

# **MS WRF Blend Tank Mixer**

**(#18-0057-UT)**

CONTRACT DOCUMENTS & SPECIFICATIONS

**Prepared for**



CITY OF CLEARWATER

BID DOCUMENTS

Prepared by:

Jones Edmunds & Associates, Inc.  
324 South Hyde Park Avenue, Suite 250  
Tampa, Florida 33606

Jones Edmunds Project No. 03720-054-01  
Certificate of Authorization #1841

June 2020

City of Clearwater, Florida

CITY OF CLEARWATER  
MS WRF BLEND TANK MIXER



THIS ITEM HAS BEEN DIGITALLY SIGNED AND SEALED BY DAVID TAYLOR YONGE, PE ON THE DATE ADJACENT TO THE SEAL.

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David T Yonge

Digitally signed by David T Yonge  
DN: CN=David T Yonge,  
OU=A01410D00000173290C043500003677,  
O=JONES EDMUNDS AND ASSOCIATES  
INC, C=US  
Date: 2020.08.12 14:54:32-04'00'

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David Taylor Yonge, PhD, PE  
FL Professional Engineer No. 85457  
Jones Edmunds & Associates, Inc.  
324 S. Hyde Park Ave., Suite 250  
Tampa, Florida 33606  
Divisions 1, 2, 9, 11, and 15

CITY OF CLEARWATER  
MS WRF BLEND TANK MIXER



THIS ITEM HAS BEEN ELECTRONICALLY SIGNED BY DAVID S. MORRIS, PE ON THE DATE INDICATED USING A DIGITAL SIGNATURE.

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David S.  
Morris

Digitally signed by  
David S. Morris  
Date: 2020.08.12  
12:15:08 -04'00'

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David S. Morris, PE  
FL Professional Engineer No. 74717  
Wekiva Engineering, LLC.  
711 N. Orange Ave., Suite A  
Winter Park, Florida 32789  
Divisions 3 and

CITY OF CLEARWATER  
MS WRF BLEND TANK MIXER



THIS ITEM HAS BEEN DIGITALLY SIGNED BY WILLARD C.  
HOANSHELT, PE ON THE DATE INDICATED USING A DIGITAL  
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Digitally signed by  
Willard C Hoanshelt  
Date: 2020.08.12  
15:11:23 -04'00'

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Willard C. Hoanshelt, PE  
FL Professional Engineer No. 42593  
EMI Consulting Specialties, Inc.  
5742 River Bed Road  
Groveland, Florida 34736  
Divisions 13 and 16

MS WRF BLEND TANK MIXER  
(#18-0057-UT)

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Prepared in the Office of the City Engineer

# SECTION 1

## INVITATION TO BID NOTICE TO CONTRACTORS

### **MS WRF Blend Tank Mixer Project**

Documents and plans for Project # 18-0057-UT are available at  
<https://www.myclearwater.com/business/engineering-construction-bids>

**The work includes:** Upgrades to the existing Sludge Holding Tank including new Sludge Holding Tank Stairs, Walkway, Cover, and Mixer. Installation of three new Dewatering Feed Pumps and a Truck Off-Loading and Recirculation Pump. Replacement of the existing pump pad with a structure elevated beyond the 100-year flood plain. Yard Piping, Electrical, Controls, and other improvements. All questions should be directed to David Ojeda at [David.Ojeda@myclearwater.com](mailto:David.Ojeda@myclearwater.com).

**Pre-Bid Conference: Virtual**

Friday, September 4, 2020 10am (EST)

**Virtual meeting** details will be posted at:

<https://www.myclearwater.com/business/engineering-construction-bids>

**Pre-qualification Submittal DEADLINE:**

Wednesday, September 23, 2020

**Category:** Wastewater & Water Treatment Facilities

**Pre-qualification Amount:** \$2,500,000.00

**Bid Opening:** Wednesday, October 7, 2020 2:30pm (EST)

**Location (Staff Only):** City of Clearwater, Municipal Services Building Room 130, 100 S. Myrtle Ave., Clearwater, FL 33756

**Virtual meeting** details will be posted at:

<https://www.myclearwater.com/business/engineering-construction-bids>.

**Mail or Drop Bid Off:**

City of Clearwater, Project #18-0057-UT, Attn: Lori Vogel, Procurement Office, 3<sup>rd</sup> Floor, 100 S. Myrtle Ave, Clearwater, FL 33756-5520

Issued by Lori Vogel, CPPB, Procurement Manager

For additional information contact Engineering Dept.:  
727-562-4750

# SECTION II

## INSTRUCTIONS TO BIDDERS

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## **1. COPIES OF BIDDING DOCUMENTS**

- 1.1. Complete sets of the Bidding Documents are accessible through the City of Clearwater website at address: [www.myclearwater.com/bid](http://www.myclearwater.com/bid). Price of Contract Documents and Plans, as indicated on the DVC Marketing Plan Room, reflects reproduction costs only, which is non-refundable. Bidding Documents may include, but aren't limited to, plans, specifications, bond forms, contract form, affidavits, bid/proposal form and Addendums.
- 1.2. Complete sets of Bidding Documents must be used in preparing bids. Neither the City nor the Engineer shall be liable for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents, by Bidders, sub-bidders or others.

## **2. QUALIFICATION OF BIDDERS**

- 2.1. Each prospective Bidder must pre-qualify to demonstrate, to the complete satisfaction of the City of Clearwater, that the Bidder has the necessary facilities, equipment, ability, financial resources and experience to perform the work in a satisfactory manner. An application package for pre-qualification may be obtained by contacting the City of Clearwater, Engineering Department, P.O. Box 4748, Clearwater, Florida 33758-4748 (mailing address); 100 South Myrtle Avenue, Clearwater, Florida 33756-5520 (street address) or by phone at (727) 562-4750. Pre-qualification requirement information is also available on the City of Clearwater Website at address:

[www.myclearwater.com/government/city-departments/engineering/construction-management](http://www.myclearwater.com/government/city-departments/engineering/construction-management).

Contractors wanting to pre-qualify to bid on a project as a General Contractor must do so two weeks (ten work days) prior to the bid opening date. Bidders currently pre-qualified by the City do not have to make reapplication. It is the Contractor's responsibility to confirm pre-qualification status before a Bid Opening.

The Contractor shall provide copies of the current Contractor License/Registration with the State of Florida and Pinellas County in the bid response.

## **3. EXAMINATION OF CONTRACT DOCUMENTS AND SITE**

- 3.1. It is the responsibility of each Bidder, before submitting a Bid, to (a) examine the Contract Documents thoroughly; (b) visit the site to become familiar with local conditions that may in any manner affect cost, progress, performance or furnishing of the work; (c) consider and abide by all applicable federal, state and local laws, ordinances, rules and regulations; and (d) study and carefully correlate Bidder's observations with the Contract Documents, and notify Engineer in writing of all conflicts, errors or discrepancies in the Contract Documents.
- 3.2. For the purposes of bidding or construction, bidder may rely upon the accuracy of the technical data contained in reports of explorations and tests of subsurface conditions at the site which have been utilized by the Engineer in the preparation of the Contract Documents, but not upon non-technical data, interpretations or opinions contained therein or for the completeness thereof. Drawings relating to physical conditions of existing surface and subsurface conditions (except Underground Facilities) which are at or contiguous to the site and which have been utilized by the Engineer in preparation of the Contract Documents, may be relied upon by Bidder for accuracy of the technical data contained in such drawings but not upon the completeness thereof for the purposes of bidding or construction.

- 3.3. Information and data reflected in the Contract Documents with respect to Underground Facilities at or contiguous to the site are based upon information and data furnished to the City and Engineer by owners of such Underground Facilities or others, and the City does not assume responsibility for the accuracy or completeness thereof unless expressly provided in the Contract Documents.
- 3.4. Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders on subsurface conditions, Underground Facilities, other physical conditions, possible conditions, and possible changes in the Contract Documents due to differing conditions appear in the General Conditions.
- 3.5. Before submitting a Bid, each Bidder shall, at Bidder's own expense, make or obtain any additional examinations, investigations, explorations, tests and studies and obtain any additional information and data which pertain to the physical conditions (surface, subsurface and Underground Facilities) at or contiguous to the site or otherwise which may affect cost, progress, performance or furnishing the work in accordance with the time, price and other terms and conditions of the Contract Documents.
- 3.6. On request in advance, City will provide each Bidder access to the site to conduct such explorations and tests at Bidder's own expense as each Bidder deems necessary for submission of a Bid. Bidder shall fill all holes and clean up and restore the site to its former condition upon completion of such explorations and tests.
- 3.7. The lands upon which the Work is to be performed, rights-of-way and easements for access thereto and other lands designated for use by the Contractor in performing the Work are identified in the Contract Documents. All additional lands and access thereto required for temporary construction facilities or storage of materials and equipment are to be provided by the Contractor. Easements for permanent structures or permanent changes in existing structures are to be obtained and paid for by the City unless otherwise provided in the Contract Documents.
- 3.8. The submission of a Bid will constitute an unequivocal representation by the Bidder that the Bidder has complied with every requirement of these Instructions to Bidders and that, without exception, the Bid is premised upon performing and furnishing the Work required by the Contract Documents by such means, methods, techniques, sequences or procedures of construction as may be indicated in or required by the Contract Documents, and that the Contract Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions of performance and furnishing of the work.

## **4. INTERPRETATIONS AND ADDENDA**

- 4.1. All questions as to the meaning or intent of the Contract Documents are to be directed in writing to the Engineer. Interpretations or clarifications considered necessary by the Engineer in response to such questions will be issued by Addenda, via the Jiffy Reprographics Plan Room to all parties recorded by the Plan Room as plan holders having received the Bidding Documents. Questions received after the time frame specified on the pre-bid meeting agenda, prior to the date for opening of Bids, may not be answered. Only information provided by formal written Addenda will be binding. Oral and other interpretations of clarifications will be without legal effect.
- 4.2. Addenda may also be issued to modify the Bidding Documents as deemed advisable by the City or Engineer.

## **5. BID SECURITY OR BID BOND**

- 5.1. Each Bid must be accompanied by Bid Security made payable to the City of Clearwater in an amount equal to ten percent (10%) of the Bidder's maximum Bid price and in the form of a certified or cashier's check or a Proposal/Bid Bond (on form provided in Section V) issued by a surety meeting the requirements of the General Conditions.
- 5.2. The Bid Security of the Successful Bidder will be retained until such Bidder has executed the Agreement and furnished the required Payment and Performance bonds, whereupon the Bid Security will be returned. If the Successful Bidder fails to execute, deliver the Agreement and furnish the required Bonds within ten (10) days after the award of contract by the City Council, the City may annul the bid and the Bid Security of the Bidder will be forfeited. The Bid Security of any Bidder whom the City believes to have a reasonable chance of receiving the award may be retained by the City until the successful execution of the agreement with the successful Bidder or for a period up to ninety (90) days following bid opening. Security of other Bidders will be returned approximately fourteen (14) days after the Bid Opening.
- 5.3. The Bid Bond shall be issued in the favor of the City of Clearwater by a surety company qualified to do business in, and having a registered agent in, the State of Florida.

## **6. CONTRACT TIME**

- 6.1. The number of consecutive calendar days within which the work is to be completed is set forth in the Technical Specifications.

## **7. LIQUIDATED DAMAGES**

- 7.1. Provisions for liquidated damages are set forth in the Contract Agreement, Section V.

## **8. SUBSTITUTE MATERIAL AND EQUIPMENT**

- 8.1. The contract, if awarded, will be on the basis of material and equipment described in the Drawings or specified in the Specifications without consideration of possible substitute or "or equal" items. Whenever it is indicated in the Drawings or specified in the Specifications that a substitute or "or equal" item may be furnished or used, application for its acceptance will not be considered by the Engineer until after the effective date of the Contract Agreement. The procedure for submittal of any such application is described in the General Conditions and as supplemented in the Technical Specifications.

## **9. SUBCONTRACTORS**

- 9.1. If requested by the City or Engineer, the Successful Bidder, and any other Bidder so requested, shall, within seven (7) days after the date of the request, submit to the Engineer an experience statement with pertinent information as to similar projects and other evidence of qualification for each Subcontractor, supplier, person and organization to be used by the Contractor in the completion of the Work. The amount of subcontract work shall not exceed fifty percent (50%) of the Work except as may be specifically approved by the Engineer. If the Engineer, after due investigation, has reasonable objection to any proposed Subcontractor, supplier, other person or organization, he may, before recommending award of the Contract to the City Council, request the Successful Bidder to submit an acceptable substitute without an increase in Contract Price or Contract Time. If the Successful Bidder declines to make any such substitution, the City may award the contract to the next lowest and most responsive Bidder

that proposes to use acceptable Subcontractors, Suppliers, and other persons and organizations. Declining to make requested substitutions will not constitute grounds for sacrificing the Bid Security to the City of any Bidder. Any Subcontractor, supplier, other person or organization listed by the Contractor and to whom the Engineer does not make written objection prior to the recommendation of award to the City Council will be deemed acceptable to the City subject to revocation of such acceptance after the Effective Date of the Contract Agreement as provided in the General Conditions.

- 9.2. No Contractor shall be required to employ any Subcontractor, supplier, person or organization against whom he has reasonable objection.

## **10. BID/PROPOSAL FORM**

- 10.1. The Bid/Proposal Form is included with the Contract Documents and shall be printed in ink or typewritten. All blanks on the Bid/Proposal Forms must be completed. Unit Prices shall be to no more than two decimal points in dollars and cents. The Bidder must state in the Bid/Proposal Form in words and numerals without delineation's, alterations or erasures, the price for which they will perform the work as required by the Contract Documents. Bidders are required to bid on all items in the Bid/Proposal form. The lump sum for each section or item shall be for furnishing all equipment, materials, and labor for completing the section or item as per the plans and contract specifications. Should it be found that quantities or amounts shown on the plans or in the proposal, for any part of the work, are exceeded or should they be found to be less after the actual construction of the work, the amount bid for each section or item will be increased or decreased in direct proportion to the unit prices bid for the listed individual items.
- 10.2. Bids by corporations shall be executed in the corporate name by the president or a vice-president (or other corporate officer accompanied by evidence of authority to sign) and the corporate seal shall be affixed. The corporate address and state of incorporation shall be shown below the Signature. If requested, the person signing a Bid for a corporation or partnership shall produce evidence satisfactory to the City of the person's authority to bind the corporation or partnership.
- 10.3. Bids by partnerships shall be executed in the partnership name and signed by a general partner, whose title shall appear under the signature and the official address of the partnership shall be shown below the signature.
- 10.4. All names shall be typed or printed below the signature.

## **11. SUBMISSION OF BIDS**

- 11.1. Sealed Bids shall be submitted at or before the time and at the place indicated in the Advertisement for Bids and shall be submitted in a sealed envelope with the project name and number on the bottom left hand corner. If forwarded by mail, the Bid shall be enclosed in another envelope with the notation "Bid Enclosed" on the face thereof and addressed to the City of Clearwater, attention Purchasing Manager. Bids will be received at the office indicated in the Advertisement until the time and date specified. Bids in any other form will not be accepted.
- 11.2. The sealed bid envelope shall contain, but not be limited to, the Proposal/Bid Bond and corresponding Power of Attorney, Affidavit, Non Collusion Affidavit, Proposal (pages one

and two), Addendum Sheet, Bidder's Proposal, and Scrutinized Companies and Business Operations with Cuba and Syria Certification Form.

## **12. MODIFICATION AND WITHDRAWAL OF BIDS**

- 12.1. Bids may be modified or withdrawn by an appropriate document duly executed (in the manner that a Bid must be executed) and delivered as described in the Advertisement of Bids. A request for withdrawal or a modification shall be in writing and signed by a person duly authorized to do so. Withdrawal of a Bid will not prejudice the rights of a Bidder to submit a new Bid prior to the Bid Date and Time. After expiration of the period for receiving Bids, no Bid may be withdrawn or modified.
- 12.2. After a bid is received by the City, the bidder may request to modify the bid for typographical or scrivener's errors only. The bidder must state in writing to the City that a typographical or scrivener's error has been made by the bidder, the nature of the error, the requested correction of the error, and what the adjusted bid amount will be if the correction is accepted by the City. The City reserves the right at its sole discretion to accept, reject, or modify any bid.

## **13. REJECTION OF BIDS**

- 13.1. To the extent permitted by applicable State and Federal laws and regulations, the City reserves the right to reject any and all Bids, and to waive any and all informalities. Grounds for the rejection of a bid include but are not limited to a material omission, unauthorized alteration of form, unauthorized alternate bids, incomplete or unbalanced unit prices, or irregularities of any kind. Also, the City reserves the right to reject any Bid if the City believes that it would not be in the best interest of the public to make an award to that Bidder, whether because the Bid is not responsive or the Bidder is unqualified or of doubtful financial ability or fails to meet any other pertinent standard or criteria established by the City. The City reserves the right to decide which bid is deemed to be the lowest and best in the interest of the public.

## **14. DISQUALIFICATION OF BIDDER**

- 14.1. Any or all bids will be rejected if there is any reason for believing that collusion exists among the bidders, the participants in such collusion will not be considered in future proposals for the same work. Each bidder shall execute the Non-Collusion Affidavit contained in the Contract Documents.

## **15. OPENING OF BIDS**

- 15.1. Bids will be opened and read publicly at the location and time stated in the Advertisement for Bids. Bidders are invited to be present at the opening of bids.

## **16. LICENSES, PERMITS, ROYALTY FEES AND TAXES**

- 16.1. The Contractor shall secure all licenses and permits (and shall pay all permit fees) except as specifically stated otherwise in the Technical Specifications. The Contractor shall comply with all Federal and State Laws, County and Municipal Ordinances and regulations, which in any manner effect the prosecution of the work. City of Clearwater building permit fees and impact fees will be waived except as specifically stated otherwise in the Technical Specifications.

- 16.2. The Contractor shall assume all liability for the payment of royalty fees due to the use of any construction or operation process, which is protected by patent rights except as specifically stated otherwise in the Technical Specifications. The amount of royalty fee, if any, shall be stated by the Contractor.
- 16.3. The Contractor shall pay all applicable sales, consumer, use and other taxes required by law. The Contractor is responsible for reviewing the pertinent State Statutes involving the sales tax and sales tax exemptions and complying with all requirements.
- 16.4. The City of Clearwater is exempt from state sales tax on materials purchased by the City and incorporated into the WORK. The City of Clearwater reserves the right to implement the Owner Direct Purchase (ODP) Option, as may be indicated in the Scope of Work Description in Section IV – Technical Specifications and as defined in Section III – General Conditions.

## **17. IDENTICAL TIE BIDS/VENDOR DRUG FREE WORKPLACE**

- 17.1. In accordance with the requirements of Section 287.087 Florida Statutes regarding a Vendor Drug Free Workplace, in the event of identical tie bids, preference shall be given to bidders with drug-free workplace programs. Whenever two or more bids which are equal with respect to price, quality, and service are received by the City 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 or all of the tied bidders have a drug-free workplace program. In order to have a drug-free workplace program, a contractor shall supply the City with a certificate containing the following six statements and the accompanying certification statement:
  - (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 as to the dangers of drug abuse in the workplace, the business's policy of maintaining a drug-free workplace, any available drug counseling, rehabilitation, and employee assistance programs, and the penalties that may be imposed upon employees for drug abuse 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 of 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.

I certify that this firm does/does not (select only one) fully comply with the above requirements.

## **18. AWARD OF CONTRACT**

- 18.1. Discrepancies between words and figures will be resolved in favor of words. Discrepancies in 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.
- 18.2. In evaluating the Bids, the City will consider the qualifications of the Bidders, whether or not the Bids comply with the prescribed requirements, unit prices, and other data as may be requested in the Bid/Proposal form. The City may consider the qualifications and experience of Subcontractors, suppliers and other persons and organizations proposed by the Contractor for the Work. The City may conduct such investigations as the City deems necessary to assist in the evaluation of any Bid and to establish the responsibility, qualifications and financial ability of Bidders, proposed Subcontractors, Suppliers and other persons, and organizations to perform and furnish the Work in accordance with the Contract Documents to the City's satisfaction within the prescribed time.
- 18.3. If the Contract is to be awarded, it will be awarded to the lowest responsible, responsive Bidder whose evaluation by the City indicates to the City that the award will be in the best interest of the City.
- 18.4. Award of contract will be made for that combination of base bid and alternate bid items in the best interest of the City, however, unless otherwise specified all work awarded will be awarded to only one Contractor.
- 18.5. The successful bidder/contractor will be required to comply with Section 119.0701, Florida Statutes (2014), specifically to:
  - (a) Keep and maintain public records that ordinarily and necessarily would be required by the City of Clearwater in order to perform the service;
  - (b) Provide the public with access to public records on the same terms and conditions that the City of Clearwater would provide the records and at a cost that does not exceed the cost provided in this chapter or as otherwise provided by law;
  - (c) Ensure that public records that are exempt or confidential and exempt from public records disclosure requirements are not disclosed except as authorized by law; and
  - (d) Meet all requirements for retaining public records and transfer, at no cost, to the City of Clearwater all public records in possession of the contractor upon termination of the contract and destroy any duplicate public records that are exempt or confidential and exempt from public records disclosure requirements. All records stored electronically must be provided to the public agency in a format that is compatible with the information technology systems of the City of Clearwater.

## **19. BID PROTEST**

### **19.1. RIGHT TO PROTEST:**

Any actual bidder who is aggrieved in connection with the solicitation or award of a contract may seek resolution of his/her complaints initially with the Purchasing Manager, and if not satisfied, with the City Manager, in accordance with protest procedures set forth in this section.

**19.2. PROTEST PROCEDURE:**

- A. A protest with respect to the specifications of an invitation for bid or request for proposal shall be submitted in writing a minimum of five (5) work days prior to the opening of the bid or due date of the request for proposals, unless the aggrieved person could not have been reasonably expected to have knowledge of the facts giving rise to such protest prior to the bid opening or the closing date for proposals. Opening dates for bids or due dates for requests for proposal will be printed on the bid/request document itself.
- B. Protests in respect to award of contract shall be submitted in writing a maximum of five (5) work days after notice of intent to award is posted, or is mailed to each bidder, whichever is earlier. Notice of intent to award will be forwarded to bidders upon telephonic or written request. Protests of recommended award should cite specific portions of the City of Clearwater Code of Ordinances that have allegedly been violated.
- C. Exceptions to the five (5) day requirements noted in both A and B above may be granted if the aggrieved person could have not been reasonably expected to have knowledge of the facts giving rise to such protest prior to the bid opening, posting of intent to award, or due date for requests for proposals. Request for exceptions should be made in writing, stating reasons for the exception.
- D. The Purchasing Manager shall respond to the formal written protest within five (5) work days of receipt. The Purchasing Manager's response will be fully coordinated with the appropriate Department Director and the Assistant City Manager.
- E. If the protestor is not satisfied with the response from the Purchasing Manager, he/she may then submit in writing within five (5) work days of receipt of that response his/her reason for dissatisfaction, along with copies of his/her original formal protest letter and the response from the Purchasing Manager, to the City Manager.
- F. The City Manager as Purchasing Agent for the City has the final authority in the matter of protests. The City Manager will respond to the protestor within ten (10) work days of receipt of the appeal.

**19.3. PROTEST FEE:**

When filing a formal protest, the protesting vendor must include a fee in the amount of 5% of the selected vendor's total bid to offset the City's additional expenses related to the protest. This fee shall not exceed \$2,500 nor be less than \$50. If either the Purchasing Manager or the City Manager upholds the protest, the City will refund 100% of the fee paid.

**19.4. STAY OF PROCUREMENT DURING PROTEST:**

In the event of a timely protest, the Purchasing Manager shall not proceed with the solicitation or award of contract until all administrative remedies have been exhausted or until the City Manager makes written determination that the award of contract without delay is necessary to protect the best interest of the City.

**20. TRENCH SAFETY ACT**

- 20.1. The Bidder shall comply with the provisions of the City of Clearwater's Ordinance related to trench digging (Ordinance No. 7918-08) along with the Florida Trench Safety Act (Sections 553.60-553.64, Florida Statutes) and the provisions of the Occupational Safety

and Health Administration's (OSHA) excavation safety standards, 29 C.F.R.s 1926.650 Subparagraph P, or current revisions of these laws.

## **21. CONSTRUCTION SITE EROSION AND SEDIMENT CONTROL MANAGEMENT MEASURES**

- 21.1. The Bidder shall comply with the provisions of the Environmental Protection Agency (EPA) National Pollution Discharge Elimination System (NPDES) stormwater permit and implement stormwater pollution prevention plans (SWPPP's) or stormwater management programs (both using best management practices (BMPs) that effectively reduce or prevent the discharge of pollutants into receiving waters.
- A. The control of construction-related sediment loadings is critical to maintaining water quality. The implementation of proper erosion and sediment control practices during the construction stage can significantly reduce sediment loadings to surface waters.
  - B. Prior to land disturbance, prepare and implement an approved erosion and sediment control plan or similar administrative document that contains erosion and sediment control provisions.

NPDES Management Measures available at City of Clearwater Engineering Environmental Division and EPA websites to help address construction-related Best Management Practices.

# SECTION III

## GENERAL CONDITIONS

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# 1. DEFINITIONS

## *Addenda*

Written or graphic instruments issued prior to the opening of Bids which clarify, correct or change the Bidding Requirements or the contract documents.

## *Agent*

Architect, engineer or other outside agency, consultant or person acting on behalf of the City.

## *Agreement*

The written contract between Owner and Contractor covering the Work to be performed; other Contract Documents are attached to the Agreement and made a part thereof as provided therein.

