitter.
- B. Remote display units shall be wall mounted or mounted on a pipe stand fastened to a concrete base provided by the Contractor. Remote display units located outdoors in direct shall be protected with a sunshield.
- C. Remote displays shall be Emerson Process Management (Rosemount) Model 751 Field Signal Indicator, or approved equal.

2.06 REMOTE SEALS

- A. Remote seals shall be furnished with pressure indicating transmitters as shown on the Drawings. Remote seals shall be furnished and installed complete with capillary tubes, link kits, and fill fluid as required for a complete and functional installation.
- B. Remote seals, link kits, and other appurtenances shall be manufactured by the pressure indicating transmitter manufacturer, and installed pursuant to all manufacturer's recommendations.

2.07 SURGE SUPPRESSION

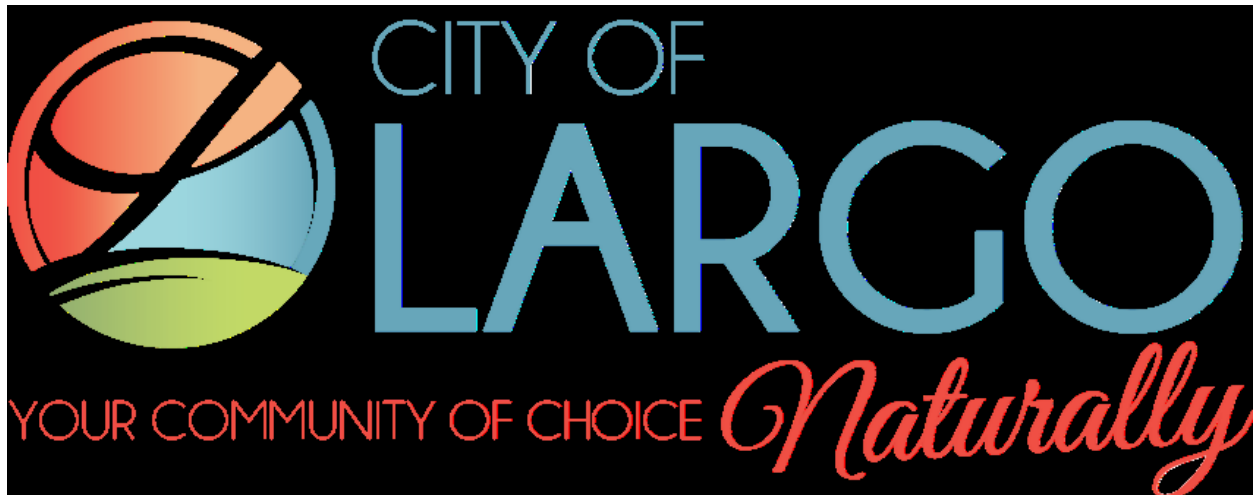
- A. A dedicated 4-20mA signal surge suppression device shall be provided for and each pressure transmitter or remote display.

PART 3 - EXECUTION

3.01 REQUIREMENTS

- A. Gauge pressure indicating transmitters shall be factory calibrated and a copy of the calibration report shall be in the O&M manual.
- B. Install instruments in accordance with Section 17000, Instrumentation and Control – General.
- C. Install instruments in strict accordance with the manufacturer's recommendations.

[END OF SECTION]



ADDENDUM # 1

ITB 24-B-806

TRENCHLESS SANITARY AND STORM SEWER REHAB SERVICES

TO: POTENTIAL PROPOSERS

FROM: Kezia Southern, Procurement Analyst

DATE: July 18, 2024

PLEASE NOTE THE FOLLOWING INFORMATION REGARDING THIS ITB

- **Bid deadline extended to August 1, 2024 at 4pm**
- Local Preference Policy applies to this bid and the supplemental form has been added to Demandstar
- Questions and answers provided in Demandstar. Document labeled "Questions"

Please return the signed original of this Addendum with your ITB package.

I have read and understand this addendum.

SIGNATURE: _____

FIRM: _____

PRINTED NAME AND TITLE: _____