## *Application for Payment*

The form accepted by Engineer which is to be used by Contractor in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

## *Approve*

The word approve is defined to mean satisfactory review of the material, equipment or methods for general compliance with the design concepts and with the information given in the Contract Documents. It does not imply a responsibility on the part of the Engineer to verify in every detail conformance with the Drawings and Specifications.

## *Bid*

The offer or proposal of the bidder submitted on the prescribed form setting forth the prices for the work to be performed.

## *Bidding Documents*

The advertisement or invitation to Bid, instructions to bidders, the Bid form, and the proposed Contract Documents (including all Addenda issued prior to receipt of Bids).

## *Bonds*

Performance and payment bonds and other instruments of security.

## *Change Order*

A written order to Contractor signed by Owner and Contractor authorizing an addition, deletion or revision in the Work, or an adjustment in the Contract Price or the Contract Time issued on or after the effective date of the Agreement.

## *City*

The City of Clearwater, Pinellas County, Florida.

## *Construction Inspector*

A person who is the authorized representative of the Construction Manager and inspects City construction projects in order to insure the Contractor's work complies with the intent of the Contract Documents.

## *Construction Manager*

The person who is typically in responsible charge of City construction projects. The Construction Manager assumes responsibility for the management of construction contracts at the Preconstruction Conference. The Construction Manager chairs the

### SECTION III – General Conditions

Preconstruction Conference and is the authority on any disputes or decisions regarding contract administration and performance. The Construction Manager typically acts as the Owner's Representative during construction.

#### *Contract Documents*

The Agreement, Addenda (which pertain to the Contract Documents), Contractor's Bid (including documentation accompanying the bid and any post-Bid documentation submitted prior to the execution of the Agreement) when attached as an exhibit to the Agreement, the Bonds, Instructions to Bidders, these General Conditions, any Supplementary Conditions, the Specifications and the Drawings, any other exhibits identified in the Agreement, together with all Modifications issued after the execution of the Agreement.

#### *Contract Price*

The Contract price constitutes the total compensation (subject to authorized adjustments) payable by Owner to Contractor for performing the Work.

#### *Contract Time*

The number of days or the date stated in the Agreement for the completion of the Work.

#### *Contractor*

The Person with whom the Owner has entered into the Agreement. For the purposes of this contract, the person, firm or corporation with whom this contract or agreement has been made by the City of Clearwater or its duly authorized representative.

#### *Critical Path Method Construction Schedule—CPM*

A graphic format construction schedule that displays construction activities as they relate to one another for the purpose of identifying the most efficient way to perform the work in a timely manner. The critical path identifies which activity is critical to the execution of the schedule.

#### *Day*

A calendar day of twenty-four (24) hours measured from midnight to the next midnight.

#### *Defective*

An adjective which when modifying the word Work refers to Work that is unsatisfactory, faulty or deficient, or does not conform to the Contract Documents or does not meet the requirements of any inspection, reference standard, test or approval referred to in the Contract Documents, or has been damaged prior to Engineers recommendation of final payment.

#### *Drawings*

The drawings, which will be identified in Technical Specifications or the Agreement, which show the character and scope of the Work to be performed and which have been prepared or approved by Engineer and are referred to in the contract documents. Shop drawings are not Drawings as so defined.

#### *Engineer*

The duly appointed representative of the City Manager of the City of Clearwater. For the purposes of this contract, the City Engineer of the City of Clearwater, Pinellas County, Florida, or his authorized representative. For certain projects, the Engineer may serve as the Owner's Representative during construction.

*Engineer's Consultant*

A Person having a contract with Engineer to furnish services as Engineer's independent professional associate or consultant with respect to the Project and who is identified as such in the Supplementary Conditions.

*F.D.O.T Specifications*

The Standard Specifications for Road and Bridge Construction as issued by the Florida Department of Transportation (latest English edition).

*Furnish*

The words "furnish", "furnish and install", "install", and "provide" or words of similar meaning shall be interpreted, unless otherwise specifically stated, to mean "furnish and install complete in place and ready for service".

*Inspection*

The term "inspection" and the act of inspecting means examination of construction to ensure that it conforms to the design concept expressed in the Drawings and Specifications. These terms shall not be construed to mean supervision, superintending or overseeing.

*Laws and Regulations*

Any and all applicable laws, rules, regulations, ordinances, codes and orders of any kind of governmental bodies, agencies, authorities and courts having jurisdiction.

*Liens*

Liens, charges, security interests or encumbrances upon real property or personal property.

*Milestone*

A principal event specified in the contract Documents relating to an intermediate completion date or time prior to the final completion date.

*Notice to Proceed (NTP)*

A written notice given by the Owner to the Contractor fixing the date on which the Contract Time will commence to run and on which Contractor shall start to perform his obligations under the Contract Documents.

*Owner*

The City of Clearwater, Florida. For the purposes of this contract, the person who is the City's authorized representative from the City's Department with whom will be responsible for the maintenance and operation of the Work once the Work is completed. For certain projects, a designee of the Owner may serve as the Owner's Representative during construction.

*Owner's Representative*

Designee of the Owner with authority to act on behalf of the Owner during construction.

*Person*

A natural person, or a corporation, partnership, firm, organization, or other artificial entity.

*Project*

The total construction of which the Work to be provided under the Contract Documents may be the whole or a part as indicated elsewhere in the Contract Documents.

*Partial Utilization*

Use by Owner of a substantially completed part of the Work for the purpose for which is intended (or a related purpose) prior to Final Completion of all the Work.

*Representative of Contractor*

The Contractor shall assign a responsible person or persons, one of whom shall be at the construction site at all times that work is progressing. The names and positions of these persons shall be submitted to the City Engineer at the time of the pre-construction conference. This person or persons shall not be changed without written approval of City Engineer.

*Request for Information (RFI)*

An official written request for clarification of the intent of the contract documents from the Contractor to the Engineer.

*Shop Drawing*

All drawings, diagrams, illustrations, schedules and other data which are specifically prepared by or for Contractor to illustrate some portion of the Work and all illustrations, brochures, standard schedules, performance charts, instructions, diagrams and other information prepared by a supplier and submitted by Contractor to illustrate material or equipment for some portion of the Work.

*Specifications*

Those portions of the Contract Documents consisting of written technical descriptions of materials, equipment, construction systems, standards and workmanship as applied to the Work and certain administrative details applicable thereto.

*Subcontractor*

A person having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work at the site.

*Substantial Completion*

The Work (or a specified part thereof) which has progressed to the point where, in the opinion of Engineer, as evidenced by Engineer's definitive certificate of Substantial Completion, it is sufficiently complete, in accordance with the Contract documents, so that the Work (or specified part) can be utilized for the purposes for which it is intended; or if no such certificate is issued, when the Work is complete and ready for final payment as evidenced by the Engineer's recommendation of final payment. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

*Supplementary Conditions*

The part of the Contract which amends or supplements these General Conditions.

*Supplier*

A manufacturer, fabricator, supplier, distributor, material man or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by the Contractor.

*Surety*

Any person, firm or corporation which is bound with Contractor and which engages to be responsible for Contractor and his acceptable performance of the Work by a Bid, Performance or Payment Bond.

*Underground Facilities*

All pipelines, conduits, ducts, cables, wires manholes, vaults, tanks, tunnels or other such facilities or attachments, and any encasements containing such facilities which have been

installed underground to furnish any of the following services or materials: electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, sewage and drainage removal or treatment, traffic or other control systems or water.

*Unit Price Work*

Work to be paid for on the basis of unit prices.

*Work*

The entire completed construction or the various separately identifiable parts thereof required to be furnished under the Contract Documents. Work includes and is the result of performing or furnishing labor and incorporating materials and equipment into the construction, and performing or furnishing services and furnishing documents, all as required by the Contract Documents.

*Work Change Directive*

A written directive to Contractor, issued on or after the Effective Date of the Agreement and signed by the Engineer, ordering an addition, deletion, or revision in the Work, or responding to differing or unforeseen physical conditions under which the Work is to be performed or emergencies. Work Change Directive will not change the Contract Price or Contract Time but is evidence that the parties expect that the change directed or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.

## **2. PRELIMINARY MATTERS**

### **2.1. DELIVERY OF BONDS AND CERTIFICATES OF INSURANCE**

When Contractor delivers the executed Agreements to the Owner, Contractor shall also deliver to the Owner such Bonds and Certificates of Insurance as Contractor may be required to furnish by this contract.

### **2.2. COPIES OF DOCUMENTS**

Engineer shall furnish to Contractor one (1) copy of Contract Documents for execution. Additional copies will be furnished, upon request, at the cost of reproduction.

### **2.3. COMMENCEMENT OF CONTRACT TIME/NOTICE TO PROCEED; STARTING THE PROJECT**

The Contract Time will commence on the day indicated in the Notice to Proceed. Contractor shall start to perform the work on the date the Contract Time commences to run. No work shall be done at the site prior to the date that the Contract Time commences to run. Pursuant to Section 255.05(1)(b), Florida Statutes, the Notice to Proceed cannot be issued until Contractor provides City with a certified copy of the recorded bond issued by the Pinellas County Clerk of Court.

## **2.4. BEFORE STARTING CONSTRUCTION**

Before undertaking each part of the Work, Contractor shall carefully study and compare the Contract Documents and check and verify pertinent figures shown thereon and all applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error or discrepancy which Contractor may discover; and shall obtain a written interpretation or clarification from Engineer before proceeding with any work effected thereby; however, Contractor shall not be liable to the Owner for failure to report any conflict, error or discrepancy in the Drawings or Specifications, unless Contractor had actual knowledge thereof or should reasonably have known thereof.

No verbal agreement or conversation with any officer, Agent or employee of the Owner or Engineer's Consultant, either before or after the execution of this Contract, shall affect or modify any of the terms or obligations herein contained. Contractor shall not commence any work at any time without approved insurance required by these General Conditions. Failure to obtain this insurance will be the sole responsibility of the Contractor.

## **2.5. PRECONSTRUCTION CONFERENCE**

After Contract has been fully executed and before the start of the Work, the Owner's Representative shall schedule a preconstruction conference to be attended by Contractor, Engineer, Owner and others as appropriate to establish a working understanding among the parties as to the Work and to discuss the schedule of the Work and general Contract procedures.

The Contractor shall submit to the Owner's Representative prior to the Notice to Proceed, a color Critical Path Method (CPM) Construction Schedule. This is to be a sequence of events including submittal review and procurement. Notice to Proceed is usually established at the preconstruction conference and such date can be inserted into the schedule at that time. The Contractor shall also submit a Submittal Schedule for review by the Engineer. This is to make sure that the list is complete, and this schedule shall be the basis of a Submittal Log.

The Contractor shall submit to the Owner's Representative prior to the Notice to Proceed, a completed Emergency Call List, a completed Authorized Signature List, and Verification of Illegal Discharge Construction Site Training.

## **2.6. PROGRESS MEETINGS**

The Contractor is required to attend Progress Meetings. These meetings will be scheduled on a weekly, bi-weekly, or monthly basis depending on the needs of the project. The Contractor shall bring to each meeting an updated submittal log, an updated request for information (RFI) log, a look-ahead schedule to cover the project activity from the current meeting to the next meeting, and all material test reports generated in the same time period.

# **3. CONTRACT DOCUMENTS, INTENT**

## **3.1. INTENT**

The Contract Documents comprise the entire Agreement between Owner and the Contractor concerning the Work. They may be altered only by written agreement. The Contract Documents are complementary; what is called for by one is as binding as if called for by all. It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be

constructed in accordance with the Contract Documents. Any Work, materials or equipment which may reasonably be inferred from the Contract Documents or from prevailing custom or from trade usage as being required to produce the intended result will be furnished and performed whether or not specifically called for. When words or phrases, which have a well-known technical or construction industry or trade meaning, are used to describe Work, materials or equipment, such words or phrases shall be interpreted in accordance with that meaning. Clarifications and interpretations of the Contract Documents shall be issued by the Owner's Representative. Reference to standards, specifications, manuals or codes of any technical society, organization or association, or to the code, Laws or Regulation of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard specification, manual or code, or Laws or Regulations in effect at the time of opening of Bids except as may be otherwise specifically stated in the Contract Documents. However, no provision of any referenced standard specification, manual or code, whether or not specially incorporated by reference in the responsibilities of Owner or Contractor as set forth in the Contract Documents, shall change the duties and responsibilities of Owner, Contractor, Engineer or Owner's Representative, or any of their Agents or employees from those set forth in the Contract Documents. Clarifications and interpretations of the Contract shall be issued by the Owner's Representative. Each and every provision of law and clause required by law to be inserted in these Contract documents shall be deemed to be inserted herein, and they shall be read and enforced as though it were included herein, and if through mistake or otherwise, any such provision is not inserted, or if not correctly inserted, then upon the application of either party, the Contract Documents shall forthwith be physically amended to make such insertion.

### **3.2. REPORTING AND RESOLVING DISCREPANCIES**

If, during the performance of the Work, Contractor discovers any conflict, error, ambiguity or discrepancy within the Contract Documents or between the Contract Documents and any provision of any such Law or Regulation applicable to the performance of the Work or of any such standard, specification, manual or code or of any instruction of any Supplier, Contractor shall report it to the Owner's Representative in writing at once, and Contractor shall not proceed with the Work affected thereby (except in an emergency) until an amendment or supplement to Contract Documents has been issued by one of the methods provided in these General Specifications, provided however, that Contractor shall not be liable to Owner, or Owner's Representative for failure to report any such conflict, error, ambiguity or discrepancy unless Contractor knew or reasonably should have known thereof.

## **4. AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; REFERENCE POINTS**

### **4.1. AVAILABILITY OF LANDS**

The Owner shall furnish, as indicated in the Contract Documents, the lands upon which the Work is to be Performed, rights-of-way, easements, rights of entry for access thereto, and such other lands which are designated for the use of contractor. The Owner shall identify any encumbrances or restrictions not of general application but specifically related to use of lands so furnished with which contractor will have to comply in performing the Work. Easements for permanent structures or permanent changes in existing facilities will be obtained and paid for by the Owner, unless otherwise provided in the Contract Documents.

## **4.2. INVESTIGATIONS AND REPORTS**

Reference is made to the Supplementary Conditions and Technical Specifications for identification of those reports of investigations and tests of subsurface and latent physical conditions at the site or otherwise affecting cost, progress or performance of the Work which have been relied upon by Engineer in preparation of the Drawings and Specifications. Such reports are not guaranteed as to accuracy or completeness and are not part of the Contract Documents. Contractor shall promptly notify the Owner's Representative in writing of any subsurface or latent physical conditions at the site, or in an existing structure, differing materially from those indicated or referred to in the Contract Documents. Engineer will promptly review those conditions and advise if further investigation or tests are necessary. Owner or Engineer shall obtain the necessary additional investigations and tests and furnish copies to the Engineer and Contractor. If Engineer finds that the results of such investigations or tests indicate that there are subsurface or latent physical conditions, which differ materially from those, indicated in the contract Documents, and which could not reasonably have been anticipated by Contractor, a work change, or Change Order will be issued incorporating the necessary revisions.

## **4.3. PHYSICAL CONDITIONS, UNDERGROUND FACILITIES**

The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities or by others. Unless otherwise expressly provided in the Contract Documents, Owner and Engineer shall not be responsible for the accuracy or completeness of any such information or data; and the cost of all the following will be included in the Contract Price and contractor shall have full responsibility for: (i) reviewing and checking all such information and data, (ii) locating all Underground Facilities shown or indicated in the Contract Documents, (iii) coordination of the Work with the owners of such Underground Facilities during construction, and (iv) the safety and protection of all such Underground Facilities and repairing any damage thereto resulting from the Work. The Contractor is required to call the Sunshine State One Call of Florida prior to any excavation per State regulations and to notify any utility owners who are not a member of the Sunshine State One Call of Florida prior to any excavation. The Sunshine State One Call of Florida is an agency for the protection and location of utilities prior to any excavation and contact number is available in local telephone directory.

## **4.4. REFERENCE POINTS**

Engineer shall provide engineering surveys to establish reference points for construction, which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, unless otherwise noted in the Contract, shall protect and preserve the established reference points and shall make no changes or relocations without the prior written approval of the Owner and Engineer. Contractor shall report to Engineer whenever any reference point 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 by a surveyor licensed in the State of Florida. The Contractor is referred to the Technical Specifications for more specific information regarding the provision of construction surveys. If a City survey crew is assigned to the project and there is excessive stake replacement caused by negligence of Contractor's forces after initial line and grade have been set, as determined by the Engineer, the Contractor will be charged at the rate of \$100.00 per hour. Time shall be computed for actual time on the project. All time shall be computed in one-hour increments with a minimum charge of one hour.

## 5. BONDS AND INSURANCE

### 5.1. PERFORMANCE AND PAYMENT BOND/CONTRACT BOND

Contractor shall furnish a Performance and Payment Bond pursuant to Section 255.05, Florida Statutes in an amount equal to the Contract Price as security for the faithful performance and payment of all Contractor's obligations under the Contract Documents. This bond shall remain in effect at least one year after the date when final payment becomes due, unless a longer period of time is prescribed by laws and regulations or by the Contract Documents. Contractor shall also furnish such other Bonds as are required by the Supplementary Conditions. All Bonds shall be in the form prescribed by the Contract Documents in Section V and shall be executed by such sureties as are named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Audit Staff, Bureau of Government Financial Operations, U.S. Treasury Department. All bonds signed by an agent must be accompanied by a certified copy of such agents' authority to act. All bonds shall be deemed to contain all of the Conditions of Section 255.05, Florida Statutes, even if such language is not directly contained within the bond and the Surety shall be licensed and qualified to do business in the State of Florida. Owner reserves the right to reject any surety. If the Surety on any Bond furnished by the Contractor is declared bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of these Contract Documents, the Contractor shall within five days after notice thereof substitute another Bond and surety, both of which must be acceptable to Owner.

### 5.2. INSURANCE REQUIREMENTS

The Contractor shall, at its own cost and expense, acquire and maintain (and cause any subcontractors, representatives or agents to acquire and maintain) during the term with the City, sufficient insurance to adequately protect the respective interest of the parties. Coverage shall be obtained with a carrier having an AM Best Rating of A-VII or better. In addition, the City has the right to review the Contractor's deductible or self-insured retention and to require that it be reduced or eliminated.

Specifically, the Contractor must carry the following minimum types and amounts of insurance on an occurrence basis or in the case of coverage that cannot be obtained on an occurrence basis, then coverage can be obtained on a claims-made basis with a minimum four (4) year tail following the termination or expiration of this Agreement:

The following insurance limits may be achieved by a combination of primary and umbrella/excess liability policies.

#### 5.2.1. COMMERCIAL GENERAL LIABILITY INSURANCE

Commercial General Liability Insurance coverage, including but not limited to, premises operations, products/completed operations, products liability, contractual liability, advertising injury, personal injury, death, and property damage in the minimum amount of \$1,000,000 (one million dollars) per occurrence and \$2,000,000 (two million dollars) general aggregate.

## **5.2.2. COMMERCIAL AUTOMOBILE LIABILITY INSURANCE**

Commercial Automobile Liability Insurance coverage for any owned, non-owned, hired or borrowed automobile is required in the minimum amount of \$1,000,000 (one million dollars) combined single limit.

## **5.2.3. WORKERS' COMPENSATION AND EMPLOYER'S LIABILITY INSURANCE**

Statutory Workers' Compensation Insurance coverage in accordance with the laws of the State of Florida, and Employer's Liability Insurance in the minimum amount of \$100,000 (one hundred thousand dollars) each employee each accident, \$100,000 (one hundred thousand dollars) each employee by disease and \$500,000 (five hundred thousand dollars) aggregate by disease with benefits afforded under the laws of the State of Florida. Coverage should include Voluntary Compensation, Jones Act, and U.S. Longshoremen's and Harbor Worker's Act coverage where applicable. Coverage must be applicable to employees, contractors, subcontractors, and volunteers, if any.

## **5.2.4. PROFESSIONAL LIABILITY/MALPRACTICE/ERRORS OR OMISSIONS INSURANCE**

Professional Liability/Malpractice/Errors or Omissions Insurance coverage appropriate for the type of business engaged in by the Contractor with minimum limits of \$1,000,000 (one million dollars) per occurrence. If a claims-made form of coverage is provided, the retroactive date of coverage shall be no later than the inception date of claims-made coverage, unless prior policy was extended indefinitely to cover prior acts. Coverage shall be extended beyond the policy year either by a supplemental extended reporting period (ERP) of as great a duration as available, and with no less coverage and with reinstated aggregate limits, or by requiring that any new policy provide a retroactive date no later than the inception date of claims-made coverage.

## **5.2.5. CONTRACTOR'S EQUIPMENT/INLAND MARINE/PROPERTY INSURANCE**

If Contractor is using its own property in connection with the performance of its obligations under this Agreement, then Contractor's Equipment–Inland Marine Insurance and/or Property Insurance on an "All Risks" basis with replacement cost coverage for property and equipment in the care, custody and control of others is recommended. City is not responsible for Contractor's (or any sub-contractors, representatives, or agents) equipment or property.

## **5.2.6. BUILDER'S RISK INSURANCE**

The City will provide at its expense, Builder's Risk Insurance for the project to cover all risks of loss in the complete and full value of the project. Contractor agrees to cooperate in a timely manner with providing any information or documentation required for the application and by the carrier as the project proceeds.

## **5.3. OTHER INSURANCE PROVISIONS**

Upon approval of this Agreement by City Council, and then annually upon the anniversary date(s) of the insurance policy's renewal date(s) for as long as this Agreement remains in effect, the Contractor will furnish the City with a Certificate of Insurance(s) (using appropriate ACORD

certificate, SIGNED by the Issuer, and with applicable endorsements) evidencing all of the coverage set forth above and naming the City as an “Additional Insured.” In addition when requested in writing from the City, Contractor will provide the City with certified copies of all applicable policies. The address where such certificates and certified policies shall be sent or delivered is as follows:

City of Clearwater  
Engineering Department  
Attn: Construction Office Specialist  
P.O. Box 4748  
Clearwater, FL 33758-4748

1. The **Description** (of Operations/Locations/Vehicles) should specify Project Name and Project Number.
2. Contractor shall provide thirty (30) days written notice of any cancellation, non-renewal, termination, material change or reduction in coverage.
3. Contractor’s insurance as outlined above shall be primary and non-contributory coverage for Contractor’s negligence.
4. Contractor reserves the right to appoint legal counsel to provide for the Contractor’s defense, for any and all claims that may arise related to Agreement, work performed under this Agreement, or to Contractor’s design, equipment, or service. Contractor agrees that the City shall not be liable to reimburse Contractor for any legal fees or costs as a result of Contractor providing its defense as contemplated herein.

The stipulated limits of coverage above shall not be construed as a limitation of any potential liability to the City, and the City’s failure to request evidence of this insurance shall not be construed as a waiver of Contractor’s (or sub-contractors, representatives, or agents) obligation to provide the insurance coverage specified.

## 5.4. WAIVER OF RIGHTS

The Owner and Contractor intend that all policies purchased in accordance with Article on Insurance will protect the Owner, Contractor, Subcontractors, Engineer, Engineer's Consultants and all other persons or entities identified in the Supplementary Conditions to be listed as insured or additional insured in such policies and will provide primary coverage for all losses and damages caused by the perils covered thereby. All such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any of the insured or additional insured thereunder, the Owner and Contractor waive all rights against each other and their respective officers, directors, employees and agents for all losses and damages caused by, arising out of or resulting from any of the perils covered by such policies and any other property insurance applicable to the work; and, in addition, waive all such rights against Sub-contractors, Engineer, Engineer's Consultants and all other persons or entities identified in the Supplementary Conditions to be listed as insured or additional insured under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance otherwise payable under any policy so issued. In addition, the Owner waives all rights against Contractor, Subcontractors, Engineer, Engineer's Consultant and the officers, directors, employees and agents of any of them for: (i) loss due to business interruption, loss of use or other consequential loss extending beyond direct physical loss or damage to the Owner property or the Work caused by, arising out of or resulting from fire or other peril, whether or not insured by the Owner and; (ii) loss or damage to the completed Project or part thereof caused by, arising out of or resulting from fire or other insured

peril covered by any property insurance maintained on the completed Project or part thereof by the Owner during partial utilization, after substantial completion or after final payment.

## **6. CONTRACTORS RESPONSIBILITIES**

### **6.1. SUPERVISION AND SUPERINTENDENCE**

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

Contractor shall be responsible to see that the completed work complies accurately with the Contract Documents. Contractor shall keep on the work at all times during its progress a competent resident superintendent, who shall not be replaced without notice to the Owner's Representative except under extraordinary circumstances. The superintendent will be Contractor's representative at the site and shall have authority to act on behalf of Contractor. All communications to the superintendent shall be as binding as if given to Contractor. The Contractor's superintendent shall keep a mobile cell phone on his person, so he can be contacted whenever necessary.

Contractor shall employ only competent persons to do the work and whenever the Owner's Representative shall notify Contractor, in writing, that any person on the work appears to be incompetent, unfaithful, disorderly, disrespectful or otherwise unsatisfactory, such person shall be removed from the project and shall not again be employed on it except with the written consent of the Owner's Representative. Contractor represents the City of Clearwater and shall conduct themselves in a professional manner to the public at all times.

Contractor shall reimburse Owner for additional engineering and inspection costs incurred as a result of overtime work in excess of the regular working hours or on the Owner normally approved holidays. At such times when Inspector overtime is required, the Contractor shall sign an overtime slip documenting such hours and the Contractor shall be provided a copy for his records. At the end of the project and prior to payment of withheld retainage funds, the Contractor shall deliver to the Owner a check made out to the Owner of Clearwater for full reimbursement of all Inspector overtime hours. Withheld retainage shall not be released until the Owner has received this check. Minimum number of chargeable hours for inspection costs on weekends or holidays shall be four hours. The cost of overtime inspection per hour shall be \$80.00 per hour.

Contractor shall provide and maintain in a neat and sanitary condition, such sanitary accommodations for the use of Contractor's employees as may be necessary to comply with the requirements of Laws and Regulations and the Engineer.

### **6.2. LABOR, MATERIALS AND EQUIPMENT**

Contractor shall provide competent, suitably qualified personnel to survey, lay out and construct the work as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the site. 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 indicated in the Contract Documents, all work at the site shall be performed during regular working hours.

Contractor shall adhere to the Community Development Code, Section 3-1508 regarding noise restrictions from 6:00 p.m. to 7:00 a.m. any day and all day Sunday. Contractor will not permit overtime work or the performance of work on Saturday, Sunday, or any legal holiday without Owner consent given after prior notice to Engineer.

Unless otherwise specified in the General Requirements, Contractor shall furnish and assume full responsibility for all 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 furnishing, performance, testing, start-up and completion of the Work.

All materials and equipment installed in the Work shall be of good quality and new, except as otherwise provided in the Contract Documents. If required by Engineer, Contractors shall furnish satisfactory evidence (including reports of required tests) as to the quality of materials and equipment. The Contractor shall provide suitable and secure storage for all materials to be used in the Work so that their quality shall not be impaired or injured. Materials that are improperly stored, may be rejected by the Engineer without testing.

All materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned in accordance with the instructions of the applicable manufacturer, fabricator, supplier, or distributor, except as otherwise provided in the Contract Documents.

The City of Clearwater, at its sole discretion, reserves the right to purchase major equipment or materials to be incorporated into the Work under the Owner Direct Purchase (ODP) Option, per Section III, Article 21. In such event, the Contractor shall cooperate and assist the Owner of Clearwater, at no additional cost, to implement the ODP documents and procedures.

### **6.3. SUBSTITUTES AND "OR EQUAL" ITEMS**

Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent or "or equal" item or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be accepted by Engineer. If in Engineer's sole discretion an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by Engineer for approval. If in the Engineer's sole discretion an item of material or equipment proposed by Contractor does not qualify as an "or equal" item, it may be considered as a proposed substitute item. Contractor shall submit sufficient information as required by the Engineer to allow the Engineer to determine that the item of material or equipment proposed is essentially equivalent to that named and is an acceptable substitute therefore. Request for review of proposed substitute and "or equal" will be not be accepted by Engineer from anyone other than Contractor.

Request for substitute and "or equal" items by Contractor must be submitted in writing to Owner's Representative and will contain all information as Engineer deems necessary to make a determination. Request for substitute shall identify why a substitute is submitted and include advantages to the Owner. All data provided by Contractor in support of any proposed substitute or "or equal" item will be at Contractor's expense. Engineer will be allowed a reasonable time to evaluate each proposal or submittal made per this paragraph. Engineer will be sole judge of acceptability.

## 6.4. SUBCONTRACTORS, SUPPLIERS AND OTHERS

The Contractor shall deliver to the Owner's Representative before or at the preconstruction conference a list of all Subcontractors, suppliers and other persons and organizations proposed by the Contractor for Work to be performed on the Project. The Contractor shall include with this list the qualifications and references for each Subcontractor, supplier or other person and organization for review and approval. Any changes to this list must be submitted to the Owner's Representative for approval prior to the substitution of any Subcontractors, suppliers or other persons and organizations before performing any Work on the Project for the Contractor.

Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers and other persons performing or furnishing any of the work under a direct or indirect contract with Contractor just as Contractor is responsible for Contractor's own acts and omissions. Nothing in the Contract Documents shall create for the benefit of any such Subcontractor, Supplier or other person any contractual relationship between Owner or Engineer and any Subcontractor, Supplier or other person, nor shall it create any obligation on the part of Owner or Engineer to pay or to see to the payment of any moneys due any such Subcontractor, Supplier or other person. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors, Suppliers and other persons performing or furnishing any of the work under a direct or indirect contract with Contractor. Contractor shall require all Subcontractors, Suppliers and such other persons performing or furnishing any of the work to communicate with the Engineer through Contractor.

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.

All work performed for Contractor by a Subcontractor or Supplier will be pursuant to an appropriate agreement between Contractor and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer.

Contractor shall not pay or employ any Subcontractor, Supplier or other person or organization whether initially or as a substitute, against whom Owner or Engineer may have reasonable objection. Contractor shall not be required to employ any Subcontractor, Supplier or other person or organization to furnish or perform any of the work against whom Contractor has reasonable objection.

Owner or Engineer will not undertake to settle any differences between Contractor and his Subcontractors or between Subcontractors.

## 6.5. USE OF PREMISES

Contractor shall confine construction equipment, the storage of materials and equipment and the operations of works to the site and land areas identified in and permitted by the Contract Documents on other land areas permitted by Laws and Regulations, right-of-way, permits and easements, and shall not unreasonably encumber the premises with construction equipment or other materials or equipment. Contractor shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof or of any adjacent land or areas, resulting from the performance of the Work. Should any claim be made by any such owner or occupant because of the performance of the Work, Contractor shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceed in or

at law. Contractor shall, to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner, Engineer, Engineer's Consultant and their officials, directors, employees and agents from and against all claims, costs, losses and damages arising out of or resulting from any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer or any other party indemnified hereunder to the extent caused by or based upon Contractor's performance of the Work.

During the progress of the Work, Contractor shall keep the premises free from accumulations of waste materials, rubbish and other debris resulting from the Work. At the completion of the Work or at intervals established by the Engineer, Contractor shall remove all waste materials, rubbish and debris from and about the premises as well as all tools, appliances, construction equipment and machinery and surplus materials. Contractor shall restore to original condition all property not designated for alteration by the Contract Documents.

### **6.5.1. STAGING AREAS**

The Contactor shall obtain and deliver to the City written permission for the use of all staging and storage areas outside of the Limits of Construction. Use of right of way within the limits of construction must be approved by the City. All applicable erosion control, tree barricade and restoration, including time limits, specifications, etc., must be followed.

### **6.5.2. RESTORATION TIME LIMITS**

The timely restoration of all impacted areas, especially right-of-ways, is very important to the Citizens of Clearwater therefore, these time limits are imposed:

- Debris piles shall be removed within five (5) consecutive calendar days.
- Concrete driveways and sidewalks shall be replaced within ten (10) consecutive calendar days of removal. Resident access shall be maintained at all times.
- All arterial and collector roadways shall be restored ASAP.
- Local streets and asphalt driveways shall be restored as soon as a sufficient quantity is generated, however, this is never to exceed fifteen (15) consecutive calendar days. Local and resident access shall be maintained at all times.
- Any irrigation systems or components damaged or impacted by construction activities shall be repaired or replaced “in-kind” within forty-eight (48) hours to minimize the loss of turfgrass or landscape plantings, particularly during periods of drought.
- Sod must be restored “in-kind” within fourteen (14) consecutive calendar days of a successful pipe pressure test, removal of concrete forms, backfill of excavations, replacement of driveways or sidewalks or another project specific milestone. It must be watered for a period of thirty (30) days after it is placed. Erosion control and dust control of denuded areas must be maintained at all times.

If the project or a portion of it does not involve right-of ways, then a different schedule of sod restoration may be considered.

## **6.6. LICENSE AND PATENT FEES, ROYALTIES AND TAXES**

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 or Engineer in the Contract Documents.

To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner, Engineer, Engineer's Consultants and the officers, directors, employees, agents and other consultants of each and any of them from and against all claims, costs, losses and damages arising out of or resulting from 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, and shall defend all such claims in connection with any alleged infringement of such rights.

Contractor shall pay all sales, consumer, use and other taxes required to be paid by Contractor in accordance with the Laws and Regulations of the State of Florida and other governmental agencies, which are applicable during the performance of the work.

## **6.7. LAWS AND REGULATIONS**

Contractor shall give all notices and comply with all Laws and Regulations applicable to furnishing and performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Owner's Representative shall be responsible for monitoring Contractor's compliance with any Laws or Regulations. If Contractor performs any work knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all claims, costs, losses and damages caused by or arising out of such work; however, it shall not be Contractor's primary responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations to the Owner to report and resolve discrepancies as described above.

When City projects include Federal or State funding, the requirements of Executive Order 11-02 shall be adhered to utilizing the Homeland Security E-Verify System to verify employment eligibility.

## **6.8. PERMITS**

Unless otherwise provided in the Supplementary Conditions, Contractor shall obtain and pay for all construction permits and licenses. The Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work, which are applicable at the time of opening of Bids. Contractor shall pay all charges of utility owners for connections to the work, and the Owner shall pay all charges of such utility owners for capital costs related thereto such as plant investment fees.

Unless otherwise stated in the Contract Documents, Clearwater Building Permit Fees will be waived.

## **6.9. SAFETY AND PROTECTION**

Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to: (i) all persons on the work site or who may be affected by the work, (ii) all the Work and materials and equipment to be incorporated therein, whether in storage on or off the site; and (iii) other property

at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities and Underground Facilities not designated for removal, relocation or replacement in the course of construction. In the event of temporary suspension of the work, or during inclement weather, or whenever Owner's Representative may direct; Contractor shall, and shall cause Subcontractors, to protect carefully the Work and materials against damage or injury from the weather. If, in the opinion of the Owner's Representative, any portion of Work or materials shall have been damaged or injured by reason of failure on the part of the Contractor or any Subcontractors to so protect the Work, such Work and materials shall be removed and replaced at the expense of Contractor. The Contractor shall initiate and maintain an accident prevention program which shall include but shall not be limited to the establishment and supervision of programs for the education and training of employees in the recognition, avoidance and prevention of unsafe conditions and acts. Contractor shall provide first aid services and medical care to his employees. The Contractor shall develop and maintain an effective fire protection and prevention program and good housekeeping practices at the site of contract performance throughout all phases of construction, repair, alteration or demolition. Contractor shall require appropriate personal protective equipment in all operations where there is exposure to hazardous conditions. The Engineer may order that the work stop if a condition of immediate danger to the Owner's employees, equipment or if property damage exists. This provision shall not shift responsibility or risk of loss for injuries or damage sustained from the Contractor to Owner, and the Contractor shall remain solely responsible for compliance with all safety requirements and for the safety of all persons and property at the site of Contract performance. The Contractor shall instruct his employees required to handle or use toxic materials or other harmful substances regarding their safe handling and use. The Contractor shall take the necessary precautions to protect pedestrians and motorists from harm, and to prevent disruptions of such traffic due to construction activity.

Contractor shall comply with all applicable Laws and Regulations of any public body having jurisdiction for safety of persons or property and to protect them from damage, injury or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify owners of adjacent property and of Underground Facilities and utility owners when execution of the work may affect them, and shall cooperate with them in the protection, removal, relocation and replacement of their property. All damage, injury or loss to any property caused, directly or indirectly, in whole or part, by Contractor, any Subcontractor, Supplier or any other person or organization directly or indirectly employed by any of them to perform or furnish any of the work or anyone for whose acts any of them may be liable, shall be remedied by Contractor. Contractor's duties and responsibilities for safety and for protection of the Work shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor that the Work is acceptable.

## **6.10. EMERGENCIES**

In emergencies affecting the safety or protection of persons or the Work or property at the site or adjacent thereto, Contractor, with or without special instruction or authorization from Owner or the Owner's Representative, is obligated to act to prevent 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. If the Owner's Representative 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 to document the consequences of such action.

## 6.11. DRAWINGS

### 6.11.1. SHOP DRAWINGS, SAMPLES, RFIs, AND SUBMITTAL REVIEW

Contractor shall submit Shop Drawings to Engineer for review and approval as called for in the Technical Specifications or required by the Engineer. The 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 materials and equipment Contractor proposes to provide and to enable Engineer to review the information. Contractor shall also submit Samples to Engineer for review and approval. Before submitting each Shop Drawing or Sample, Contractor shall have determined and verified: (i) all field measurements, quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers and similar information with respect thereto, (ii) all materials with respect to intended use, fabrication, shipping, handling, storage, assembly and installation pertaining to the performance of the Work, and (iii) all information relative to Contractor's sole responsibilities in respect to means, methods, techniques, sequences and procedures of construction and safety precautions and programs incident thereto. Contractor shall also have reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples with the requirements of the Work and the Contract Documents. Each submittal will have a transmittal cover sheet identifying the shop drawing name, number, and technical specification reference; will bear a stamp or specific written indication that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review and approval of that submittal. At the time of submission, Contractor shall give Engineer specific written notice of such variations, if any, that the Shop Drawing or Sample submitted may have from the requirements of the Contract Documents, such notice to be in a written communication separate from the submittal; and, in addition, shall cause a specific notation to be made on each Shop Drawing and Sample submitted to Engineer for review and approval of each such variation.

The Contractor shall maintain a submittal log as mentioned in Article 2.5. The Engineer shall receive updated copies at each progress meeting, and the Engineer shall respond to each submittal within fourteen (14) consecutive calendar days. The Contractor shall maintain a request for information (RFI) log as mentioned in Article 2.5. The Engineer shall receive updated copies at each progress meeting, and the Engineer shall respond to each RFI within fourteen (14) consecutive calendar days. The untimely submission of Submittal or RFIs shall not be grounds for a delay claim from the Contractor.

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

Engineer's review and approval of Shop Drawings or Samples shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has in writing called Engineer's attention to each such variation at the time of submission and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample approval; nor will any approval by the Engineer relieve the Contractor from responsibility for complying with the requirements of paragraph above discussing field measurements by the Contractor.

Contractor shall furnish required submittals with complete information and accuracy in order to achieve required approval of an item within two (2) submittals. Owner's Representative reserves the right to backcharge Contractor, for Engineer's costs for resubmittals that account for a number greater than twenty percent (20%) of the total number of first time submittals, per the approved initial submittal log. Owner's Representative reserves the right to backcharge Contractor for all third submittals. The number of first-time submittals shall be equal to the number of submittals agreed to by Engineer and Contractor. All costs to Engineer involved with subsequent submittal of Shop Drawings, Samples or other items requiring approval will be backcharged to Contractor at the rate of 3.0 times direct technical labor cost by deducting such costs from payments due Contractor for Work completed. In the event that Contractor requests a substitution for a previously approved item, all of Engineer's costs in the reviewing and approval of the substitution will be backcharged to Contractor, unless the need for such substitution is beyond the control of Contractor.

### **6.11.2. AS-BUILT DRAWINGS**

The Contractor shall keep and maintain one set of blueprints, As-Built Drawings, in good order and legible condition to be continuously marked-up at the job site. The Contractor shall mark and annotate neatly and clearly all project conditions, locations, configurations and any other changes or deviations which may vary from the details represented on the original Contract Plans, including revisions made necessary by Addenda, Shop Drawings, and Change Orders during the construction process. The Contractor shall record the horizontal and vertical locations, in the plan and profile, of all buried utilities that differ from the locations indicated or which were not indicated on the Contract Plans and buried (or concealed), construction and utility features which are revealed during the construction period.

The As-Built Drawings shall be available for inspection by the Engineer, Engineer's Consultant, and the Owner's Representative at all times during the progress of the Project.

The As-Built Drawings shall be reviewed by the Owner's Representative, or his designee, for accuracy and compliance with the requirements of "As-Built Drawings" prior to submittal of the monthly pay requests. The pay requests shall be rejected if the marked-up redline prints do not conform to the "As-Built Drawings" requirements. As-Built Drawings shall be submitted to the Owner Inspector for approval upon completion of the project and prior to acceptance of final pay request. Final pay request shall not be processed until As-Built Drawings have been reviewed by the Engineer or the Engineer's Consultant for accuracy and completeness.

Prior to placing new potable water mains in service, the Contractor shall provide the Engineer intersection drawings, as specified for the water mains.

The Owner's acceptance of the "As-Built Drawings" does not relieve the Contractor of the sole responsibility for the accuracy and completeness of the As-Built Drawings.

### **6.11.2.1. General**

The Contractor shall prepare an “AS-BUILT SURVEY” per chapter 5J-17.052, Florida Administrative Code (see definition below), signed and sealed by a Florida registered land surveyor. The contractor will deliver to the Owner two hard copies of signed and sealed As-Built Drawings and an AutoCAD file.

**5J-17.050 Definition:** (10)(a) *As-Built Survey: a survey performed to obtain horizontal and/or vertical dimensional data so that constructed improvements may be located and delineated: also known as Record Survey.*

This survey shall be clearly titled “As-Built Survey” and shall be signed and sealed by a Florida registered land surveyor. The survey must be delivered to the Owner of Clearwater Construction Division upon substantial completion of the project. If this condition is not met, the Owner will procure the services of a Professional Surveyor and Mapper registered in the State of Florida and will back charge the contractor a fee of \$1,800 per day or any portion thereof to provide the Owner with the required As-Built Survey.

### **6.11.2.2. Sanitary and Storm Sewer Piping Systems**

1. Manholes and inlets shall be located by survey coordinates (northing, easting and elevation) based on the approved horizontal and vertical datum or utilize the stationing supplied on the construction plans. New and replaced service connections shall be dimensioned to the nearest downstream manhole. All manholes, cleanouts and catch basin invert and rim elevations, manhole and catch basin dimensions, pipe sizes, and pipe material shall also be noted on the plan view and also on the profile if one exists. The terminal ends of all subdrains, inverts of all pipe in structures, and the flow line of inlets shall also be noted on the plan view and also on the profile if one exists.
2. Pipe materials and areas of special construction shall be noted.

### **6.11.2.3. Pressure Pipe construction (Water, Reclaimed Water, Force main)**

All pipes shall be located by survey coordinates (northing, easting and elevation) based on the approved horizontal and vertical datum or utilize the stationing supplied on the construction plans. Coordinates shall be at all pipe bends, tees, valves, reducers, and deflections. Also, all new and replaced service connections for potable and reclaimed water will be located as described above. Additionally, there must be survey coordinates no further than 100 feet apart on linear type construction and shall denote top of pipe elevation at those points.

### **6.11.2.4. Electrical and Control Wiring**

The as-built drawings shall include all changes to the original Contract Plans. The as-built drawings shall also include the size, color, and number of wires and conduit. For projects where this information is too voluminous to be contained on the blueline prints, the Contractor shall prepare supplemental drawings, on same size sheets as the blueline prints, showing the additional conduit runs, 1-line diagrams, ladder diagrams, and other information. The wiring schematic diagrams shall show termination location and wiring identification at each point on the ladder diagram.

### **6.11.2.5. Horizontal and Vertical Control**

The As-Built survey shall be based on the original datum used for the construction design plans or if required by the Owner the datum shall be referenced to the North American Datum of 1983/90 (horizontal) and the North American Vertical Datum of 1988. The unit of measurement shall be the United States Foot. Any deviation or use of any other datum, (horizontal and or vertical), must be approved by the Owner of Clearwater Engineering Department.

### **6.11.2.6. Standards**

The As-Built survey shall meet the Minimum Technical Standards per Chapter 5J-17 and the Clearwater CAD STANDARDS set forth below. In addition to locating all improvements that pertain to the as-built survey it is the requirement of the Owner to have minimum location points at every change in direction and no more than 100 feet apart on all pressure pipes.

### **6.11.2.7. Other**

The As-Built drawings shall reflect any differences from the original Contract Plans, in the same level of detail and units of dimensions as the Plans.

## **6.11.3. CAD STANDARDS**

### **6.11.3.1. Layer Naming**

#### **6.11.3.1.1. Prefixes and Suffixes**

|    |   |
|----|---|
| DI | prefix denotes digitized or scanned entities  |
| EP | prefix denotes existing points - field collected  |
| EX | prefix denotes existing entities - line work and symbols  |
| PR | prefix denotes proposed entities - line work and symbols  |
| FU | prefix denotes future entities (proposed but not part of this contract) - line work and symbols |
| TX | suffix denotes text – use for all text, no matter the prefix                                    |

#### **6.11.3.1.2. Layer Naming Definitions:**

|       |   |
|-------|---|
| GAS   | gas lines and appurtenances               |
| ELEC  | power lines and appurtenances             |
| PHONE | telephone lines and appurtenances         |
| CABLE | cable TV lines and appurtenances          |
| BOC   | curbs                                     |
| WALK  | sidewalk                                  |
| WATER | water lines and appurtenances, sprinklers |
| STORM | storm lines and appurtenances             |
| TREES | trees, bushes, planters                   |

|          |  |
|----------|--|
| SANITARY | sanitary lines and appurtenances           |
| FENCE    | all fences                                 |
| BLDG     | buildings, sheds, finished floor elevation |
| DRIVE    | driveways                                  |
| EOP      | edge of pavement without curbs             |
| TRAFFIC  | signal poles, control boxes                |
| TOPBANK  | top of bank                                |
| TOESLOPE | toe of slope                               |
| TOPBERM  | top of berm                                |
| TOEBERM  | toe of berm                                |
| SEAWALL  | seawall                                    |
| CONCSLAB | concrete slabs                             |
| WALL     | walls, except seawall                      |
| SHORE    | shoreline, water elevation                 |
| CL       | centerline of road                         |
| CLD      | centerline of ditch                        |
| CLS      | centerline of swale                        |
| CORNER   | property corners, monumentation            |
| BENCH    | benchmark, temporary benchmarks            |

Other layers may be created as required, using above format.

#### **6.11.3.2. Layer Properties**

All layers will use standard AutoCAD linetypes, bylayer.

All layers will use standard AutoCAD colors, bylayer.

All text will use standard AutoCAD fonts.

#### **6.11.3.3. Text Styles**

Text style for EX layers will use the simplex font, oblique angle of 0°, and a text height of .008 times the plot scale.

Text style for PR and FU layers will use the simplex font, oblique angle of 22.5°, and a text height of .010 times the plot scale.

#### **6.11.4. DELIVERABLES**

The as-built survey shall be produced on bond material, 24" x 36" at a scale of 1"=20' unless approved otherwise. The consultant shall deliver two hard copies and one digital copy of all drawings. Requested file formats are: Autodesk DWG and Adobe PDF files.

Please address any questions regarding format to Mr. Tom Mahony, at (727) 562-4762 or e-mail address [Thomas.Mahony@myClearwater.com](mailto:Thomas.Mahony@myClearwater.com).

## **6.12. CONTRACTOR'S GENERAL WARRANTY AND GUARANTEE**

Contractor warrants and guarantees to Owner, Engineer and Engineer's Consultants that all Work will be in accordance with the Contract Documents and will not be defective. Contractor's warranty and guarantee hereunder includes defects or damage caused by abuse, vandalism, modification or operation by persons other than Contractor, Subcontractors or Suppliers. Until the acceptance of the Work by the Owner, the Work shall be under the charge and care of the Contractor, and he shall take every necessary precaution against injury or damage to any part thereof by action of the elements, or from any other cause whatsoever, arising from the execution or non-execution of the Work. The Contractor shall rebuild, repair and make good, at his own expense, all injuries or damages to any portion of the Work occasioned by any cause before its completion and final acceptance by the Owner. In addition, "the Contractor shall remedy any defects in the work at his own expense and pay for any damage to other work resulting therefrom which appear within a period of one year from the date of final acceptance".

Contractor's warranty and guarantee hereunder excludes improper maintenance and operation by Owner's employees and normal wear and tear under normal usage for any portion of the Work, which has been partially accepted by the Owner for operation prior to final acceptance by the Owner. 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: (i) observations by Owner's Representative, (ii) recommendation of any progress or final payment by Owner's Representative, (iii) the issuance of a certificate of Substantial Completion or any payment by the Owner to contractor under the Contract Documents, (iv) use or occupancy of the Work or any part thereof by Owner, (v) any acceptance by Owner or any failure to do so, (vi) any review and approval of a Shop Drawing or Sample submittal or the issuance of a notice of Acceptance by the Engineer.

## **6.13. CONTINUING THE WORK**

Contractor shall carry on the work and adhere to the progress schedule during all disputes or disagreements with the Owner. No work shall be delayed or postponed pending resolution of any disputes or disagreements, except as the Owner or Contractor may otherwise agree in writing.

## **6.14. INDEMNIFICATION**

To the fullest extent permitted by law, Contractor agrees to defend, indemnify, and hold the City, its officers, agents, and employees, harmless from and against any and all liabilities, demands, claims, suits, losses, damages, causes of action, fines or judgments, including costs, attorneys', witnesses', and expert witnesses' fees, and expenses incident thereto, relating to, arising out of, or resulting from: (i) the services provided by Contractor personnel under this Agreement; (ii) any negligent acts, errors, mistakes or omissions by Contractor or Contractor personnel; and (iii) Contractor or Contractor personnel's failure to comply with or fulfill the obligations established by this Agreement.

Contractor will update the City during the course of the litigation to timely notify the City of any issues that may involve the independent negligence of the City that is not covered by this indemnification.

The City assumes no liability for actions of Contractor and will not indemnify or hold Contractor or any third party harmless for claims based on this Agreement or use of Contractor-provided supplies or services.

Notwithstanding anything contained herein to the contrary, this indemnification provision shall not be construed as a waiver of any immunity to which Owner is entitled or the extent of any limitation of liability pursuant to § 768.28, Florida Statutes. Furthermore, this provision is not intended to nor shall be interpreted as limiting or in any way affecting any defense Owner may have under § 768.28, Florida Statutes or as consent to be sued by third parties.

## **6.15. CHANGES IN COMPANY CONTACT INFORMATION**

Contractor shall notify Owner by US mail addressed to the City Engineer of any changes in company contact information. This includes contact phone, address, project manager, email addresses, etc.

## **6.16. PUBLIC RECORDS**

The CONTRACTOR will be required to comply with Section 119.0701, Florida Statutes.

**IF THE CONTRACTOR HAS QUESTIONS REGARDING THE APPLICATION OF CHAPTER 119, FLORIDA STATUTES, TO THE CONTRACTOR'S DUTY TO PROVIDE PUBLIC RECORDS RELATING TO THIS CONTRACT, CONTACT THE CUSTODIAN OF PUBLIC RECORDS, Rosemarie Call, phone: 727-562-4092 or [Rosemarie.Call@mclearwater.com](mailto:Rosemarie.Call@mclearwater.com), 600 Cleveland Street, Suite 600, Clearwater, FL 33755.**

The Contractor's duty to comply with public records law applies specifically to:

- a) Keep and maintain public records required by the City of Clearwater (hereinafter “public agency”) to perform the service being provided by the contractor hereunder.
- b) Upon request from the public agency’s custodian of public records, provide the public agency with a copy of the requested records or allow the records to be inspected or copied within a reasonable time at a cost that does not exceed the cost provided for in Chapter 119, Florida Statutes, as may be amended from time to time, or as otherwise provided by law.
- c) Ensure that public records that are exempt or confidential and exempt from public records disclosure requirements are not disclosed except as authorized by law for the duration of the contract term and following completion of the contract if the contractor does not transfer the records to the public agency.
- d) Upon completion of the contract, transfer, at no cost, to the public agency all public records in possession of the contractor or keep and maintain public records required by the public agency to perform the service. If the contractor transfers all public records to the public agency upon completion of the contract, the contractor shall destroy any public records that are exempt or confidential and exempt from public records disclosure requirements. If the contractor keeps and maintains public records upon completion of

the contract, the contractor shall meet all applicable requirements for the retaining public records. All records stored electronically must be provided to the public agency, upon request from the public agency's custodian of public records in a format that is compatible with the information technology systems of the public agency.

- e) A request to inspect or copy public records relating to a public agency's contract for services must be made directly to the public agency. If the public agency does not possess the requested records, the public agency shall immediately notify the contractor of the request and the contractor must provide the records to the public agency or allow the records to be inspected or copied within a reasonable time.
- f) The Contractor hereby acknowledges and agrees that if the Contractor does not comply with the public agency's request for records, the public agency shall enforce the contract provisions in accordance with the contract.
- g) A contractor who fails to provide the public records to the public agency within a reasonable time may be subject to penalties under Section 119.10, Florida Statutes.
- h) If a civil action is filed against a contractor to compel production of public records relating to a public agency's contract for services, the court shall assess and award against the contractor the reasonable costs of enforcement, including reasonable attorney fees, if:
  - 1. The court determines that the contractor unlawfully refused to comply with the public records request within a reasonable time; and
  - 2. At least 8 business days before filing the action, the plaintiff provided written notice of the public request, including a statement that the contractor has not complied with the request, to the public agency and to the contractor.
- i) A notice complies with subparagraph (h)2. if it is sent to the public agency's custodian of public records and to the contractor at the contractor's address listed on its contract with the public agency or to the contractor's registered agent. Global Express Guaranteed, or certified mail, with postage or shipping paid by the sender and with evidence of delivery, which may be in an electronic format.
- j) A contractor who complies with a public records request within 8 business days after the notice is sent is not liable for the reasonable costs of enforcement.

## 7. OTHER WORK

### 7.1. RELATED WORK AT SITE

The City reserves the right to have its own forces enter the construction site at any time and perform work as necessary in order to perform infrastructure repair or maintenance, whether related to the project or not. The Contractor will allow complete access to all utility owners for these purposes.

The City may have its own forces perform new work related to the project, however, this work will be identified in the Contract Scope of Work and coordination will be such that this activity is denoted in the Contractor's CPM Schedule so as not to cause any delays or interference with the Contractor's work or schedule.

### 7.2. COORDINATION

If the Owner contracts with others for the performance of other work on the Project at the site, the following will be set forth in the Scope of Work: (i) the person who will have authority and responsibility for coordination of the activities among the various prime contractors will be identified; (ii) the specific matters to be covered by such authority and responsibility will be

itemized; and (iii) the extent of such authority and responsibilities will be provided. Unless otherwise provided in the Supplementary Conditions, the Owner shall have sole authority and responsibility in respect of such coordination.

## **8. OWNERS RESPONSIBILITY**

Except as otherwise provided in these General Conditions, the Owner shall issue all communications from the Owner to the Contractor through Owner's Representative.

The Owner shall furnish the data required of the Owner under the Contract Documents promptly and shall make payments to Contractor promptly when they are due as provided in these General Conditions.

The Owner is obligated to execute Change Orders as indicated in the Article on Changes In The Work.

The Owner's responsibility in respect of certain inspections, tests, and approvals is set forth in the Article on Tests and Inspections.

In connection with the Owner's right to stop work or suspend work, see the Article on Engineer may Stop the Work. The Article on Suspension of Work and Termination deals with the Owner's right to terminate services of Contractor under certain circumstances.

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 furnishing or performance of the Work. The Owner will not be responsible for Contractor's failure to perform or furnish the Work in accordance with the Contract Documents.

## **9. OWNER REPRESENTATIVE'S STATUS DURING CONSTRUCTION**

### **9.1. OWNERS REPRESENTATIVE**

Dependent of the project type, the Owner's Representative during the construction period will either be the Construction Manager, the Engineer, or a designee of the Project's Owner. The duties, responsibilities and the limitations of authority of Owner's Representative during construction are set forth in the Contract Documents and shall not be extended without written consent of Owner and Engineer.

### **9.2. CLARIFICATIONS AND INTERPRETATIONS**

Engineer will issue with reasonable promptness such written clarifications or interpretations of the requirements of the Contract Documents regarding design issues only, in the form of Submittal responses, RFI responses, Drawings or otherwise, as Engineer may determine necessary, which shall be consistent with the intent of and reasonably inferable from Contract Documents. All other clarifications and interpretations of the Contract Documents shall be issued from the Owner's Representative. Such written clarifications and interpretations will be binding on the Owner and Contractor. If Contractor believes that a written clarification or interpretation justifies an adjustment in the Contract Price or the Contract Time and the parties are unable to agree to the

amount or extent thereof, if any, Contractor may make a written claim therefore as provided in the Articles for Change of Work and Change of Contract Time.

### **9.3. REJECTING OF DEFECTIVE WORK**

The Owner's Representative or the Engineer will have authority to disapprove or reject Work which Owner's Representative or the Engineer believes to be defective, or that Owner's Representative or the Engineer believes will not produce a completed Project that conforms to the Contract Documents or that will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. The Owner's Representative or the Engineer will also have authority to require special inspection or testing of the Work whether or not the Work is fabricated, installed or completed.

### **9.4. SHOP DRAWINGS, CHANGE ORDERS, AND PAYMENTS**

In connection with Engineer's authority as to Shop Drawings and Samples, see articles on Shop Drawings and Samples. In connection with Owner's Representative authority as to Change Orders, see the articles on Changes of Work, Contract Price and Contract Time. In connection with Owner's Representative authority as to Applications for Payment, see the articles on Payments to Contractor and Completion.

### **9.5. DECISIONS ON DISPUTES**

The Owner's Representative will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the work thereunder. Claims, disputes and other matters relating to the acceptability of the work or the interpretation of the requirements of the Contract Documents pertaining to the performance and furnishing of the work and Claims under the Articles for Changes of Work, Changes of Contract Time and Changes of Contract Price will be referred initially to Owner's Representative in writing with a request for a formal decision in accordance with this paragraph. Written notice of each such claim, dispute or other matter will be delivered by the claimant to Owner's Representative and the other party to the Agreement promptly, but in no event later than thirty (30) days, after the start of the occurrence or event giving rise thereto, and written supporting data will be submitted to Owner's Representative and the other party within sixty (60) days after the start of such occurrence or event unless Owner's Representative allows an additional period of time for the submission of additional or more accurate data in support of such claim, dispute or other matter. The opposing party shall submit any response to Owner's Representative and the claimant within thirty (30) days after receipt of the claimant's last submittal, unless Owner's Representative allows additional time. Owner's Representative will render a formal decision in writing within thirty (30) days after receipt of the opposing party's submittal, if any, in accordance with this paragraph. Owner Representative's written decision on such claim, dispute or other matter will be final and binding upon the Owner and Contractor unless (i) an appeal from Owner Representative's decision is taken within thirty (30) days of the Owner Representative's decision, or the appeal time which may be stated in a Dispute Resolution Agreement between Owner and Contractor for the settlement of disputes or (ii) if no such Dispute Resolution Agreement has been entered into, a written notice of intention to appeal from Owner Representative's written decision is delivered by the Owner or Contractor to the other and to Owner's Representative within thirty (30) days after the date of such decision and a formal proceeding is instituted by the appealing party in a forum of competent jurisdiction to exercise such rights or remedies as the appealing party may have with respect to such claim,

dispute or other matter in accordance with applicable Laws and Regulations within sixty (60) days of the date of such decision, unless otherwise agreed in writing by the Owner and Contractor.

When functioning as interpreter and judge, Owner's Representative will not show partiality to the Owner or Contractor and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity. The rendering of a decision by Owner's Representative with respect to any such claim, dispute or other matter will be a condition precedent to any exercise by the Owner or Contractor of such rights or remedies as either may otherwise have under the Contract Documents or by Laws or Regulations in respect of any such claim, dispute or other matter pursuant the Article on Dispute Resolution.

## **9.6. LIMITATIONS ON OWNER REPRESENTATIVE'S RESPONSIBILITIES**

Neither Owner Representative's authority or responsibility under this paragraph or under any other provision of the Contract Documents nor any decision made by Owner's Representative 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 Owner's Representative shall create, impose or give rise to any duty owed by Owner's Representative to Contractor, any Subcontractor, any Supplier, any other person or organization or to any surety for or employee or agent of any of them.

Owner's Representative 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 furnishing or performance of the work. Owner's Representative will not be responsible for Contractor's failure to perform or furnish the work in accordance with the Contract Documents.

Owner's Representative will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other person or organization performing or furnishing any of the work.

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

The limitations upon authority and responsibility set forth in this paragraph shall also apply to Owner Representative's CEI, the Engineer's Consultants, and assistants.

## **10. CHANGES IN THE WORK**

Without invalidating the Agreement and without notice to any surety, the Owner may, at any time or from time to time, order additions, deletions or revisions in the Work. Such additions, deletions or revisions will be authorized by a Written Amendment, a Change Order, or a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as may otherwise be specifically provided).

If the Owner and Contractor are unable to agree as to the extent, if any, of an adjustment in the Contract Price or an adjustment of the Contract Time that should be allowed as a result of a Work Change Directive, a claim may be made therefore as provided in these General Conditions.

Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Time with respect to any Work performed that is not required by the Contract Documents as amended, modified and supplemented as provided in these General Conditions except in the case of an emergency as provided or in the case of uncovering work as provided in article for Uncovering Work.

The Owner and Contractor shall execute appropriate Change Orders or Written Amendments recommended by Owner's Representative covering:

- changes in the work which are (i) ordered by the Owner (ii) required because of acceptance of defective work under the article for Acceptance of Defective Work or correcting defective Work under the article for Owner May Correct Defective Work or (iii) agreed to by the parties;
- changes in the Contract Price or Contract Time which are agreed to by the parties; and
- changes in the Contract Price or Contract Time which embody the substance of any written decision rendered by Owner's Representative pursuant to the article for Decisions on Disputes;
- provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, Contractor shall carry on the Work and adhere to the progress schedule as provided in the article for Continuing the Work.

If notice of any change affecting the general scope of the work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Time) is required by the provisions of any Bond to be given to a surety, the giving of any such notice will be Contractor's responsibility, and the amount of each applicable Bond will be adjusted accordingly.

## **11. CHANGES IN THE CONTRACT PRICE**

### **11.1. CHANGES IN THE CONTRACT PRICE**

The Contract Price constitutes the total compensation (subject to authorized adjustments) payable to Contractor for performing the Work. All duties, responsibilities and obligations assigned to or undertaken by Contractor shall be at Contractor's expense without change in the Contract Price. The Contract Price may only be adjusted by a Change Order or by a Written Amendment. Any claim for an adjustment in the Contract Price shall be based on a written notice of claim stating the general nature of the claim, to be delivered by the party making the claim to the other party and to Owner's Representative or promptly (but in no event later than thirty days) after the start of the occurrence or event giving rise to the claim. Notice of the amount of the claim with supporting data shall be delivered within sixty (60) days after the start of such occurrence or event, unless Owner's Representative allows additional time for claimant to submit additional or more accurate data in support of the claim, and shall be accompanied by claimant's written statement that the claimed adjustment covers all known amounts to which the claimant is entitled as a result of said occurrence or event. No claim for an adjustment in the Contract Price will be valid if not submitted in accordance with this paragraph. The value of any Work covered by a Change Order or of any claim for an adjustment in the Contract Price will be determined as follows: (i) where the Work

involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved (ii) where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit), (iii) where the Work is not covered by unit prices contained in the Contract Documents and agreement is reached to establish unit prices for the Work.

Where the work involved is not covered by unit prices contained in the Contract Documents and where the Owner's Representative, the Owner, the Engineer, the Engineer's Consultant, and Contractor cannot mutually agree on a lump sum price, the City of Clearwater shall pay for directed changes in the Work, on "COST REIMBURSEMENT" basis. The Contractor shall apply for compensation, detailing Contractors forces, materials, equipment, subcontractors, and other items of direct costs required for the directed work.

The application for Cost Reimbursement shall be limited to the following items:

1. Labor, including foremen, for those hours associated with the direct work (actual payroll cost, including wages, fringe benefits, labor insurance and labor taxes established by law). Expressly excluded from this item are all costs associated with negotiating the subject change.
2. Materials associated with the change, including sales tax. The costs of materials shall be substantiated through vendors' invoices.
3. Rental or equivalent rental costs of equipment, including necessary transportation costs if specifically used for the Work. The rental rates shall not exceed the current rental rates prevailing in the locality or as defined in the rental Rate Blue Book for Construction Equipment (a.k.a. DataQuest Blue Book). The rental rate is defined as the full-unadjusted base rental rate for the appropriate item of construction equipment and shall cover the costs of all fuel, supplies, repairs, insurance, and other costs associated with supplying the equipment for work ordered. Contractor-owned equipment will be paid for the duration of time required to complete the work. Utilize lowest cost combination of hourly, daily, weekly, or monthly rates. Do not exceed estimated operating costs given in Blue Book. Operating costs will not be allowed for equipment on stand-by.
4. Additional costs for Bonds, Insurance if required by the City of Clearwater.

The following fixed fees shall be added to the costs of the directed work performed by the Contractor or Subcontractor.

- A. A fixed fee of fifteen percent (15%) shall be added to the costs of Item 1 above. If work is performed by a subcontractor, the Contractor's fee shall not exceed five percent (5%), and the subcontractor's fee shall not exceed ten percent (10%).
- B. A fixed fee of ten percent (10%) shall be added to the costs of Item 2 above.
- C. No markup shall be added to the costs of Items 3 and 4.

The fixed fees shall be considered the full compensation for all cost of general supervision, overhead, profit, and other general expense.

## **11.2. ALLOWANCES AND FINAL CONTRACT PRICE ADJUSTMENT**

It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be furnished and performed for such sums as may be acceptable to Owner and Engineer. Contractor agrees that: (i) the 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 (ii) Contractor's costs for unloading and handling on the site, labor, installation costs, overhead, profit and other expenses contemplated for the 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.

Prior to final payment, an appropriate Change Order will be issued as recommended by Owner's Representative to reflect actual amounts due Contractor on account of Work covered by allowances and all the Work actually performed by the Contractor, and the Contract Price shall be correspondingly adjusted.

## **11.3. UNIT PRICE WORK**

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 established unit price for each separately identified item of unit price work times the estimated quantity of each item as indicated in the Agreement. 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. Determinations of the actual quantities and classifications of Unit Price Work performed by Contractor will be made by Owner's Representative. 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. The Owner or Contractor may make a claim for an adjustment in the Contract Price if: (i) 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 Contract Documents; and (ii) there is no corresponding adjustment with respect to any other item of Work; and (iii) if Contractor believes that Contractor is entitled to an increase in Contract Price as a result of having incurred additional expense or the Owner believes that the 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. On unit price contracts, Owner endeavors to provide adequate unit quantities to satisfactorily complete the construction of the project. It is expected that in the normal course of project construction and completion that not all unit quantities will be used in their entirety and that a finalizing change order which adjusts contract unit quantities to those unit quantities actually used in the construction of the project will result in a net decrease from the original Contract Price. Such reasonable deduction of final Contract Price should be anticipated by the Contractor in his original bid.

## **12. CHANGES IN THE CONTRACT TIME**

The Contract Time (or Milestones) may only be changed by a Change Order or a Written Amendment. Any claim for an adjustment of the Contract Time (or Milestones) shall be based on written notice delivered by the party making the claim to the other party and to Owner's Representative promptly, but in no event later than thirty (30) days, after the occurrence of the event giving rise to the claim and stating the general nature of the claim. Notice of the extent of the claim with supporting data shall be delivered within sixty (60) days after such occurrence,

unless Owner's Representative allows an additional period of time to ascertain more accurate data in support of the claim, and shall be accompanied by the claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant has reason to believe it is entitled as a result of the occurrence of said event. All claims for adjustment in the Contract Time (or Milestones) shall be determined by Owner's Representative. No claim for an adjustment in the Contract Time (or Milestones) will be valid if not submitted in accordance with the requirements of this paragraph.

All time limits stated in the Contract Documents are of the essence of the Agreement.

Where Contractor is prevented from completing any part of the work within the Contract Time (or Milestones) due to delay beyond the control of Contractor, the Contract Time (or Milestones) may be extended in an amount equal to the time lost due to such delay if a claim is made therefore as provided in the article for Changes in the

Work. Delays beyond the control of Contractor shall include, but not be limited to, acts by the Owner, acts of utility owners or other contractors performing other work as contemplated by the article for Other Work, fires, floods, epidemics, abnormal weather conditions or acts of God. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of Contractor.

Where Contractor is prevented from completing any part of the Work within the Contract Times (or Milestones) due to delay beyond the control of both the Owner and Contractor, an extension of the Contract Time (or Milestones) in an amount equal to the time lost due to such delay shall be Contractor's sole and exclusive remedy for such delay. In no event shall the Owner be liable to Contractor, any Subcontractor, any Supplier, any other person, or to any surety for or employee or agent of any of them, for damages arising out of or resulting from (i) delays caused by or within the control of Contractor, or (ii) delays beyond the control of both parties including but not limited to fires, floods, epidemics, abnormal weather conditions, acts of God or acts by utility owners or other contractors performing other work as contemplated by paragraph for Other Work.

## **13. TESTS AND INSPECTIONS, CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK**

### **13.1. TESTS AND INSPECTION**

Contractor shall give Owner's Representative and Engineer timely notice of readiness of the Work for all required inspections, tests or approvals, and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.

Contractor shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests, or approvals required by the Contract Documents. The costs for these inspections, tests or approvals shall be borne by the Contractor except as otherwise provided in the Contract Documents.

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 including all Owner Building Departments and Owner Utility Departments, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests or approvals, pay all costs in connection therewith, and furnish Owner's Representative the required certificates of inspection or approval. Unless otherwise stated in the Contract Documents, Owner permit and impact fees will be waived. Contractor shall also be responsible for arranging and

obtaining and shall pay all costs in connection with any inspections, tests or approvals required for Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work, or of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation of the Work.

If any Work (or the work of others) that is to be inspected tested or approved is covered by Contractor without written concurrence of Owner's Representative, it must, if requested by Owner's Representative, be uncovered for observation. Uncovering Work as provided in this paragraph shall be at Contractor's expense unless Contractor has given Owner's Representative and Engineer timely notice of Contractor's intention to cover the same and Owner's Representative has not acted with reasonable promptness in response to such notice.

### **13.2. UNCOVERING THE WORK**

If any Work is covered contrary to the written request of Owner's Representative, it must, if requested by Owner's Representative, be uncovered for Owner Representative's observation and replaced at Contractor's expense.

If Owner's Representative considers it necessary or advisable that covered Work be observed by Owner's Representative or inspected or tested by others, Contractor, at Owner Representative's request, shall uncover, expose or otherwise make available for observation, inspection or testing as Engineer or Owner's Representative may require, that portion of the Work in question, furnishing all necessary labor, material and equipment. If it is found that such Work is defective, Contractor shall pay all claims, costs, losses and damages caused by, arising out of or resulting from such uncovering, exposure, observation, inspection and testing and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and the Owner shall be entitled to an appropriate decrease in the Contract Price for the costs of the investigation, and, if the parties are unable to agree as to the amount thereof, may make a claim therefore as provided in the article for Change in Contract Price. If, however, such Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Time (or Milestones), or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement and reconstruction; and, if the parties are unable to agree as to the amount or extent thereof, Contractor may make a claim therefore as provided the article for Change in Contract Price and Change of Contract Time.

### **13.3. OWNER'S REPRESENTATIVE MAY STOP THE WORK**

If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to furnish or perform the Work in such a way that the completed Work will conform to the Contract Documents, Engineer or Owner's Representative 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's Representative to stop the Work shall not give rise to any duty on the part of Owner's Representative or Owner to exercise this right for the benefit of Contractor or any surety or other party. If the Owner's Representative stops Work under this paragraph, Contractor shall be entitled to no extension of Contract Time or increase in Contract Price.

### **13.4. CORRECTION OR REMOVAL OF DEFECTIVE WORK**

If required by Engineer or Owner's Representative, Contractor shall promptly, as directed, either correct all defective Work, whether or not fabricated, installed or completed, or, if the Work has

been rejected by Engineer or Owner's Representative, remove it from the site and replace it with Work that is not defective. Contractor shall pay all claims, costs, losses and damages caused by or resulting from such correction or removal (including but not limited to all costs of repair or replacement of work of others).

### **13.5. WARRANTY/CORRECTION PERIOD**

If within one year after the date of Substantial Completion or such longer period of time as may be prescribed by Laws or Regulations or by the terms of any applicable special guarantee required by the Contract Documents or by any specific provision of the Contract Documents, any Work is found to be defective, Contractor shall promptly, without cost to the Owner and in accordance with the Owner's written instructions; (i) correct such defective Work, or, if it has been rejected by the Owner, remove it from the site and replace it with Work that is not defective and (ii) satisfactorily correct or remove and replace any damage to other Work or the work of others resulting therefrom. If Contractor does not promptly comply with the terms of such instructions, or in an emergency where delay would cause serious risk of loss or damage, the Owner may have the defective Work corrected or the rejected. Work removed and replaced, and all claims, costs, losses and damages caused by or resulting from such removal and replacement (including but not limited to all costs of repair or replacement of work of others) will be paid by Contractor.

In special circumstances where a particular item of equipment is placed in continuous service before Final Completion of all the Work, the correction period for that item may start to run from an earlier date if specifically, and expressly so provided in the Specifications or by Written Amendment.

Where defective Work (and damage to other Work resulting therefrom) has been corrected, removed or 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.

### **13.6. ACCEPTANCE OF DEFECTIVE WORK**

If, instead of requiring correction or removal and replacement of defective Work, the Owner prefers to accept it, the Owner may do so.

Contractor shall pay all claims, costs, losses and damages attributable to the Owner's evaluation of and determination to accept such defective Work such costs to be approved by Owner's Representative as to reasonableness. If any such acceptance occurs prior to Owner Representative's recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and the Owner shall be entitled to an appropriate decrease in the Contract Price, and, if the parties are unable to agree as to the amount thereof, the Owner may make a claim therefore as provided in article for Change of Contract Price. If the acceptance occurs after the Owner Representative's recommendation for final payment an appropriate amount will be paid by Contractor to the Owner.

### **13.7. OWNER MAY CORRECT DEFECTIVE WORK**

If Contractor fails within a reasonable time after written notice from Owner's Representative to correct defective Work or to remove and replace rejected Work as required by Owner's Representative in accordance with the article for Correction and Removal of Defective Work 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, the Owner may, after seven days' written notice to Contractor, correct and remedy any such deficiency. In exercising the rights and remedies under this paragraph the Owner shall proceed expeditiously. In connection with such corrective and remedial action, the 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 the Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's Representatives, Agents and employees, the Owner's other contractors, and Owner's Representative, Engineer, and Engineer's Consultants access to the site to enable the Owner to exercise the rights and remedies under this paragraph. All claims, costs, losses and damages incurred or sustained by the Owner in exercising such rights and remedies will be charged against Contractor and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and the Owner shall be entitled to an appropriate decrease in the Contract Price, and, if the parties are unable to agree as to the amount thereof, the Owner may make a claim therefore as provided in the article for Change of Contract Price. Such claims, costs, losses and damages will include but not be limited to all costs of repair or replacement of work of others destroyed or damaged by correction, removal or replacement of Contractor's defective Work. Contractor shall not be allowed an extension of the Contract Time (or Milestones) because of any delay in the performance of the Work attributable to the exercise by the Owner of the Owner's rights and remedies hereunder.

## **14. PAYMENTS TO CONTRACTOR AND COMPLETION**

Requests for payment shall be processed in accordance with F.S. 218.735 and as described herein. Progress payments on account of Unit Price Work will be based on the number of units completed.

### **14.1. APPLICATION FOR PROGRESS PAYMENT**

Contractor shall submit (not more often than once a month) to Owner's Representative for review an Application for Payment filled out and signed by Contractor covering the Work completed once each month and accompanied by such supporting documentation as is required by the Owner's Representative and the Contract Documents. Unless otherwise stated in the Contract Documents, payment will not be made for materials and equipment not incorporated in the Work. Payment will only be made for that portion of the Work, which is fully installed including all materials, labor and equipment. A retainage of not less than five (5%) of the amount of each Application for Payment for the total of all Work, including as-built survey and Inspector overtime reimbursement, completed to date will be held until final completion and acceptance of the Work covered in the Contract Documents. No progress payment shall be construed to be acceptance of any portion of the Work under contract.

The Contractor shall review with the Engineer or the Construction Inspector all quantities and work for which payment is being applied for and reach agreement prior to submittal of an Official Pay Request. The Engineer or the Construction Inspector will verify that the on-site marked up as-built drawings are up to date with the work and are in compliance with the Contract Documents.

In addition to all other payment provisions set out in this contract, the Owner's Representative may require the Contractor to produce for Owner, within fifteen (15) days of the approval of any progress payment, evidence and/or payment affidavit that all subcontractors and suppliers have been paid any sum or sums then due. A failure on the part of the contractor to provide the report

as required herein shall result in further progress or partial payments being withheld until the report is provided.

## **14.2. CONTRACTOR'S WARRANTY OF TITLE**

Contractor warrants and guarantees that title to all Work, materials and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to the Owner no later than the time of payment, free and clear of liens. No materials or supplies for the Work shall be purchased by Contractor or Subcontractor subject to any chattel mortgage or under a conditional sale contact or other agreement by which an interest is retained by the seller. Contractor warrants that he has good title to all materials and supplies used by him in the Work, free from all liens, claims or encumbrances. Contractor shall indemnify and save the Owner harmless from all claims growing out of the lawful demands of Subcontractors, laborers, workmen, mechanics, materialmen, and furnishers of machinery and parts thereof, equipment, power tools, and all supplies incurred in the furtherance of the performance of this Contract. Contractor shall at the Owner's request, furnish satisfactory evidence that all obligations of nature hereinabove designated have been paid, discharged, or waived. If Contractor fails to do so, then the Owner may, after having served written notice on said Contractor either pay unpaid bills, of which the Owner has written notice, or withhold from the Contractor's unpaid compensation a sum of money deemed reasonably sufficient to pay any and all such lawful claims until satisfactory evidence is furnished that all liabilities have been fully discharged, whereupon payment to Contractor shall be resumed in accordance with the terms of this Contract, but in no event shall the provisions of this sentence be construed to impose any obligations upon the Owner to the Contractor or the Surety. In paying any unpaid bills of the Contractor, the Owner shall be deemed the agent of Contractor and any payment so made by the Owner shall be considered as payment made under the Contract by the Owner to Contractor, and the Owner shall not be liable to Contractor for any such payment made in good faith.

## **14.3. REVIEW OF APPLICATIONS FOR PROGRESS PAYMENTS**

The Owner's Representative will within twenty (20) business days after receipt authorize and process payment by the Owner a properly submitted and documented Application for payment, unless the application requires review by an Agent. If the Application for payment requires review and approval by an Agent, properly submitted and documented Applications for payment will be paid by the Owner within twenty-five (25) business days. If an Application for payment is rejected, notice shall be given within twenty (20) business days of receipt indicating the reasons for refusing payment. The reasons for rejecting an Application will be submitted in writing, specifying deficiencies and identifying actions that would make the Application proper. In the latter case, Contractor may make the necessary corrections and resubmit the Application. The Owner's Representative or Agent may refuse to recommend the whole or any part of any payment to Owner. Owner's Representative or Agent may also refuse to recommend any such payment, or, because of subsequently discovered evidence or the results of subsequent inspections or test, nullify any such payment previously recommended, to such extent as may be necessary in Owner Representative's or Agent's opinion to protect the Owner from loss because: (i) the Work is defective, or completed Work has been damaged requiring correction or replacement, (ii) the Contract Price has been reduced by amendment or Change Order, (iii) the Owner has been required to correct defective Work or complete Work, or (iv) Owner's Representative or Agent has actual knowledge of the occurrence of any of the events enumerated in the article on Suspension of Work and Termination.

The Owner may refuse to make payment of the full amount recommended by the Owner's Representative or Agent because: (i) claims have been made against the Owner on account of Contractor's performance or furnishing of the Work, (ii) Liens have been filed in connection with the Work, except where Contractor has delivered a specific Bond satisfactory to the Owner to secure the satisfaction and discharge of such Liens, (iii) there are other items entitling the Owner to a set-off against the amount recommended, or (iv) the Owner has actual knowledge of any of the events described in this paragraph. The Owner shall give Contractor notice of refusal to pay in accordance with the time constraints of this section with a copy to the Owner's Representative or Agent, stating the reasons for such actions, and Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by the Owner and Contractor, when Contractor corrects to the Owner's satisfaction the reasons for such action.

#### **14.4. PARTIAL UTILIZATION**

Use by the Owner at the Owner's option of any substantially completed part of the Work which (i) has specifically been identified in the Contract Documents, or (ii) Owner, Engineer, Owner's Representative, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by the Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, may be accomplished prior to Final Completion of all the Work subject to the following:

The Owner at any time may request Contractor in writing to permit the Owner to use any such part of the Work which the Owner believes to be ready for its intended use and substantially complete. If Contractor agrees that such part of the Work is substantially complete, Contractor will certify to Owner, Owner's Representative, and Engineer that such part of the Work is substantially complete and request Owner's Representative to issue a certificate of Substantial Completion for that part of the Work. Contractor at any time may notify Owner, Owner's Representative, and Engineer in writing that Contractor considers any such part of the Work ready for its intended use and substantially complete and request Owner's Representative to issue a certificate of Substantial Completion for that part of the Work. Within a reasonable time after either such request, Owner, Contractor, Owner's Representative, 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, Owner's Representative, and Contractor in writing giving the reasons therefore. If Engineer considers that part of the Work to be substantially complete, the provisions of the articles for Substantial Completion and Partial Utilization 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.

#### **14.5. FINAL INSPECTION**

Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Owner's Representative will make a final inspection with Engineer, Owner and Contractor and will within thirty (30) days notify Contractor in writing of particulars in which this inspection reveals that the Work is incomplete or defective. The Owner's Representative will produce a final punch list, deliver it to the Contractor within five (5) days of completion and assign a date for this work to be completed not less than thirty (30) days from delivery of the list. Failure to include any corrective work or pending items does not alter the responsibility of the contractor to complete all the construction services purchased pursuant to the contract. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

## **14.6. FINAL APPLICATION FOR PAYMENT**

After Contractor has completed all such corrections to the satisfaction of Owner's Representative and has delivered in accordance with the Contract Documents all maintenance and operating instructions, As-built/Record Drawings, schedules, guarantees, Bonds, certificates or other evidence of insurance required by the paragraph for Bonds and Insurance, certificates of inspection, Inspector overtime reimbursement as required in the Contract Documents and other documents, Contractor may make application for final payment following the procedure for progress payments. The final Application for Payment shall be accompanied (except as previously delivered) by: (i) all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by paragraph for Bonds and Insurance, and (ii) executed consent of the surety to final payment using the form contained in Section V of the Contract Documents.

Prior to application for final payment, Contractor shall clean and remove from the premises all surplus and discarded materials, rubbish, and temporary structures, and shall restore in an acceptable manner all property, both public and private, which has been damaged during the prosecution of the Work and shall leave the Work in a neat and presentable condition.

## **14.7. FINAL PAYMENT AND ACCEPTANCE**

If through no fault of Contractor, final completion of the Work is significantly delayed and if Owner's Representative so confirms, the Owner shall, upon receipt of Contractor's final Application for payment and recommendation of Owner's Representative, and without terminating the Agreement, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by the Owner for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if Bonds have been furnished as required in paragraph for Bonds and Insurance, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by Contractor to Owner's Representative with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that such payment shall not constitute a waiver of claims.

If on the basis of Owner Representative's observation of the Work during construction and final inspection, and Owner Representative's review of the final Application for Payment and accompanying documentation, all as required by the Contract Documents, Owner's Representative is satisfied that the Work has been completed and Contractor's other obligations under the Contract Documents have been fulfilled, Owner's Representative will indicate in writing his recommendation of payment and present the Application to Owner for payment. Thereupon, Owner's Representative will give written notice to Owner and Contractor that the Work is acceptable subject to the provisions of this article. Otherwise, Owner's Representative will return the Application 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. If the Application and accompanying documentation are appropriate as to form and substance, the Owner shall, within twenty (20) days after receipt thereof pay contractor the amount recommended by Owner's Representative.

## **14.8. WAIVER OF CLAIMS**

The making and acceptance of final payment will constitute: a waiver of all claims by the Owner against Contractor, except claims arising from unsettled Liens, from defective Work appearing

after final inspection, from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from Contractor's continuing obligations under the Contract Documents; and a waiver of all claims by Contractor against the Owner other than those previously made in writing and still unsettled.

## **15. SUSPENSION OF WORK AND TERMINATION**

### **15.1. OWNER MAY SUSPEND THE WORK**

At any time and without cause, Owner's Representative may suspend the Work or any portion thereof for a period of not more than ninety (90) days by notice in writing to Contractor, which will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be allowed an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension if Contractor makes an approved claim therefore as provided in the articles for Change of Contract Price and Change of Contract Time.

### **15.2. OWNER MAY TERMINATE**

Upon the occurrence of any one or more of the following events; if Contractor persistently fails 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 as adjusted from time to time);

- if Contractor disregards Laws and Regulations of any public body having jurisdiction;
- if Contractor disregards the authority of Owner's Representative;
- if Contractor otherwise violates in any substantial way any provisions of the Contract Documents; or if the Work to be done under this Contract is abandoned, or if this Contract or any part thereof is sublet, without the previous written consent of the Owner, or if the Contract or any claim thereunder is assigned by Contractor otherwise than as herein specified, or at any time Owner's Representative certifies in writing to the Owner that the rate of progress of the Work or any part thereof is unsatisfactory or that the work or any part thereof is unnecessarily or unreasonably delayed.

The Owner may, after giving Contractor (and the surety, if any), seven days' written notice and, to the extent permitted by Laws and Regulations, terminate the services of Contractor, exclude Contractor from the site and take possession of the Work and of all Contractor's tools, appliances, construction equipment and machinery at the site and use the same to the full extent they could be used by Contractor (without liability to Contractor for trespass or conversion), incorporate in the Work all materials and equipment stored at the site or for which the Owner has paid Contractor but which are stored elsewhere, and finish the Work as the Owner may deem expedient. In such case Contractor shall not be entitled to receive any further payment until the Work is finished. If the unpaid balance of the Contract Price exceeds all claims, costs, losses and damages sustained by the Owner arising out of or resulting from completing the Work such excess will be paid to Contractor.

If such claims, costs, losses and damages exceed such unpaid balance, Contractor shall pay the difference to the Owner. Such claims, costs, losses and damages incurred by the Owner will be reviewed by Owner's Representative as to their reasonableness and when so approved by Owner's Representative incorporated in a Change Order, provided that when exercising any rights or

remedies under this paragraph the Owner shall not be required to obtain the lowest price for the Work performed.

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

Upon seven (7) days' written notice to Contractor and Owner's Representative, the Owner may, without cause and without prejudice to any other right or remedy of the Owner, elect to terminate the Agreement. In such case, Contractor shall be paid (without duplication of any items):

for 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;

for 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;

for all claims, costs, losses and damages incurred in settlement of terminated contracts with Subcontractors, Suppliers and others; and for reasonable expenses directly attributable to termination.

Contractor shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

### **15.3. CONTRACTOR MAY STOP WORK OR TERMINATE**

If, through no act or fault of Contractor, the Work is suspended for a period of more than ninety (90) days by the Owner or under an order of court or other public authority, or the Owner's Representative fails to act on any Application for Payment within thirty (30) days after it is submitted or the Owner fails for thirty (30) days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven (7) days' written notice to the Owner and Owner's Representative, and provided the Owner or Owner's Representative does not remedy such suspension or failure within that time, terminate the Agreement and recover from the Owner payment on the same terms as provided in the article for the Owner May Terminate. However, if the Work is suspended under an order of court through no fault of Owner, the Contractor shall not be entitled to payment except as the Court may direct. In lieu of terminating the Agreement and without prejudice to any other right or remedy, if Owner's Representative has failed to act on an Application for Payment within thirty (30) days after it is submitted, or the Owner has failed for thirty (30) days to pay Contractor any sum finally determined to be due, Contractor may upon seven (7) days' written notice to the Owner and Owner's Representative stop the Work until payment of all such amounts due Contractor. The provisions of this article are not intended to preclude Contractor from making claim under paragraphs for Change of Contract Price or Change of Contract Time or otherwise for expenses or damage directly attributable to Contractor's stopping Work as permitted by this article.

### **16. DISPUTE RESOLUTION**

If and to the extent that the Owner and Contractor have agreed on the method and procedure for resolving disputes between them that may arise under this Agreement, such dispute resolution

method and procedure will proceed. If no such agreement on the method and procedure for resolving such disputes has been reached, subject to the provisions of the article for Decisions on Disputes, the Owner and Contractor may exercise such rights or remedies as either may otherwise have under the Contract Documents or by Laws or Regulations in respect of any dispute provided, however, that nothing herein shall require a dispute to be submitted to binding arbitration.

## **17. MISCELLANEOUS**

### **17.1. SUBMITTAL AND DOCUMENT FORMS**

The form of all submittals, notices, change orders, pay applications, logs, schedules and other documents permitted or required to be used or transmitted under the Contract Documents shall be determined by the Owner's Representative subject to the approval of Owner.

### **17.2. GIVING NOTICE**

Whenever any provision of the Contract Documents requires the giving of written notice, notice will be deemed to have been validly given if delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or if delivered or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

### **17.3. NOTICE OF CLAIM**

Should the Owner or Contractor suffer injury or damage to person or property because of any error, omission or any act of the other party or of any of the other party's officers, employees or agents or others for whose acts the other party is legally liable, claim will be made in writing to the other party within a reasonable time of the first observance of such injury or damage. The provisions of this paragraph shall not be construed as a substitute for or a waiver of the provisions of any applicable statute of limitations or repose.

### **17.4. PROFESSIONAL FEES AND COURT COSTS INCLUDED**

Whenever reference is made to "claims, costs, losses and damages," the phrase shall include in each case, but not be limited to, all fees and charges of engineers, architects, attorneys and other professionals and all court or other dispute resolution costs.

### **17.5. ASSIGNMENT OF CONTRACT**

The Contractor shall not assign this contract or any part thereof or any rights thereunder without the approval of Owner, nor without the consent of surety unless the surety has waived its rights to notice of assignment.

### **17.6. RENEWAL OPTION**

Annual Contracts issued through the Engineering Department may be renewed for up to three (3) years, upon mutual consent of both the Owner and the Contractor/Vendor. All terms, conditions and unit prices shall remain constant unless otherwise specified in the contract specifications or in the Invitation to bid. Renewals shall be made at the sole discretion of the Owner and must be agreed to in writing by both parties. All renewals are contingent upon the availability of funds, and the satisfactory performance of the Contractor as determined by the Construction Department.

## **17.7. ROLL-OFF CONTAINERS AND/OR DUMPSTERS**

All City construction projects shall utilize City of Clearwater Solid Waste roll-off containers and/or dumpsters for their disposal and hauling needs. For availability or pricing contact William Buzzell, at the City of Clearwater, Solid Waste Department, by phone: (727) 562-4929 or email: [William.Buzzell@myClearwater.com](mailto:William.Buzzell@myClearwater.com).

## **18. ORDER AND LOCATION OF THE WORK**

The City reserves the right to accept and use any portion of the work whenever it is considered to the public interest to do so. The Engineer shall have the power to direct on what line or street the Contractor shall work and order thereof.

## **19. MATERIAL USED**

All material incorporated into the final work shall be new material unless otherwise approved by the Engineer. If requested by the Engineer, the Contractor shall furnish purchase receipts of all materials.

## **20. CONFLICT BETWEEN PLANS AND SPECIFICATIONS**

The various Contract Documents shall be given precedence, in case of conflict, error or discrepancy, as follows: Modifications, Contract Agreement, Addenda, Supplementary General Conditions, General Conditions, Supplementary Technical Specifications and Technical Specifications. In a series of Modifications or Addenda the latest will govern. In the case of an inconsistency between Drawings and Specifications or within either Document not clarified by addendum, the better quality, more stringent or greater quantity of Work shall be provided in accordance with the Engineer/Architect's interpretation.

## **21. OWNER DIRECT PURCHASE (ODP)**

### **21.1. SALES TAX SAVINGS**

The Owner reserves the right to purchase certain portions of the materials or equipment for the Project directly in order to save applicable sales tax in compliance with Florida Law since owner is exempt from the payment of sales tax. The contract price includes Florida sales and other applicable taxes for materials, supplies, and equipment which will be a part of the Contractor's Work. Owner-purchasing of construction materials or equipment, if selected, will be administered on a deductive Change Order basis. The contract price shall be reduced by the actual cost of the materials or equipment purchased by owner plus the normally applicable sales tax, even if the actual cost is in excess of the cost for the materials or equipment as-bid by the Contractor. For purposes of calculating engineering fees, contractor fees, architects' fees, and any other amounts that are based on the contract amount, however, the original, as-bid contract amount shall be used.

Direct purchase shall be considered for single items or materials that exceed \$10,000 in value and/or items identified in Section V, Bidders Proposal. The Contractor shall provide the Owner an ODP Summary of all intended suppliers, vendors, equipment and materials for consideration as ODP materials or equipment (refer to ODP Instructions in Contract Appendix).

## 21.2. TITLE AND OWNER RISK

Owner will issue Purchase Orders and provide a copy of Owner's Florida Consumer Certification of Tax Exemption and Certificate of Entitlement directly to the Vendor for ODP materials or equipment. Invoices for ODP materials or equipment shall be issued to the Owner, and a copy sent to the Contractor.

Notwithstanding the transfer of ODP materials or equipment by the Owner to the Contractor's possession, the Owner shall retain legal and equitable title to any and all ODP materials or equipment; therefore, the owner assumes the risk of damage or loss at the time of purchase or delivery of items, unless material is damaged as the result of negligence by the Contractor.

## 21.3. CONTRACTOR'S RECEIPT OF MATERIALS

The Contractor shall be fully responsible for all matters relating to the receipt of materials or equipment furnished to the Owner including, but not limited to, verifying correct quantities, verifying documents of orders in a timely manner, coordinating purchases, providing and obtaining all warranties and guarantees required by the Contract Documents, and inspection and acceptance of the goods at the time of delivery. The Owner shall coordinate with Contractor and Vendor delivery schedules, sequence of delivery, loading orientation, and other arrangements normally required by the Contractor for the particular materials or equipment furnished. The Contractor shall provide all services required for the unloading and handling of materials or equipment. The Contractor agrees to indemnify and hold harmless the Owner from any and all claims of whatever nature resulting from non-payment of goods to suppliers arising from the action of the Contractor.

As ODP materials or equipment are delivered to the job site, the Contractor shall visually inspect all shipments from the suppliers and approve the vendor's invoice for items delivered. The Contractor shall assure that each delivery of ODP materials or equipment is accompanied by documentation adequate to identify the Purchase Order against which the purchase is made. This documentation may consist of a delivery ticket and/or an invoice from the supplier conforming to the Purchase Order together with such additional information as the Owner may require. The Contractor will then forward an electronic copy of the invoice and supporting documentation to the Owner for payment within fourteen (14) calendar days of receipt of said goods or materials. Such payment shall be directly from public funds, from Owner to Vendor.

The Contractor shall insure that ODP materials or equipment conform to the Specifications and determine prior to acceptance of goods at time of delivery if such materials or equipment are patently defective, and whether such materials or equipment are identical to the materials or equipment ordered and match the description on the bill of lading. If the Contractor discovers defective or non-conformities in ODP materials or equipment upon such visual inspection, the Contractor shall not utilize such nonconforming or defective materials or equipment in the Contractor's Work and instead shall properly notify the Owner of the defective or nonconforming condition so that repair or replacement of those materials or equipment can occur without undue delay or interruption to the Project. If the Contractor fails to perform such inspection and otherwise incorporates into the Contractor's Work such defective or nonconforming ODP materials or equipment, the condition of which it either knew or should have known by performance of an inspection, Contractor shall be responsible for all damages to the Owner, resulting from Contractor's incorporation of such materials or equipment into the Project, including liquidated damages.

## **21.4. ODP RECORDS, WARRANTIES AND INDEMNIFICATION**

The Contractor shall maintain records of all ODP materials or equipment it incorporates into Contractor's Work from the stock of ODP materials or equipment in its possession. The Contractor shall account monthly to the Owner for any ODP materials or equipment delivered into the Contractor's possession, indicating portions of all such materials or equipment which have been incorporated in the Contractor's Work.

The Contractor shall be responsible for obtaining and managing all warranties and guarantees for all materials, equipment and products as required by the Contract Documents. All repair, maintenance, or damage-repair calls shall be forwarded to the Contractor for resolution with the appropriate supplier, vendor, or subcontractor.

The Owner shall indemnify and hold Contractor harmless from any sales tax (and interest and penalties incurred in connection therewith) in the event there is a final determination that purchases made by Owner, which Owner treats as being exempt from sales tax, are subject to sales tax. "Final determination" shall mean an assessment by the Department of Revenue that is no longer subject to protest, or a determination of a court having jurisdiction over such matters that is final and not subject to appeal. Contractor agrees to promptly notify owner of any audit, assessment, proposed assessment or notice of deficiency issued with regard to the Project and relating to ODP materials or equipment. ODP Purchase Orders must be closed out prior to closing out the contract/Contractor Purchase Order. If material costs needed for project exceed the ODP Purchase Order amount, the ODP Purchase Order will not be increased. Amounts in excess of the ODP Purchase Order will be paid for by the Contractor.

## **22. RESIDENT NOTIFICATION OF START OF CONSTRUCTION**

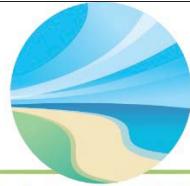
### **22.1. GENERAL**

The Contractor shall notify all residents along the construction route or within a 500-foot radius, unless stated otherwise in the Contract Documents, with a printed door hanger notice indicating the following information about the proposed construction work and the Contractor performing the work: City seal or logo; the scheduled date for the start of construction; the type of construction; general sequence and scheduling of construction events; possibility of water service disruption and/or colored water due to construction efforts; Contractor's name, the Superintendent's name, Contractor address and telephone number; Contractor's company logo (optional); requirement for residents to remove landscaping and/or other private appurtenances which are in conflict with the proposed construction; and other language as appropriate to the scope of Contract work. Sample door hanger including proposed language shall be approved by the City prior to the start of construction. Notification shall be printed on brightly colored and durable card stock and shall be a minimum of 4-1/4 by 11 inches in size. Notification (door hanger) shall be posted to residences and businesses directly affected by the Contractor's activities no later than seven (7) days prior to the start of construction activity. Directly affected by the Contractor's activities shall mean all Contractor operations including staging areas, equipment and material storage, principal access routes across private property, etc. Contractor cannot start without proper seven (7) day notice period to residents. Contractor is required to maintain sufficient staff to answer citizen inquiries during normal business hours and to maintain appropriate message recording equipment to receive citizen inquires after business hours.

### **SECTION III – General Conditions**

Resident notification by the Contractor is a non-specific pay item to be included in the bid items provided in the contract proposal.

## 22.2. EXAMPLE



**CLEARWATER**  
BRIGHT AND BEAUTIFUL • BAY TO BEACH

**NOTICE OF CONSTRUCTION**

TODAY'S DATE: \_\_\_\_/\_\_\_\_/\_\_\_\_

**PLEASE EXCUSE US FOR ANY INCONVENIENCE**

We are the construction contractor performing the (*state project name*) for the City of Clearwater in your area. The work will be performed in the public right-of-way adjacent to your property. This notice is placed a minimum of seven (7) days in advance of construction to notify property owners of the pending start of construction.

(*Brief description of the construction process to be expected by the property owners*)

The construction process may necessitate the removal of certain items from the right-of-way. Typical items such as sprinklers, grass, and postal approved mailboxes will be replaced by the contractor within a reasonably short period of time. The replacement of driveways and sidewalks will be made using standard asphalt or concrete materials. The property owner is responsible for the expense and coordination to replace driveways and sidewalks which have customized colors, textures and/or materials. Small trees, shrubs, landscaping materials, unauthorized mailboxes or structures within the right-of-way which must be removed due to the construction process will not be replaced. The property owner is responsible to relocate any such items which the property owner wishes to save prior to the start of construction. Vehicles parked on the streets or within the right-of-way may be required to be placed elsewhere.

We are available to answer any questions you may have regarding the construction process or any particular item that must be relocated. Please contact our Construction Manager \_\_\_\_\_ at (727) \_\_\_\_\_. We will be more than happy to assist you.

Construction is anticipated to begin on: \_\_\_\_\_.

**Company Name**  
**Company Address**  
**Contractor Phone Number**

## 23. PROJECT INFORMATION SIGNS

### 23.1. SCOPE AND PURPOSE

The Owner desires to inform the general public on the Owner's use and expenditure of public funding for general capital improvement and maintenance projects. To help accomplish this purpose, the Contractor is required to prepare and display public project information signs during the full course of the contract period. These signs will be displayed at all location(s) of active work. Payment to Contractor for the preparation, installation and management of project sign(s) shall be

included in the cost of the work. The number of and type of signs will be stated in SECTION IV, SCOPE OF WORK.

## **23.2. PROJECT SIGN, FIXED OR PORTABLE**

Sign type shall be "fixed" on stationary projects and "portable" on projects which have extended locations or various locations. The particular wording to be used on the signs will be determined after contract award has been approved. Contractor will be provided the wording to be used on sign at the preconstruction conference.

### **23.3. FIXED SIGN**

Fixed sign shall be 4-foot by 6-foot (4'x6') in size and painted on a sheet of exterior grade plywood of the same size and a minimum thickness of 1/2-inches. Sign shall be attached to a minimum of two (2) 4-inch by 4-inch (4"x4") below grade pressure treated (P.T.) wooden posts and braced as necessary for high winds. Posts shall be long enough to provide secure anchoring in the ground. Bottom of sign must be a minimum of 24-inches above the ground. Alternate mounting system or attachment to fencing or other fixed structure can be considered for approval. Sign shall be painted white on both sides with exterior rated paint.

### **23.4. PORTABLE SIGNS**

Portable sign shall be a minimum of 24-inches by 30-inches (24"x30") in size and will be attached to a standard sized portable traffic barricade. Sign material shall be aluminum, 0.080-inches or thicker, background of white reflective sheeting, and shall be silkscreen or vinyl lettering. Portable sign shall be two signs located and attached to each side of the traffic barricade.

### **23.5. SIGN COLORING**

Background shall be white. Project Descriptive Name shall be in blue lettering. All other lettering shall be black. Basic lettering on sign shall be in all capital letters, of size proportional to the sign itself. Each sign shall depict the City's logo. The Project Manager/City Representative shall provide the appropriate electronic logo file(s) to the Contractor.

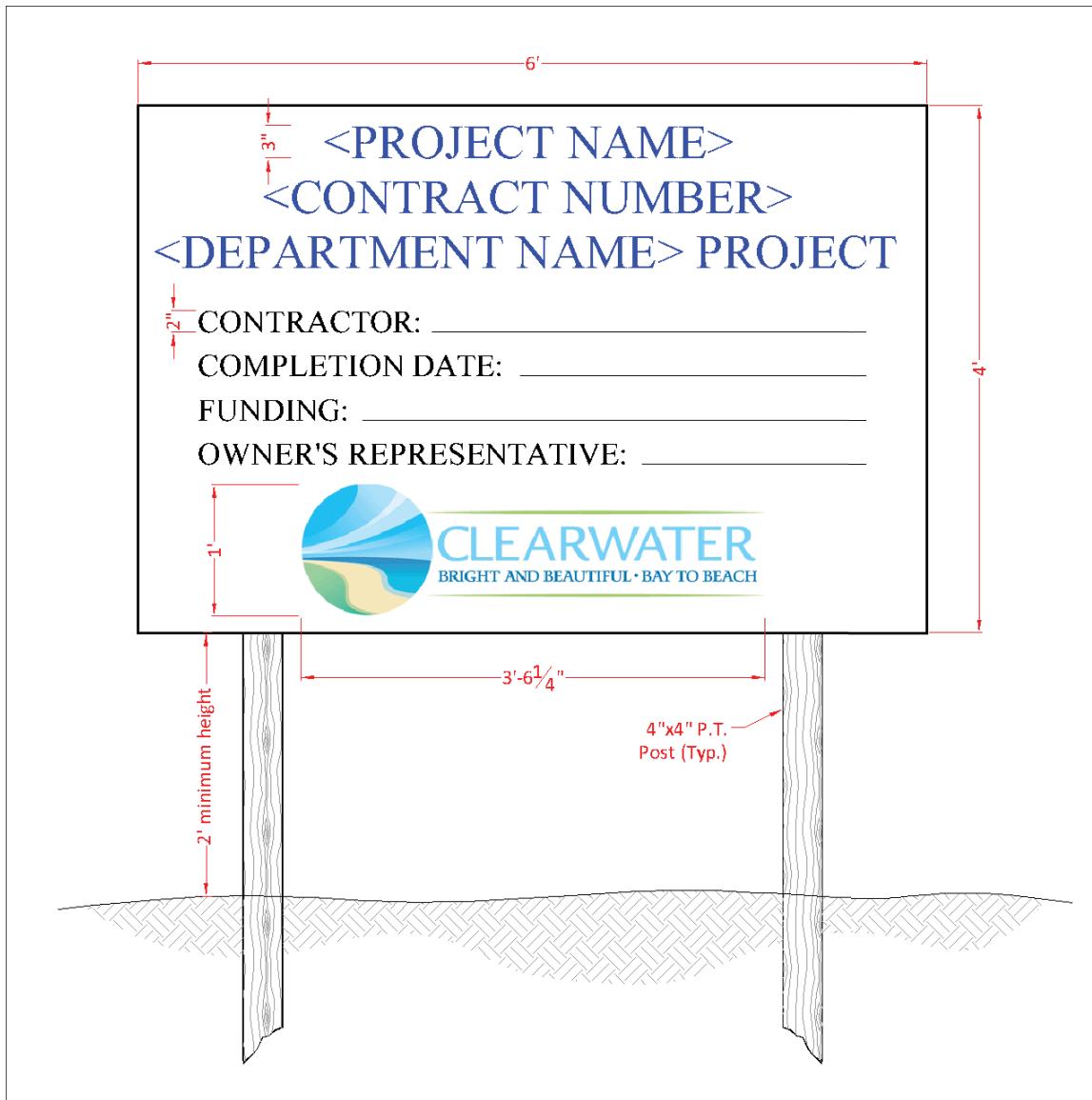
### **23.6. SIGN PLACEMENT**

Signs shall be placed where they are readily visible by the general public which pass by the project site. Signs are not to be placed where they may become a hazard or impediment to either pedestrian or vehicular traffic. For construction projects outside of the Owner's right-of-way, the signs will be placed on the project site. For projects constructed inside of the Owner's right-of-way, the signs will be placed in the right-of-way. Portable signs are to be moved to the locations of active work on the project. Multiple portable signs will be necessary where work is ongoing in several locations at the same time. Fixed signs are to be placed at the start of construction and will remain in place until the request for final payment.

### **23.7. SIGN MAINTENANCE**

The Contractor is responsible for preparation, installation, movement, maintenance, replacement, removal and disposal of all project signs during the full course of the contract period. The Contractor will place and secure portable signs from dislocation by wind or other actions. Signs are to be cleaned as necessary to maintain legibility and immediately replaced if defaced.

## 23.8. TYPICAL PROJECT SIGN



## 24. AWARD OF CONTRACT, WORK SCHEDULE AND GUARANTEE

It will be required that the work will commence not later than five (5) calendar days after the Engineer gives written Notice to Proceed (NTP), which notice shall be given as outlined in Article 2 of these General Conditions.

It is further required that all work within this contract be completed within the indicated number of consecutive calendar days as determined in Section IV, Scope of Work. Contract Time to commence at start date noted on the Notice to Proceed. If the Contractor fails to complete the work within the stipulated time, the City will retain the amount stated in the Contract, per calendar day, for each day that the contract remains incomplete. The work shall be discontinued on Saturdays, Sundays, and approved Holidays. If it becomes necessary for the Contractor to perform work on Saturdays, Sundays, and approved City of Clearwater Employee Holidays, that in the opinion of the Engineer, will require the presence of Inspectors, the Contractor shall pay the City of

### SECTION III – General Conditions

Clearwater, Florida, the amount of Four Hundred Eighty Dollars (\$480.00) per each eight-hour (8) day for each Inspector given such assignment.

The Contractor shall remedy any defects in the work at his own expense and pay for any damage to other work resulting therefrom which appear within a period of one (1) year from the date of final acceptance.

## **25. SCRUTINIZED COMPANIES AND BUSINESS OPERATIONS WITH CUBA AND SYRIA CERTIFICATION FORM AND ISRAEL CERTIFICATION FORM**

Pursuant to Section 287.135, Florida Statutes, any vendor, company, individual, principal, subsidiary, affiliate, or owner on the Scrutinized Companies with Activities in Sudan List, the Scrutinized Companies with Activities in the Iran Petroleum Energy Sector List, or is engaged in business operations in Cuba or Syria, is ineligible for, and may not bid on, submit a proposal for, or enter into or renew a contract with the City of Clearwater for goods or services for an amount equal to or greater than one million (\$1,000,000.00) dollars. Any vendor, company, individual, principal, subsidiary, affiliate, or owner on the Scrutinized Companies that Boycott Israel List, or is engaged in a boycott of Israel, is ineligible for, and may not bid on, submit a proposal for, or enter into or renew a contract with the City of Clearwater for goods or services for ANY amount.

Each entity submitting a bid, proposal, or response to a solicitation must certify to the City of Clearwater that it is not on the aforementioned lists, or engaged in business operations in Cuba or Syria, or engaged in a boycott of Israel at the time of submitting a bid, proposal or response, in accordance with Section 287.135, Florida Statutes. Business Operations means, for purposes specifically related to Cuba or Syria, engaging in commerce in any form in Cuba or Syria, including, but not limited to, acquiring, developing, maintaining, owning, selling, possessing, leasing or operating equipment, facilities, personnel, products, services, personal property, real property, military equipment, or any other apparatus of business or commerce. Boycott Israel or boycott of Israel means refusing to deal, terminating business activities, or taking other actions to limit commercial relations with Israel, or persons or entities doing business in Israel or in Israeli-controlled territories, in a discriminatory manner. A statement by a company that it is participating in a boycott of Israel, or that it has initiated a boycott in response to a request for a boycott of Israel or in compliance with, or in furtherance of, calls for a boycott of Israel, may be considered as evidence that a company is participating in a boycott of Israel.

The certification forms (the Certification) are attached hereto, and must be submitted, along with all other relevant contract documents, at the time of submitting a bid, proposal, or response. Failure to provide the Certification may deem the entity's submittal non-responsive. If the City of Clearwater determines that an entity has submitted a false certification form, 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 the Scrutinized Companies that Boycott Israel List, or engaged in business operations in Cuba or Syria, or engaged in a boycott of Israel, then the contract may be terminated at the option of the City of Clearwater. Other than the submission of a false certification, the City of Clearwater, on a case-by-case basis and in its sole discretion, may allow a company to bid on, submit a proposal for, or enter into or renew a contract for goods or services, if the conditions set forth in Section 287.135, Florida Statutes, apply.

The City retains the right to pursue civil penalties and any other applicable rights and remedies as provided by law for the false submission of the attached certification forms.

**SECTION III – General Conditions**

See Section V of the Contract for Certification Forms to be executed and submitted with the Bid/Proposal Form.

# SECTION IV

## TECHNICAL SPECIFICATIONS

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## **100 SERIES: GENERAL**

### **101. SCOPE OF WORK**

Project Name: Marshall St. WRF Blend Tank Mixer Project

Project Number: 18-0057-UT

#### **Scope of Work:**

This Work shall be performed in accordance with the Contract Documents and generally includes, but is not limited to, the following:

1. Demolish the following within the extents of the Existing Sludge Holding Tank: FRP Cover, Stairs, Supports, Structural Walkway, Aeration Piping, Existing Piping (as shown in the Contract Drawings).
2. Remove Grit, Sludge, and Rags remaining in existing Sludge Holding Tank and dispose off-site in accordance with FDEP regulations.
3. Temporarily remove, store, and protect FRP Odor Control Duct for reconnection to new Sludge Holding Tank Cover.
4. Install new Sludge Holding Tank Stairs and Walkway.
5. Drain, clean, and coat the interior (walls and floor) and exterior (walls) of the existing Sludge Holding Tank.
6. Demolish the existing Pump Station Pad and replace with structure elevated beyond the 100-year flood plain.
7. Install two LED Light Pole systems and modify the existing Light Pole to be LED as specified on the Drawings near the Sludge Holding Tank.
8. Install a New Mixer in the Sludge Holding Tank.
9. Install a New Aluminum Cover with Access Ladders and Harness Tie-Off Points from Walkway on the Sludge Holding Tank.
10. Install New Truck Off-Loading and Recirculation Pump Station (as shown in the contract Drawings) southeast of the Sludge Holding Tank.
11. Remove and replace Dewatering Feed Pump Station Pumps and Piping located at the Sludge Holding Tank.
12. Remove concrete sidewalk and pad (as shown in the Contract Drawings), leaving appropriate base and support for stair landing and stair columns supports.
13. Remove and replace process and drain piping to Sludge Holding Tank (as shown in the Contract Drawings).
14. Incorporate Electrical, Arc Flash Requirements, Instrumentation & Controls (I&C) and SCADA Integration for proposed improvements.

The Contractor shall provide copies of a current Contractor License/Registration with the state of Florida and Pinellas County in the bid response.

The Contractor shall provide fixed project signs as described in SECTION III, ARTICLE 23 of the Contract Documents. The final number of project signs will be determined at the beginning of the project based on the Contractor's schedule of work submitted for approval. Additional project signs may be required at no additional cost to the Owner due to the Contractor's schedule of work.

|   |
|---|
| <b>Contract Period: 300 Consecutive Calendar Days</b> |
|---|

## **102. FIELD ENGINEERING**

### **102-1. LINE AND GRADE PERFORMED BY THE CONTRACTOR**

Unless otherwise specified, the Contractor shall provide and pay for field engineering service required for the project. Such work shall include survey work to establish lines and levels and to locate and lay out site improvements, structures, and controlling lines and levels required for the construction of the work. Also included are such Engineering services as are specified or required to execute the Contractor's construction methods. Engineers and Surveyors shall be licensed professionals under the laws of the State of Florida. The Contractor shall provide three (3) complete sets of As-built Surveys to the Engineer prior to final payment being made as outlined in Section III (General Conditions), Article 6.11.2 of these Contract Documents.

#### **102-1.1. GRADES, LINES AND LEVELS**

Existing basic horizontal and vertical control points for the project are those designated on the Drawings or provided by the City. Control points (for alignment only) shall be established by the Engineer. The Contractor shall locate and protect control points prior to starting site work and shall preserve all permanent reference points during construction. In working near any permanent property corners or reference markers, the Contractor shall use care not to remove or disturb any such markers. In the event that markers must be removed or are disturbed due to the proximity of construction work, the Contractor shall have them referenced and reset by a Professional Land Surveyor licensed in the State of Florida.

#### **102-1.2. LAYOUT DATA**

The Contractor shall layout the work at the location and to the lines and grades shown on the Drawings. Survey notes indicating the information and measurements used in establishing locations and grades shall be kept in notebooks and furnished to the Engineer with the record drawings for the project.

### **102-2. LINE AND GRADE PERFORMED BY THE CITY**

If line and grade is supplied by the City, at the completion of all work the Contractor shall be responsible to have furnished to the project inspector a replacement of the wooden lath and stakes used in the construction of this project. Excessive stake replacement caused by negligence of Contractor's forces, after initial line and grade have been set, as determined by the City Engineer, will be charged to the Contractor at the rate of \$100.00 per hour. Time shall be computed for actual

time on the project. All time shall be computed in one-hour increments. Minimum charge is \$100.00. The Contractor shall provide three (3) complete sets of As-built Surveys to the Engineer prior to final payment being made as outlined in Section III (General Conditions), Article 6.11.2 of these Contract Documents.

## **103. DEFINITION OF TERMS**

For the Purpose of these Technical Specifications, the Definition of Terms from Section III, Article 1 - Definitions of these Contract Documents shall apply.

For the purpose of the Estimated Quantities, the Contractor's attention is called to the fact that the estimate of quantities as shown on the Proposal is approximate and is given only as a basis of calculation upon which the award of the contract is to be made. The City does not assume any responsibility that the final quantities will remain in strict accordance with estimated quantities nor shall the Contractor plead misunderstandings or deception because of such estimate of quantities or of the character or location of the work or of other conditions or situations pertaining thereto.

### **103-1. REFERENCE STANDARDS**

Reference to the standards of any technical society, organization, or associate, or to codes of local or state authorities, shall mean the latest standard, code, specification, or tentative standard adopted and published at the date of receipt of bids, unless specifically stated otherwise.

The most stringent specification prevails in the case where more than one specification is referenced for the same task.

Contractor shall utilize applicable FDOT Standards and Specifications for tasks that are not covered by City's Standards and Specifications.

## **104. STREET CROSSINGS, ETC.**

At such crossings, and other points as may be directed by the Engineer, trenches shall be bridged in an open and secure manner, so as to prevent any serious interruption of travel upon the roadway or sidewalk, and also to afford necessary access to public or private premises. The material used, and the mode of constructing said bridges, and the approaches, thereto, must be satisfactory to the Engineer.

The cost of all such work must be included in the cost of the trench excavation.

## **105. AUDIO/VIDEO RECORDING OF WORK AREAS**

### **105-1. CONTRACTOR TO PREPARE AUDIO/VIDEO RECORDING**

Prior to commencing work, the Contractor shall have a continuous color audio/video recording taken along the entire length of the Project including all affected project areas. Streets, easements, rights-of-way, lots or construction sites within the Project must be recorded to serve as a record of pre-construction conditions.

## **105-2. SCHEDULING OF AUDIO/VIDEO RECORDING**

The video recordings shall not be made more than twenty-one (21) days prior to construction in any area.

## **105-3. PROFESSIONAL VIDEOGRAPHERS**

The Contractor shall engage the services of a professional videographer. The color audio/video recording shall be prepared by a responsible commercial firm known to be skilled and regularly engaged in the business of pre-construction color audio/video recording documentation.

## **105-4. EQUIPMENT**

All equipment, accessories, materials and labor to perform this service shall be furnished by the Contractor. The total audio/video system shall reproduce bright, sharp, clear pictures with accurate colors and shall be free from distortion, tearing, rolls or any other form of imperfection. The audio portion of the recording shall reproduce the commentary of the camera operator with proper volume, clarity and be free from distortion and interruptions. In some instances, audio/video coverage may be required in areas not accessible by conventional wheeled vehicles. Such coverage shall be obtained by walking.

## **105-5. RECORDED AUDIO INFORMATION**

Each recording shall begin with the current date, project name and be followed by the general location, i.e., viewing side and direction of progress. Accompanying the video recording of each video shall be a corresponding and simultaneously recorded audio recording. This audio recording, exclusively containing the commentary of the camera operator or aide, shall assist in viewer orientation and in any needed identification, differentiation, clarification, or objective description of the features being shown in the video portion of the recording. The audio recording shall also be free from any conversations.

## **105-6. RECORDED VIDEO INFORMATION**

All video recordings must continuously display transparent digital information to include the date and time of recording. The date information shall contain the month, day and year. The time information shall contain the hour, minutes and seconds. Additional information shall be displayed periodically. Such information shall include, but not be limited to, project name, contract number, direction of travel and the viewing side. This transparent information shall appear on the extreme upper left hand third of the screen. Camera pan, tilt, zoom-in and zoom out rates shall be sufficiently controlled such that recorded objects will be clearly viewed during video playback. In addition, all other camera and recording system controls, such as lens focus and aperture, video level, pedestal, chrome, white balance, and electrical focus shall be properly controlled or adjusted to maximize picture quality.

## **105-7. VIEWER ORIENTATION**

The audio and video portions of the recording shall maintain viewer orientation. To this end, overall establishing views of all visible house and business addresses shall be utilized. In areas where the proposed construction location will not be readily apparent to the video viewer, highly

visible yellow flags shall be placed by the Contractor in such a fashion as to clearly indicate the proposed centerline of construction. When conventional wheeled vehicles are used as conveyances for the recording system, the vertical distance between the camera lens and the ground shall not exceed ten feet (10'). The camera shall be firmly mounted such that transport of the camera during the recording process will not cause an unsteady picture.

## **105-8. LIGHTING**

All recording shall be done during time of good visibility. No videoing shall be done during precipitation, mist or fog. The recording shall only be done when sufficient sunlight is present to properly illuminate the subjects of recording and to produce bright, sharp video recordings of those subjects.

## **105-9. SPEED OF TRAVEL**

The average rate of travel during a particular segment of coverage shall be directly proportional to the number, size and value of the surface features within the construction area's zone of influence. The rate of speed in the general direction of travel of the vehicle used during videoing shall not exceed forty-four (44) feet per minute.

## **105-10. VIDEO LOG/INDEX**

All videos shall be permanently labeled and shall be properly identified by video number and project title. Each video shall have a log of that video's contents. The log shall describe the various segments of coverage contained on the video in terms of the names of the streets or location of easements, coverage beginning and end, directions of coverage, video unit counter numbers, engineering survey or coordinate values (if reasonably available) and the date.

## **105-11. AREA OF COVERAGE**

Video coverage shall include all surface features located within the zone of influence of construction supported by appropriate audio coverage. Such coverage shall include, but not be limited to, existing driveways, sidewalks, curbs, pavements, drainage system features, mailboxes, landscaping, culverts, fences, signs, Contractor staging areas, adjacent structures, etc., within the area covered by the project. Of particular concern shall be the existence of any faults, fractures, or defects. Taped coverage shall be limited to one side of the Site, street, easement or right of way at any one time.

## **105-12. COSTS OF VIDEO SERVICES**

The cost to complete the requirements under this section shall be included in the contract items provided in the proposal sheet. There is no separate pay item for this work.

## **106. STREET SIGNS**

The removal, covering or relocation of street signs by the Contractor is prohibited.

All street signs shall be removed, covered or relocated by the City's Traffic Engineering Division in accordance with Sections 700, 994, 995, and 996 of FDOT's Standard Specifications.

The Contractor shall notify the City's Traffic Engineering Division a minimum of twenty-four (24) hours in advance of the proposed sign relocation, covering or removal.

## **107. WORK ZONE TRAFFIC CONTROL**

### **107-1. CONTRACTOR RESPONSIBLE FOR WORK ZONE TRAFFIC CONTROL**

The Contractor shall be responsible to furnish, operate, maintain and remove all work zone traffic control associated with the Project, including detours, advance warnings, channelization, hazard warnings and any other necessary features, both at the immediate work site and as may be necessary at outlying points.

### **107-2. WORK ZONE TRAFFIC CONTROL PLAN**

The Contractor shall prepare a detailed traffic control plan designed to accomplish the level of performance outlined in the Scope of the Work and/or as may be required by construction permits issued by Pinellas County and/or the Florida Department of Transportation for the Project, incorporating the methods and criteria contained in Part VI, Standards and Guides for Traffic Controls for Street and Highway Construction, Maintenance, Utility and Incident Management Operations in the Manual on Uniform Traffic Control Devices published by the U.S. Department of Transportation and adopted as amended by the Florida Department of Transportation, or most recent addition. This plan shall be reviewed and approved by City Traffic Operations personnel regardless if MOT plan details are included in the contract plans.

#### **107-2.1. WORK ZONE SAFETY**

The general objectives of a program of work zone safety are to protect workers, pedestrians, bicyclists and motorists during construction and maintenance operations. This general objective may be achieved by meeting the following specific objectives:

- Provide adequate advance warning and information regarding upcoming work zones.
- Provide the driver clear directions to understanding the situation they will be facing as the driver proceeds through or around the work zone.
- Reduce the consequences of an out of control vehicle.
- Provide safe access and storage for equipment and material.
- Promote speedy completion of projects (including thorough cleanup of the site).
- Promote use of the appropriate traffic control and protection devices.
- Provide safe passageways for pedestrians through, in, and/or around construction or maintenance work zones.

Per the 2014 Design Standards (DS), Index 600 or latest revision:

“When an existing pedestrian way or bicycle way is located within a traffic control work zone, accommodation must be maintained and provision for the disabled must be provided. Only approved pedestrian longitudinal channelizing devices may be used to delineate a temporary traffic control zone pedestrian walkway. Advanced notification of sidewalk closures and marked detours shall be provided by appropriate signs.”

Per the 2014 Standard Specifications for Road and Bridge Construction or latest revision FDOT Design Standards (DS): 102-5 Traffic Control, 102-5.1 Standards, are the minimum standards for the use in the development of all traffic control plans.

## **107-3. ROADWAY CLOSURE GUIDELINES**

Roadway types: Major Arterials, Minor Arterials, Local Collectors, and Local

Following are typical requirements to be accomplished prior to closure. The number of requirements increases with traffic volume and the importance of access. Road closures affecting business or sole access routes will increase in process requirements as appropriate. For all but local streets, no road or lane closures are allowed during the Christmas holiday season and the designated “Spring Break” season without prior approval by the City Engineer.

### **107-3.1. ALL ROADWAYS**

Obtain permits for Pinellas County or Florida Department of Transportation roadways.

Traffic control devices conform to national and state standards.

#### **107-3.1.1. PUBLIC NOTIFICATION**

Standard property owner notification prior to start of construction for properties directly affected by the construction process.

### **107-3.2. MAJOR ARTERIALS, MINOR ARTERIALS, LOCAL COLLECTORS**

Consult with City Traffic Division staff for preliminary traffic control options.

Develop Formal Traffic Control Plan for Permit Submittal to Regulatory Agency as necessary.

#### **107-3.2.1. PUBLIC NOTIFICATION**

Message Board Display, Minimum of seven (7) day notice period prior to road closure and potentially longer for larger highway. The message board is to be provided by the Contractor.

### **107-3.3. MAJOR ARTERIALS, MINOR ARTERIALS**

#### **107-3.3.1. PUBLIC NOTIFICATION**

C-View Release

### **107-3.4. MAJOR ARTERIALS**

#### **107-3.4.1. PUBLIC NOTIFICATION**

News Release

The Message Board may need to be displayed for a period longer than seven (7) days.

## **107-4. APPROVAL OF WORK ZONE TRAFFIC CONTROL PLAN**

The Contractor is invited and encouraged to confer in advance of bidding, and is required, as a specification of the work, to confer in advance of beginning any work on the Project, with the Traffic Operations Division, Municipal Services Building, 100 South Myrtle Avenue, telephone (727) 562-4747, for the purpose of approval of the Contractor's proposed detailed traffic control plan. All maintenance of traffic (MOT) plans shall be signed and sealed by a Professional Engineer or an individual who is certified in the preparation of MOT plans in the State of Florida.

## **107-5. INSPECTION OF WORK ZONE TRAFFIC CONTROL OPERATION**

The Traffic Operations Division may inspect and monitor the traffic control plan and traffic control devices of the Contractor. The City's Construction Inspector assigned to the project, may make known requirements for any alterations or adjustments to the traffic control devices. The Contractor shall take direction from the Project Engineer or Project Inspector.

## **107-6. PAYMENT FOR WORK ZONE TRAFFIC CONTROL**

Payment for work zone traffic control is a non-specific pay item to be included in the construction costs associated with other specific pay items unless specifically stated otherwise.

## **107-7. CERTIFICATION OF WORK ZONE TRAFFIC CONTROL SUPERVISOR**

The City may require that the Supervisor or Foreman controlling the work for the Contractor on the Project have a current International Municipal Signal Association, Work Zone Traffic Control Safety Certification or Worksite Traffic Supervisor Certification from the American Traffic Safety Association with additional current Certification from the Florida Department of Transportation. This requirement for Certification will be noted in the Scope of Work and/or sections of these Technical Specifications. When the certified supervisor is required for the Project, the supervisor will be on the Project site at all times while work is being conducted.

The Worksite Traffic Supervisor shall be available on a twenty-four (24) hour per day basis and shall review the project on a day-to-day basis as well as being involved in all changes to traffic control. The Worksite Traffic Supervisor shall have access to all equipment and materials needed to maintain traffic control and handle traffic related situations. The Worksite Traffic Supervisor shall ensure that routine deficiencies are corrected within a twenty-four (24) hour period.

The Worksite Traffic Supervisor shall be available on the site within 45 minutes after notification of an emergency situation, prepared to positively respond to repair the work zone traffic control or to provide alternate traffic arrangements.

Failure of the Worksite Traffic Supervisor to comply with the provisions of this Subarticle may be grounds for decertification or removal from the project or both. Failure to maintain a designated Worksite Traffic Supervisor or failure to comply with these provisions will result in temporary suspension of all activities except traffic and erosion control and such other activities deemed to be necessary for project maintenance and safety.

## 108. OVERHEAD ELECTRIC LINE CLEARANCE

### 108-1. CLEARANCE OPTIONS

When working in the vicinity of overhead power lines, the Contractor shall utilize one of the following options:

Option 1 - Having the power lines de-energized and visibly grounded.

Option 2 - Maintaining a minimum distance of twenty feet (20') of clearance for voltages up to 350 kV and fifty feet (50') of clearance for voltages more than 350 kV.

Option 3 - Determine the line voltage and provide clearance in accordance with the following table.

### 108-2. REQUIRED MINIMUM CLEARANCE DISTANCES

| VOLTAGE<br>(nominal, kV, alternating current) | MINIMUM CLEARANCE DISTANCE<br>(feet)  |
|---|---|
| Up to 50                                      | 10  |
| Over 50 to 200                                | 15  |
| Over 200 to 350                               | 20  |
| Over 350 to 500                               | 25  |
| Over 500 to 750                               | 35  |
| Over 750 to 1,000                             | 45  |
| Over 1,000                                    | (as established by the utility owner/operator or registered professional engineer who is a qualified person with respect to electric power transmission and distribution) |

Note: The value that follows “to” is up to and includes that value. For example, over 50 to 200 means up to and including 200kV.

## 109. PROJECT WEB PAGES

### 109-1. WEB PAGES DESIGN

If requested by the City, Engineer shall design the Project Web Site in accordance with the current City Web Site standards and styles. Project Web Site should include general project information as: Project Name & Number, Scope description, Location, Schedule, and Project Contacts.

**Note:** Occasionally City modifies the general design of the City’s Web Site, and the Engineer shall consult the City Webmaster for the current requirements, before designing or updating the Project Web Pages.

## **109-2. WEB ACCESSIBILITY GUIDELINES**

Project Web Pages should conform to the W3C Web Accessibility Guidelines and US Section 508 guidelines whenever possible:

<http://www.w3.org/TR/1999/WAI-WEBCONTENT-19990505/>

<http://www.section508.gov/>

In particular, use of variable-width tables, user-adjustable/relative font sizes, ALT text for images, CSS whenever possible, etc. Accessibility should be a priority over design/aesthetics.

## **109-3. THE “BRIGHT & BEAUTIFUL” LOGO AND ITS USE**

The City’s “Bright & Beautiful” logo should be used for everyday business, on all print and electronic material. It should be used on all internal correspondence, brochures, advertising, vehicles, apparel and signage. It should be used only in the manner presented here, in the proportion shown here, with no alterations. It should not be condensed, lengthened, or otherwise distorted to fit a space. The logo is approved for use by City departments and is not to be used by outside vendors without the permission of the City Manager, Assistant City Manager or Public Communications office. Electronic versions of the logo should be obtained from Public Communications.

## **109-4. MAPS AND GRAPHICS**

Use of maps and graphics is recommended to illustrate the project; only approved graphics should be posted to the Project Web Pages.

## **109-5. INTERACTIVE FORMS**

The site should also include an interactive form or other options to allow the Public’s input sent back to the City regarding the Project.

## **109-6. POSTING**

The site should be presented to the City’s Webmaster for review and posting to the City’s Web Server. Posting of the Project Web Pages to a different server than City’s Web server, if approved, should be coordinated with the City’s Webmaster for resolving all accessibility and conformity issues.

## **109-7. WEB PAGES UPDATES**

Unless otherwise specified and agreed, Engineer is responsible for keeping the posted Web Pages up-to-date, by sending revisions and updates through the City Project Manager to the City’s Webmaster for posting.

## **200 SERIES: SITEWORK**

### **201. EXCAVATION FOR UNDERGROUND WORK**

The Contractor is responsible to take all necessary steps to conduct all excavation in a manner which provides for the successful completion of the proposed work while at all times maintaining the safety of the workmen, the general public and both public and private property. The Contractor's methods of work will be consistent with the standard practices and requirements of all appropriate Safety Regulatory Agencies, particularly the Occupational Safety and Health Administration (OSHA) requirements for excavation. Unless otherwise specifically stated in these plans and specifications, the methods of safety control and compliance with regulatory agency safety requirements are the full and complete responsibility of the Contractor.

For the purposes of the Contractor's safety planning in the bidding process, the contractor is to consider all excavation to be done in the performance of this contract to be in soil classified as OSHA "Type C". The Contractor's attention is called to specific requirements of OSHA for excavation shoring, employee entry, location of excavated material adjacent to excavation, the removal of water from the excavation, surface encumbrances and in particular the requirement of a "Competent Person" to control safety operations. The Contractor will identify their Competent Person to City staff at the start of construction.

City staff is required from time to time to perform inspections, tests, survey location work, or other similar activity in an excavation prepared by the Contractor. City staff, in conformance with the OSHA Excavation Safety Requirements, is to only enter an excavation in compliance with these OSHA standards. The City's staff reserve the option to refuse entry into the Contractor's excavation if, in the opinion of the City's staff, the entry into the Contractor's excavation is unsafe or does not conform to OSHA requirements. If this circumstance occurs, the Contractor must either provide the necessary safety requirements or provide alternate means for the accomplishment of the City's work at the Contractor's expense.

The construction quantities, if any, contained in the bid proposal for this contract do not contain sufficient quantities to allow the Contractor to perform excavation work using strictly the "open cut" method whereby no shoring systems are used and trench side slopes are cut to conform to OSHA safety requirements without a shoring system. In addition to safety reasons, the Contractor is required to use excavation and trench-shoring methods in compliance with all safety requirements which allow the Contractor to control the amount of restoration work necessary to complete the project.

Not more than four hundred feet (400') of trench shall be opened at one time in advance of the completed work unless written permission is received from the Engineer for the distance specified. For pipe installation projects, the trench shall be a minimum of six inches (6") wider on each side than the greatest external horizontal width of the pipe or conduit, including hubs, intended to be laid in them. The bottom of the trench under each pipe joint shall be slightly hollowed, to allow the body of the pipe to rest throughout its length. In case a trench is excavated at any place, excepting at joints, below the grade of its bottom as given, or directed by the Engineer, the filling and compaction to grade shall be done in such manner as the Engineer shall direct, without compensation.

## **202. OBSTRUCTIONS**

Any pipes, conduits, wires, mains, footings, driveways, or other structures encountered shall be carefully protected from injury or displacement. Any damage thereto shall be fully, promptly, and properly repaired by the Contractor to the satisfaction of the Engineer and the owner thereof. Any survey monument or benchmark which must be disturbed shall be carefully referenced before removal, and unless otherwise provided for, shall be replaced upon completion of the work by a registered land surveyor. Any concrete removed due to construction requirements shall be removed to the nearest expansion joint or by saw cut. Contractor shall consult Inspector for the approved means.

## **203. DEWATERING**

### **203-1. GENERAL**

Unless specifically authorized by the Engineer, all pipe, except subdrains, shall be laid "in the dry". The Contractor shall dewater trench excavation as required for the proper execution of the work, using one or more of the following approved methods: well point system, trenched gravity underdrain system, or sumps with pumps.

Well point systems must be efficient enough to lower the water level in advance of the excavation and maintain it continuously in order that the trench bottom and sides shall remain firm and reasonably dry. The well points shall be designed especially for this type of service, and the pumping unit used shall be capable of maintaining a high vacuum, and at the same time, of handling large volumes of air as well as of water.

The Contractor shall be responsible for disposing of all water resulting from trench dewatering operations and shall dispose of the water without damage or undue inconvenience to the work, the surrounding area, or the general public. Contractor shall not dam, divert, or cause water to flow in excess in existing gutters, pavements or other structures: and to do this Contractor may be required to divert the water to a suitable place of discharge as may be determined by the Engineer. Where possible, Contractor may contain produced groundwater on the project site, a dewatering plan must be submitted to the City for approval if a discharge permit is not obtained or required.

The cost of dewatering shall be included in the unit price bid per linear foot of pipe, or, in the case of other underground structures, in the cost of such structures.

### **203-2. PERMIT REQUIREMENTS**

#### **203-2.1. DEWATERING DISCHARGE**

The Contractor shall be responsible for submitting the Notice of Intent to use the Generic Permit for the Discharge of Groundwater from Dewatering Operations and associated fee in accordance with Florida DEP Requirements, F.A.C. 62-621.300(2)(b) prior to discharging of produced groundwater into the City's streets, storm sewers or waterways.

Prior to construction, a dewatering plan must be prepared and submitted to the City for review. It shall include site-specific notes and details presenting the Contractor's proposed dewatering and disposal methods. The City will field-inspect the dewatering operation throughout construction.

## **204. UNSUITABLE MATERIAL REMOVAL**

All unsuitable material, such as muck, clay, rock, etc., shall be excavated from under pipes, structures and roadways and removed from the site. All material removed is property of the Contractor, who shall dispose of said material off-site at their expense. The limits and depths of the excavation shall be determined in the field by the Engineer.

### **204-1. BASIS OF MEASUREMENT**

The basis of measurement shall be the number of cubic yards of clean fill placed as determined by either cross sections of the excavation, truck measure, or lump sum as specified in the Scope of Work and Contract Proposal. Included in the cost of cubic yards of suitable material placed is the removal, hauling and disposal of unsuitable material.

### **204-2. BASIS OF PAYMENT**

The unit price for the removal of unsuitable material shall include: all materials, equipment, tools, labor, disposal, hauling, excavating, dredging, placing, compaction, dressing surface and incidentals necessary to complete the work. If no pay item is given, the removal of unsuitable material shall be included in the most appropriate bid item.

## **205. UTILITY TIE IN LOCATION MARKING**

The tie in locations for utility laterals of water, sanitary sewer, and gas shall be plainly marked on the back of the curb. Marking placed on the curb shall be perpendicular with respect to the curb of the tie in location on the utility lateral. Marks shall not be placed on the curb where laterals cross diagonally under the curb. The tie in location shall be the end of the utility lateral prior to service connection.

Markings shall be uniform in size and shape and colors in conformance with the code adopted by the American Public Works Association as follows:

|                               |   |
|-------------------------------|---|
| SAFETY RED                    | Electric power, distribution & transmission<br>Municipal Electric Systems   |
| HIGH VISIBILITY SAFETY YELLOW | Gas Distribution and Transmission<br>Oil Distribution and Transmission<br>Dangerous Materials, Produce Lines, Steam Lines |
| SAFETY ALERT ORANGE           | Telephone and Telegraph Systems<br>Police and Fire Communications<br>Cable Television                                     |
| SAFETY PRECAUTION BLUE        | Water Systems, Slurry Pipe Lines and Potable Water  |
| SAFETY GREEN                  | Sewer Systems   |
| LAVENDER                      | Reclaimed Water, Irrigation and Slurry Lines  |

|       |                           |
|-------|---------------------------|
| WHITE | Proposed Excavation       |
| PINK  | Temporary Survey Markings |

Marks placed on curbs shall be rectangular in shape and placed with the long dimension perpendicular to the flow line of the curb. Marks placed on valley gutter and modified curb shall be six inch (6") x three inch (3") and placed at the back of the curb. Marks placed on State Road and vertical curb shall be four inch (4") x two inch (2") and be placed on the curb face.

## **206. CLEARING AND GRUBBING**

The work included in this specification includes the removal and disposal of all structures, appurtenances, asphalt, concrete, curbs, walls, trees, roots, vegetation, boulders, conduits, poles, posts, pipes, inlets, brush, stumps, debris and other obstructions resting on or protruding through the ground surface necessary to prepare the area for construction.

Clearing and grubbing shall be performed in accordance with Section 110 of FDOT's Standard Specifications. Unless otherwise specified in the contract documents, the Contractor shall take ownership of all removed material and dispose of them off-site in accordance with all Local, State and Federal Requirements.

### **206-1. BASIS OF MEASUREMENT**

The basis of measurement shall be either a lump sum quantity or the number of acres cleared and grubbed as specified on the plans or directed by the Engineer.

### **206-2. BASIS OF PAYMENT**

The pay item for clearing and grubbing shall include: all removal and disposal of materials and structures as well as all materials, hauling, equipment, tools, labor, leveling of terrain, landscape trimming and all incidentals necessary to complete the work.

## **207. EROSION AND SEDIMENT CONTROL**

### **207-1. GENERAL**

Erosion and sediment control shall conform to the requirements of the FDOT Standard Specifications for Prevention, Control, and Abatement of Erosion and Water Pollution. Contractor shall use temporary erosion and sediment control features found in the State of Florida Erosion and Sediment Control Designer and Reviewer Manual (E&SC Manual) or the City of Clearwater Standard Indices.

### **207-2. TRAINING OF PERSONNEL**

The City may require that the Supervisor or Foreman controlling the work for the Contractor on the Project have a current Florida Department of Environmental Protection (FDEP) Florida Stormwater, Erosion, and Sedimentation Control Inspector Training & Certification. All personnel working on the Project shall complete illicit discharge training once per calendar year. Contractor shall provide documentation to the City prior to Notice To Proceed. Example of training and

training sign-in sheet will be provided by the City to the Contractor at the Pre-Construction Meeting.

### **207-3. STABILIZATION OF DENUDED AREAS**

No disturbed area may be denuded for more than thirty (30) calendar days unless otherwise authorized by the City Engineer. During construction, denuded areas shall be covered by mulches such as straw, hay, filter fabric, seed and mulch, sod, or some other temporary vegetation. Within sixty (60) calendar days after final grade is established on any portion of a project site, that portion of the site shall be provided with established permanent soil stabilization measures per the original site plan, whether by impervious surface or landscaping.

### **207-4. PROTECTION AND STABILIZATION OF SOIL STOCKPILES**

Fill material stockpiles shall be protected at all times by on-site drainage controls which prevent erosion of the stockpiled material. Control of dust from such stockpiles may be required, depending upon their location and the expected length of time the stockpiles will be present. In no case shall an unstabilized stockpile remain after thirty (30) calendar days.

### **207-5. PROTECTION OF EXISTING STORM SEWER SYSTEMS**

During construction, all storm sewer inlets in the vicinity of the project shall be protected by temporary erosion and sediment control features found in the State of Florida Erosion and Sediment Control Designer and Reviewer Manual (E&SC Manual) or the City of Clearwater Standard Indices, or equals approved by the City Engineer before installation.

### **207-6. SWALES, DITCHES AND CHANNELS**

All swales, ditches and channels leading from the site shall be sodded within three (3) days of excavation. All other interior swales, etc., including detention areas will be sodded prior to issuance of a Certificate of Occupancy.

### **207-7. UNDERGROUND UTILITY CONSTRUCTION**

The construction of underground utility lines and other structures shall be done in accordance with the following standards: no more than 400 linear feet of trench shall be open at any one time; and, wherever consistent with safety and space consideration, excavated material shall be cast to the uphill side of trenches. Trench material shall not be cast into or onto the slope of any stream, channel, road ditch or waterway.

### **207-8. MAINTENANCE**

All erosion and siltation control devices shall be checked regularly, especially after each rainfall and will be cleaned out and/or repaired as required.

## **207-9. COMPLIANCE**

Failure to comply with the aforementioned requirements may result in a fine and/or more stringent enforcement procedures such as (but not limited to) issuance of a "Stop Work Order".

## **208. CONSTRUCTION AND REPAIR OF SEAWALLS AND OTHER BEACH EROSION CONTROL STRUCTURES.**

Other beach erosion control structures, accompanied by a certified survey showing the location of the groin or other beach erosion control structure and adjoining groins or other beach erosion control structures, shall be presented to the city council for final approval. Where steps are necessary to provide access along the beach to the public, then such steps shall be shown as part of the plan for groin construction prior to issuance of the permit, and such steps shall be constructed and maintained in a safe condition at all times.

### **208-1. EXISTING SEAWALLS AND REVETMENTS**

Existing seawalls and revetments on natural waterbodies may be replaced with a revetment or with a vertical seawall with the provision of rip rap placed at the base of the wall up to the mean high water line for the entire length of the seawall. Revetments and seawalls may be replaced with a vertical seawall in manmade waterbodies, provided that the seawall is within the property line and maintains the established shoreline.

### **208-2. TOP OF CAP ELEVATION**

The top of cap elevation for all replacement and new seawalls and seawall caps shall not exceed 4.8 feet N.A.V.D. If the top of a seawall cap is constructed at an elevation differing from the adjacent property owner top of cap elevation by greater than one foot, then a return wall is required to sufficiently provide for the break in grade at the property line. Seawalls exceeding 4.8 feet N.A.V.D. in height prior to the effective date of this article may be maintained, repaired and replaced to their current height.

### **208-3. SEAWALLS AND REVETMENTS LOCATED SEAWARD OF THE CCL**

Seawalls and revetments located seaward of the coastal construction setback line are controlled by regulations of the Division of Beaches and Shores of the Florida Department of Environmental Protection. Replacement of a seawall or revetment that is located seaward of the coastal construction setback line necessitates submission of a permit application to the state department of environmental protection.

### **208-4. PLACEMENT OF NEW SEAWALL**

The placement of a new seawall waterward of an existing seawall is permitted, subject to the following conditions:

- (a) A Florida registered professional engineer must certify the new seawall design.
- (b) The new seawall shall not extend more than 18 inches from the waterward face of the original alignment of the existing vertical seawall location.

- (c) The new seawall shall be placed vertically plumb.
- (d) Placing a seawall in front of an existing seawall shall only be permitted once unless the seawall behind the new seawall is removed.
- (e) Existing seawall sections that interfere with new seawall location shall be removed.
- (f) The new seawall shall include an adequate closure of gaps at each property line.
- (g) For zoning purposes, the setbacks for the property will be measured from either the property line or the waterside of the original seawall slab, whichever is more restrictive, and will not be adjusted to accommodate the new seawall addition. For purposes of pier construction, the shore normal dimensions will be measured from the waterside of the original seawall slab.

## **208-5. POST CONSTRUCTION SURVEY**

Prior to final inspection and approval of a new or replacement seawall or seawall cap, a post-construction survey shall be required. Repairs of existing seawalls and seawall caps which do not alter the height or location shall not be subject to this requirement.

## **208-6. RIP-RAP**

On all-natural waterways, an apron of rip-rap shall be placed at the base of all new and repaired seawalls up to the mean high water line for the entire length of the seawall to absorb the wave energy and protect the underlying soft earth or sand from being carried away, as well as to provide habitat for desirable marine species. This rip-rap shall be required at the base of all new seawalls and at the time that an existing seawall is repaired where the replacement constitutes greater than 50 percent of the entire length of the seawall or includes the replacement of a panel.

## **208-7. RETAINING WALL IN LIEU OF VERTICAL SEAWALL**

A retaining wall may be built as an alternative to a vertical seawall, provided that all activities, including dredging, filling, slope grading, or equipment access and similar activities and all portions of the wall are located landward of the mean high water line.

## **300 SERIES: MATERIALS**

### **301. CONCRETE**

The Contractor shall notify the Construction Inspector or City a minimum of twenty-four (24) hours in advance of all concrete placement.

Unless otherwise noted elsewhere or directed, the following requirements shall be adhered to:

All concrete work shall be performed in accordance with the latest editions of the Design and Control of Concrete Mixtures by the Portland Cement Association, the American Concrete Institute, and FDOT's Standard Specifications. Unless otherwise specified, all concrete shall have fiber mesh reinforcing and have a minimum compressive strength of 3000 psi at twenty-eight (28) days. The cement type shall be Type I and shall conform to AASHTO M-85. The aggregate shall conform to ASTM C-33. All ready-mix concrete shall conform to ASTM C-94. The slump for all concrete shall be in the range of three inches (3") to five inches (5"), except when admixtures or special placement considerations are required.

All concrete shall be tested in the following manner:

Placement of less than five cubic yards (5 cy) shall be tested at the Engineer's discretion. Otherwise, for each class, for each day, for every 50 cy or part thereof exceeding five cubic yards (5 cy), one set of three (3) compressive strength cylinders will be required (1 at 7 days and 2 at 28 days). At the discretion of the Engineer, unacceptable test results may require the Contractor to provide further tests, as determined by the Engineer, to determine product acceptability, or need for removal, and compensation or denial thereof.

### **302. EXCAVATION AND FORMS FOR CONCRETE WORK**

#### **302-1. EXCAVATION**

Excavating for concrete work shall be made to the required depth of the subgrade or base upon which the concrete is to be placed. The base or subgrade shall be thoroughly compacted to a point six inches (6") outside said concrete work before the forms are placed.

#### **302-2. FORMS**

Forms for concrete work shall be either wood or metal, except curbs. Curb forms shall be metal only, unless at radius, intermittent sections less than ten (10) linear feet or by written permission from Engineer. They shall be free from warps or bends, shall have a depth equal to the dimensions required for the depth of the concrete deposited against them and shall be of sufficient strength when staked to resist the pressure of concrete without moving or springing.

### **303. REINFORCEMENT**

When required, reinforcement shall be placed in the concrete work. Bar reinforcement shall be deformed: ASTMA-A 615, steel shall be billet Intermediate or Hard Grade: Rail Steel A.A.S.H.T.O. M42. Twisted Bars shall not be used, Fabric Reinforcement shall conform to the requirements of AASHTO M55 (ASTM A185). Welded deformed steel wire fabric for Concrete reinforcement shall meet the requirements of AASHTO M 221 (ASTM A497). Welded wires shall

be elevated by the use of chairs. Epoxy coated reinforcing Steel Bars shall meet ASTM A775/A77 requirements.

### **303-1. BASIS OF PAYMENT**

Reinforcement shall not be paid for separately. The cost of such work shall be included in the contract unit price for the item of work specified.

## **304. BACKFILL**

### **304-1. MATERIALS AND GENERAL**

Material for backfill other than under Gabion mattress shall be carefully selected from the excavated material or from other sources as may be required by the Engineer. Such material shall be granular, free from clay, muck, organic matter or debris, contain no rocks or other hard fragments greater than three inches (3") in the largest dimension and all fill shall be similar material.

Material for backfill under Gabion mattress shall be an A-1 soil meeting AASHTO M145.

Backfill shall be carried up evenly in layer not exceeding eight inches (8") in thickness and shall be compacted into place by mechanical tamping before the next layer is applied. A hydro-hammer shall not be used for compaction. Backfill placed around pipes shall be carefully placed around the sides and top of pipe by hand shovels and thoroughly compacted to twelve inches (12") above the pipe by tamping or other suitable means.

For backfill in small areas that do not permit any type of tamping, Contractor may use flowable fill to achieve required density. Flowable fill shall adhere to Section 121 of FDOT specifications.

Where wet conditions are such that dewatering by normal pumping methods would not be effective, as determined by the Engineer, Contractor may use #57 stone (meeting FDOT's specifications) and hand tamping until backfill has reached an elevation and condition such as to make the use of the mechanical tampers practical. Fully wrap the stones with a layer of Type D filter fabric of FDOT Index 199. Do not place stones within four feet (4') of the ends of trench or ditch; use normally accepted backfill material at the ends.

Where new cast-in-place concrete work is performed, do not place backfill until the specified twenty-eight (28) days compressive strength occurs.

Do not allow heavy construction equipment to cross over pipes or culverts until placing and compacting backfill material to the finished earthwork grade or to an elevation of at least four feet (4') above the top of the pipe or culvert.

The cost of backfill, flowable fill, alternative approved material for wet conditions, and extra dewatering effort to achieve required density, etc., shall be included in the contract unit price or lump sum price for the item of the work specified.

### **304-2. TESTING AND INSPECTION**

Contractor shall employ and pay for the services of an independent testing laboratory, approved by the Owner, to perform density testing on backfilled material. All testing shall be witnessed by

the Owner's Representative. The test shall be repeated until satisfactory results are obtained. The Contractor shall be charged for all retests and re-inspection services.

Backfill under all type of impervious areas and around structures: Backfill in these areas shall be compacted to a minimum of 98% Modified Proctor Test in accordance with ASTM D 1557 or ASSHTO T 180. Tests shall be performed up to the proposed bottom of pavement elevation.

Backfill outside of impervious areas: Backfill in these areas shall be compacted to a minimum of 95% Standard Proctor Test in accordance with ASTM D-698 or AASHTO T-99. Tests shall be performed up to the proposed finished grade.

**Backfill Testing:** The Contractor shall demonstrate the adequacy of backfill compaction by performing density testing. For each test location, density testing shall be performed at eight inch (8") lifts. The character of the backfill material will be observed during the excavation for density testing to determine conformance with the specifications. Density testing shall be performed using nuclear field density equipment or conventional weight-volume methods. If the weight-volume method is used, volume shall be determined by using the sand replacement test (ASTM D 1556) or liquid displacement methods (ASTM D 2167). If nuclear methods are used, the trench correction effect shall be accounted for by recalibrating the nuclear gauge on its calibration block at the location of each test prior to taking the density measurement. The Contractor shall furnish all equipment, tools, and labor to prepare the test site for testing.

**Normal Testing Frequency:** One test shall be performed for each one hundred feet (100') of backfill or fraction thereof or for each single run of pipe/culvert connecting two (2) successive structures whichever is less. The location of the test within each section shall be selected by the Owner's Representative. Testing shall progress as each one hundred foot (100') section is completed. Four (4) tests equally spaced around each structure shall be performed on each eight inch (8") lift. Testing which indicates that unacceptable material has been incorporated into the backfill, or that insufficient compaction is being obtained shall be followed by expanded testing to determine the limits of the unacceptable backfill.

**Expanded Testing Requirements:** If normal testing within a testing section indicates unacceptable backfill, the Owner's Representative may require additional testing within the same test section to determine the limits of unacceptable backfill. Additional testing required by the Owner's Representative shall be paid for by the Contractor and shall not exceed testing of four (4) additional locations within the test section. Unacceptable backfill within the limits established by the testing shall be removed and replaced by the Contractor at no additional cost to the Owner. Additional testing beyond that required may be performed by the Contractor at his expense to further delineate limits of unacceptable backfill.

## **305. RIPRAP**

The work included in this specification includes the construction of riprap as shown on the plans. The riprap shall be constructed per Section 530 of FDOT's Standard Specifications.

### **305-1. BASIS OF MEASUREMENT**

The basis of measurement for riprap shall be the dry weight in tons.

## **305-2. BASIS OF PAYMENT**

The pay item for sand-cement riprap shall include: all materials, testing, labor, grout, hauling, equipment, excavation, backfill, dressing and shaping for placement of sand-cement and all incidentals necessary to complete the work.

The pay item for rubble riprap shall include: all materials, required bedding stone, dressing and shaping for placement of bedding stone, filter fabric, testing, hauling, excavating, backfill, dressing and shaping for placement of rubble, and all incidentals necessary to complete the work. No payment will be granted if concrete or stone that exists on-site is used as rubble riprap.

## **400 SERIES: SANITARY SEWER**

### **401. SANITARY MANHOLES**

#### **401-1. BUILT UP TYPE**

Manholes shall be constructed of brick with cast iron frames and covers as shown on the drawings. Invert channels shall be constructed smooth and semicircular in shape conforming to inside of adjacent sewer section. Changes in direction of flow shall be made in a smooth curve of as large a radius as possible. Changes in size and grade of channels shall be made gradually and evenly. Invert channels shall be formed by one of the following methods: form directly into concrete manhole base, build up with brick and mortar, lay half tile in concrete, or lay full section of sewer pipe through manhole and break out top half of pipe.

The manhole floor outside of channels shall be made smooth and sloped toward channels.

Free drop in manholes from inlet pipe invert to top of floor outside the channels shall not exceed twenty four inches (24").

Standard Drop Manholes shall be constructed wherever free drop exceeds twenty four inches (24").

Manhole steps shall not be provided. Joints shall be completely filled, and the mortar shall be smoothed from inside of manholes.

The entire interior and exterior of brick manholes shall be plastered with one half inch (1/2") of mortar.

Brick used may be solid only. Brick shall be laid radially with every sixth course being a stretcher course.

#### **401-2. PRECAST TYPE**

Precast Sanitary Manholes shall conform to this specification unless otherwise approved by the City Engineer.

AASHTO M 85 Type II cement shall be used throughout with a minimum wall thickness of five inches (5"). The precast sections shall conform to ASTM C 478 latest revision. Section joints shall be a tongue and groove with "ram neck" gasket or "O" ring to provide a watertight joint. Minimum concrete strength shall be 4000 psi at 28 days.

Three sets of shop drawings and location inventory shall be submitted to the City Engineer for approval. Approval of shop drawings does not relieve Contractor of responsibility for compliance to these specifications unless letter from Contractor requesting specific variance is approved by the City Engineer.

Location inventory submitted with shop drawing shall detail parts of manhole per manhole as numbered on the construction plans. All manhole parts shall be numbered or lettered before being sent to the job site to permit proper construction placement. A plan or list of the numbering system shall be present on the job site when manhole components are delivered.

Precast manhole dimensions, drop entry, grout flow of channel, etc., shall be as shown on City of Clearwater Engineering Index #302 Sheets 1 and 2 of 2.

Manhole sections shall be rejected if abused during shipping or placement and if pipe openings are not properly aligned. The "break in" to precast manholes for pipe entry will not be allowed.

The manhole base shall be set on a pad of A 1 or A 2 Classification soil approximately five inches (5") thick to secure proper seating and bearing.

#### **401-2.1. MANHOLE ADJUSTMENT RINGS (GRADE RINGS)**

Between the top of the manhole cone and the manhole cover frame, a manhole adjustment ring shall be installed. The intent of the manhole adjustment ring is to accommodate future grade changes without disturbing the manhole. See Section IV, Article 703-7, Asphaltic Concrete – Adjustment of Manholes.

#### **401-3. DROP MANHOLES**

Standard drop inlets to manholes shall be constructed of commercial pipe, fittings and specials as detailed on the drawings.

#### **401-4. FRAMES AND COVERS**

Manhole frames and covers shall be set in a full bed of mortar with the top of the cover flush with or higher than finished grade as directed. Refer to Index 301.

#### **401-5. MANHOLE COATINGS**

The exterior and interior of all built up manholes shall be coated with two (2) coats of Type II Asphalt emulsion, moisture and damp proof (Specification ASTM D 1227 Type II Class I) as manufactured by W.R. Meadows Sealtite or approved equal.

The exterior of all precast manholes shall have a 15 mil dry thickness of Sherwin Williams Targuard® Coal Tar Epoxy or approved equal. The interior shall be AGRU SUREGRIP HDPE or PP-R Liner with a minimum thickness of two millimeters (2 mm).

#### **401-6. CONNECTIONS TO MANHOLES**

Connections to existing sanitary manholes using approved PVC sewer main shall be made with a manhole adapter coupling by NPC Kor-N-Seal® or approved water stop coupling.

### **402. RAISING OR LOWERING OF SANITARY SEWER STRUCTURES**

Sanitary Sewer Structures shall be raised or lowered as indicated on the plans or as indicated by the Engineer.

#### **402-1. BASIS OF PAYMENT**

Payment, unless covered by a bid item, shall be included in the cost of the work.

## 403. SANITARY SEWERS AND FORCE MAINS

### 403-1. MATERIALS

#### 403-1.1. GRAVITY SEWER PIPE

**GRAVITY SEWER PIPE SHALL BE POLYVINYL CHLORIDE OR DUCTILE IRON.** Polyvinyl chloride pipe and fittings shall conform to ASTM specification D 3034 for S.D.R. 35. Sewer pipe with more than ten feet (10') of cover shall be SDR 26. The pipe shall be plainly marked with the above ASTM designation. The bell end of joints and fittings shall have a rubber sealing ring to provide a tight flexible seal in conformance with ASTM D 3212. The laying length of pipe joints shall be a maximum of twenty feet (20').

Unless otherwise noted in these specifications or construction plans, Ductile Iron pipe and fittings for gravity sewer shall conform to Article 501 of these Technical Specifications for DIP water main except pipe shall be interior Protecto 401 ceramic epoxy lined in accordance with manufacturer's recommendations. Where sanitary sewer main is to be placed between building lots in a sideline easement, the sewer main shall, insofar as possible, be constructed without manholes or lateral connections within the side easement. The pipe material in the side easement between streets shall be C 900, SDR 18 polyvinyl chloride water main pipe as described in these Technical Specifications Article 501. A two-way cleanout shall be installed on each lateral at the property line.

#### 403-1.2. FORCE MAIN PIPE

**FORCE MAIN PIPE SHALL BE POLYVINYL CHLORIDE OR DUCTILE IRON.** Unless otherwise noted in the specifications or construction plans, both polyvinyl chloride and ductile iron force main pipe and fittings shall conform to Article 501 of these Technical Specifications for water main pipe except that DIP shall be Protecto 401 ceramic epoxy lined in accordance with manufacturer's recommendations.

All polyvinyl chloride pipe which has become deteriorated due to exposure to ultra violet radiation shall be rejected.

### 403-2. INSTALLATION

#### 403-2.1. GRAVITY SEWER PIPE

Installation of Thermoplastic gravity sewer pipe shall be in conformance with recommended practices contained in ASTM D 2321.

The bottom trench width in an unsupported trench shall be limited to the minimum practicable width (typically pipe OD plus eight inches (8") to twelve inches (12") on each side) allowing working space to place and compact the haunching material. The use of trench boxes and movable sheeting shall be performed in such a manner that removal, backfill and compaction will not disturb compacted haunching material or pipe alignment.

Dewatering of the trench bottom shall be accomplished using adequate means to allow preparation of bedding, placement of the haunching material and pipe in the trench without standing water.

Dewatering shall continue until sufficient backfill is placed above the pipe to prevent flotation or misalignment.

Where pipe bedding is insufficient to adequately support pipe, the Contractor will be required to remove unsuitable material and bed pipe in Class I material (one half inch (1/2") diameter aggregate) to provide firm support of pipe.

Connections to manholes with sanitary pipe shall use a joint two (2) feet in length and shall use an approved water stop around pipe joint entry.

The laterals shown on the plans do not necessarily reflect exact locations. The Contractor is required to locate all existing laterals for reconnection and to coordinate with the construction inspector the location of all new laterals.

## **403-2.2. FORCE MAIN PIPE**

Installation of force main pipe shall be in conformance with Article 501 of these Technical Specifications for water main pipe.

## **403-3. TESTING**

### **403-3.1. TESTING OF GRAVITY SEWERS**

The Contractor shall take all precautions to secure a perfectly water tight sewer under all conditions. The water tightness of a sewer which has a crown lying below groundwater level may be tested by measuring infiltration. The water tightness of sewers having crowns lying above groundwater level may be tested by filling the pipe with water so as to produce a hydrostatic head of two feet or more above the crown of the sewer at the upper end of the test section or the water table outside of the sewer, whichever is higher, and then measuring the exfiltration. In no case shall the infiltration or exfiltration exceed fifty (50) gallons per inch of diameter per mile per day. The Contractor shall furnish all labor, materials and equipment to test the amount of infiltration or exfiltration under the Engineer's direction. Where the infiltration or exfiltration is excessive, the Contractor at their own expense shall take the necessary steps to remedy such conditions by uncovering the sewer, remaking the joints or by replacing the entire length of sewer as required by the Engineer. No such repaired joints may be backfilled until after they have been tested and found to be acceptable. Care shall be taken to avoid flotation. The Contractor shall TV inspect all mains to verify the true and uniform grade and the absence of bellies or dropped joints prior to acceptance. Any dips or sags of more than five percent (5%) of the inside pipe diameter dimension shall be cause for rejection. The above tests shall be performed at the discretion of the Engineer on any or all sections of the line.

### **403-3.2. TESTING OF FORCE MAINS**

Force mains shall be tested under a hydrostatic pressure of 150 psi for two (2) hours, as described in Article 501 of these Technical Specifications for the testing of water mains.

## **403-4. BASIS OF PAYMENT**

### **403-4.1. GRAVITY SEWER PIPE**

Payment for in place sanitary sewer gravity main pipe shall be the unit price per linear foot per appropriate range of depth of cut as contained in the contract proposal. Measurement for payment shall be along the centerline of the sewer main from center to center of manholes.

Payment for laterals shall be the unit price per linear foot of pipe as measured from the centerline of the sewer main pipe to the terminal end of the lateral pipe including a two-way cleanout at the property line.

Payment for sewer pipe shall include all labor, equipment and materials necessary to complete the installation. This shall include clearing and grubbing, excavation, shoring and dewatering, backfill and grading.

### **403-4.2. FORCE MAIN PIPE**

Payment and measurement of force main pipe shall be the same as described in Article 501 of these Technical Specifications for water main pipe.

## **404. HDPE DEFORMED - REFORMED PIPE LINING**

### **404-1. INTENT**

It is the intention of this specification to provide for the trenchless restoration of eight inch (8") to twelve inch (12") sanitary sewers by the installation of a high density polyethylene, jointless, continuous, fold and form pipe liner which is watertight and chemically resistant to withstand exposure to domestic sewage including all labor, materials and equipment to provide for a complete, fully restored and functioning installation.

### **404-2. PRODUCT AND CONTRACTOR/INSTALLER ACCEPTABILITY**

The City requires that all contractors be prequalified. See General Conditions regarding contractor prequalification. In addition, the City requires a proven extensive track record for the fold and form liner system to be used in this project. All contractors submitting for prequalification approval for this project must exhibit extensive 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. The installer must be certified by the liner system manufacturer for installation of the liner system. The City reserves full and complete authority to approve the satisfactory nature of both the liner system and the installer.

### **404-3. MATERIALS**

Pipe shall be made from P. E. 3408 polyethylene resins complying with ASTM D 3350, cell classification: P.E. 345434 D for High Density. It shall be Type 3, Grade 4, Class D, according to ASTM D 1248. The Contractor shall provide certified test results for review by the Engineer, from the manufacturer, that the material conforms with the applicable requirements. Material shall have

a minimum thickness of SDR 32.5. Pipe specimens shall comply with the minimum property values shown below with the applicable ASTM requirements:

| <u>Material</u> | <u>Property</u>    | <u>ASTM Method</u> | <u>Value</u>        |
|-----------------|--------------------|--------------------|---------------------|
| HDPE            | Tensile Strength   | D 638              | 3,300 psi           |
|                 | Elasticity Modulus |                    | E=113,000 psi       |
|                 | Impact Strength    | D 256 A            | 3.0 ft-lb/in        |
|                 | Flexure Modulus    |                    | E=136,000 psi       |
|                 | Expansion Coeff.   |                    | c=0.009 in/in/deg F |

At the time of manufacture, each lot of liner shall be reviewed for defects and tested in accordance with ASTM D 2837 and D 1693. At the time of delivery, the liner shall be homogeneous throughout, uniform in color, free of cracks, holes, foreign materials, blisters, or deleterious faults. The Contractor shall provide, as requested, certified test results for review by the Engineer, from the manufacturer, that the material conforms with the applicable requirements. The Engineer may at any time request the Contractor provide test results from field samples to the above requirements.

Liner shall be marked at five (5) foot intervals or less with a coded number, which identifies the manufacturer, SDR, size, material, date, and shift on which the liner was extruded.

Lining manufacturer shall submit to the Engineer for approval as requested, complete design calculations for the liner thickness. The criteria for liner design shall be HS-20 traffic loading, water table to the ground surface, minimum expected lifetime of fifty (50) years, and no structural strength retained from the existing pipe. Any liner system must be approved by the Engineer prior to receiving bids. Request for contractor prequalification and/or liner system approval must be received by the Engineer no later than fourteen (14) days prior to the date for receiving bids.

#### **404-4. CLEANING/SURFACE PREPARATION**

It shall be the responsibility of the Contractor to clean and prepare the existing pipes for rehabilitation. The Contractor will thoroughly clean the interior of the sewers to produce a clean interior surface free of all coatings, sand, rock, roots, sludge, or other deleterious materials prior to liner insertion. Bypass pumping will be provided by the Contractor as part of the unit cost of restoration. Bypass operations are to be so arranged as to cause minimum disruptions to local traffic, residents and particularly to commercial facilities. During the cleaning and preparation operations all necessary precautions shall be taken to protect the public, all property and the sewer from damage.

All material removed from the sewers shall be the Contractor's responsibility for prompt disposal in accordance with all regulatory agency requirements. The Contractor may be required to control the rate of sewer cleaning in the sanitary system to avoid heavy pollution loads at the City's treatment plants.

## **404-5. TELEVISION INSPECTION**

After cleaning, and again after the rehabilitation work on each section of the project is completed, all pipe sections shall be visually inspected with a digital camera and recorded in DVD format as specified below.

### **404-5.1. VIDEO, PHOTO CAPTURE AND DATA COLLECTION REQUIREMENTS FOR MANHOLE AND PIPELINE INSPECTION**

This section describes the requirements of the Contractor in providing the following minimum requirements for Video, Photo Capture and Database structure to the City. The City is currently using CUES Granite XP video and data collection software. The Contractor shall provide the TV Inspections in the same Granite XP database, photo and video capture format. The Contractor-provided TV Inspections, Database, DVDs, Photos and related files shall have the ability to direct synchronize to the City's existing Granite XP database.

### **404-5.2. IMAGE (PHOTOS) CAPTURE FORMAT AND REQUIREMENTS**

The Inspection image files (pictures) shall have the ability to export to Industry Standard Formats to include JPEG, BMP, and TIFF formats and be transferable by disk, DVD and/or external hard drive to an external personal computer utilizing standard viewers and printers.

### **404-5.3. DIGITAL VIDEO FORMAT AND REQUIREMENTS**

Digital video files (Inspection Videos) shall be captured and/or recorded in the MPEG 1, 2 or 4 format or as specified by the City. The Video capture files shall be in MPEG format with data linking (Inspection Observations) to the database file(s). The "Link" of the video capture file to the database observation file is required. The inspection observation(s) shall link to the video record in real-time.

The accompanying database shall support the following code systems: WRc, PACP, CUES standard, or current code system being utilized by the City. The Database and Software program (Granite XP V2.X) shall be able to import asset data from an ArcGIS (City current version) geo-database file utilizing the network features to associate Sewer Mains with corresponding Sewer Nodes.

The database structure shall retain information on the various structures found within a sewer or storm system. It is important that the structures, nodes, manholes and pipe identifiers and related attribute information be retained as separate tables from the Inspection allowing import of existing data from multiple sources. The data structure allows different projects to reside within a single database. Information gathered in projects shall be available to view by project or by system. Data gathered during project inspection shall be available to view by the selected structure. Therefore, all inspections can be viewed on a structure even if gathered in different projects.

### **404-5.4. SYNCHRONIZATION**

The database shall have the ability to synch assets and inspections from replicated databases. The sync process should have built-in error checking for duplicates, updates and any modifications to

the data being synched. This allows for multiple sources of data to be effectively consolidated into a single unitary database for analysis and evaluation.

## **404-6. LINER INSTALLATION**

Liner shall be sized to field measurements obtained by the Contractor to provide a tight fit to the full interior circumference of the existing sanitary sewer and shall be a continuous, jointless liner product from inside of manhole to inside of manhole. Contractor shall use installation methods approved by the liner manufacturer including liner placement, reforming to fit existing pipe, pressure and heat requirements and reconnection of laterals. The Contractor shall immediately notify the Engineer of any construction delays taking place during the insertion operation. Contractor shall maintain a reasonable backup system for bypass pumping should delays or problems with pumping systems develop. Liner entries at manholes shall be smooth, free of irregularities, and watertight. No pinholes, tears, cracks, thin spots, or other defects in the liner shall be permitted. Such defects shall be removed and replaced by the Contractor at their expense. OSHA requirements for installation procedures, in particular, confined spaces are to be met.

## **404-7. LATERAL RECONNECTION**

Sanitary laterals shall be reconnected as soon as possible to renew service. Laterals are to be reconnected by means of robotics, by internally cutting out the liner to 100% of the area of the original opening. All lateral reconnections are to be grouted to prevent leakage. Grouting method and material is to be approved by the Engineer.

Any reconnections to laterals and connections to manholes which are observed to leak shall be resealed by the Contractor. All laterals discovered during the lining process are to be reconnected unless specifically directed otherwise by the City. Contractor shall notify all local system users when the sanitary system will not be available for normal usage by the delivery of door hangers with appropriate information regarding the construction project.

## **404-8. TIME OF CONSTRUCTION**

Construction schedules will be submitted by the Contractor and approved by the Engineer. At no time will any sanitary sewer service connection remain inoperative for more than an eight (8) hour period without a service bypass being operated by the Contractor. In the event that sewage backup occurs and enters buildings, the Contractor shall be responsible for cleanup, repair and property damage costs and claims.

## **404-9. PAYMENT**

Payment for sanitary sewer restoration shall be made per linear foot including all preparation, bypass pumping, equipment, labor, materials, operations, restoration, etc., to provide a fully completed and operational sewer. Payment shall be measured from center of manhole to center of manhole for the sanitary systems and from end of pipe to end of pipe for storm systems.

## **405. SANITARY MANHOLE LINER RESTORATION**

### **405-1. SCOPE AND INTENT**

It is the intent of this portion of the specification to provide for the structural rehabilitation of manhole walls and bases with solid preformed liners and made-in-place liner systems used in accordance with the manufacturer's recommendations and these specifications. In addition to these specifications, the Contractor shall comply with manufacturer's instructions and recommendations for work. Purpose of work is to eliminate infiltration, provide corrosion protection, repair voids and to restore the structural integrity of the manhole. For any particular system the Contractor will submit manufacturer's technical data and application instructions. All OSHA regulations shall be met.

### **405-2. PAYMENT**

Payment for liners shall be per vertical foot of liner installed from the base to the top of the installed liner. Liners will generally be installed to the top of existing or new corbels. No separate payment will be made for the following items: Bypass pumping; Traffic Control; Debris Disposal; Excavation, including necessary pavement removal; Shoring and/or dewatering; Structural fill; Backfill and compaction; Grout and mortar; Brick; Resetting of the manhole ring and cover; Pipe extensions and connectors necessary to the installation; Replacement of unpaved roadway and grass or shrubbery plot; Replacement of roadway base and asphalt surface; and Appurtenant work as required for a complete and operable system. The cost of such work shall be included in the pay item, per linear foot of liner.

### **405-3. FIBERGLASS LINER PRODUCTS**

#### **405-3.1. MATERIALS**

##### **405-3.1.1. LINERS**

Liners shall be fiberglass engineered to meet or exceed AASHTO H 20 loading of 16,000 pound vertical wheel load. Manhole liners are to be of the integral corbel design unless otherwise stipulated. Manhole liners are to be as large in diameter as will fit into the existing manhole. The Contractor shall measure the existing manhole immediately prior to ordering materials and is solely responsible for the fitting of the liner. Contractor will be required to submit factory certification for fiberglass liners. The manhole liner shall meet all requirements of ASTM D 3753.

##### **405-3.1.2. MORTAR**

Mortar shall be composed of one part Portland Cement Type I and between two (2) and three (3) parts clean, well graded sand, 100% of which shall pass a No. 8 sieve.

##### **405-3.1.3. GROUTING**

Grouting shall be a concrete slurry of four (4) bags of Portland Cement Type II per cubic yard of clean, well graded sand.

## **405-3.2. INSTALLATION AND EXECUTION**

Excavate an area around the top of the existing manhole sufficiently wide and deep for the removal of the manhole ring and corbel section.

Remove the frame and cover and corbel section without damaging the existing manhole walls. Care is to be taken not to allow brick or soil to fall into the existing manhole.

Remove or reinsert loose brick which protrude more than one inch from the interior wall of the manhole and which could interfere with the insertion of the fiberglass liner.

If the shelf of the manhole invert is not level around the perimeter, form a flat shelf with mortar.

Cut the liner to the proper length. Cutouts in the manhole shall be made to accommodate existing inlet and outlet pipes, drops and cleanouts.

Lower the liner into the existing manhole and set the bottom of the liner into quick setting grout. Obtain a good bottom seal to prevent the loss of grout from the annular space between the outside of the liner and the inside wall of the existing manhole. Set the liner as nearly vertical as possible. Pour six inches (6") of quick setting grout above the initial bottom seal in the annular void to insure an adequate bottom seal.

Bridge the gap from drops, laterals, force mains, cleanouts and all existing piping between the existing manhole wall and the new manhole liner with P.V.C. pipe. Use quick setting mortar to seal the area around the manhole liner and piping.

Fill the annular space between the manhole liner and the existing manhole interior walls with grout. Care must be taken not to deflect the manhole liner due to head pressure.

Set the existing manhole ring and cover using brick to make elevation adjustments as needed.

Observe water tightness and repair any visible leakage.

Backfill around the new liner and compact the backfill. Sod the disturbed area. Match existing sod.

Where manholes fall in paved areas, refer to Standard Detail Index 104, "Street and Driveway Replacement for Concrete and Asphaltic Concrete Surfaces".

## **405-4. STRONG SEAL MS-2 LINER PRODUCT SYSTEM**

This specification shall govern all work to spray apply a monolithic fiber reinforced cementitious liner to the wall and bench surfaces of brick, concrete or any other construction material; Strong Seal MS 2 product.

Described are procedures for manhole preparation, cleaning, application and testing. The applicator must be approved, trained and certified as having successfully completed factory training. The applicator/contractor shall furnish all labor, equipment and materials for applying the Strong Seal MS 2 product directly to the contour of the manhole to form a structural cementitious liner of a minimum one half inch (1/2") thickness using a machine specially designed for the application. All aspects of the installation shall be in accordance with the manufacturer's recommendations and with the following specifications which includes:

1. The elimination of active infiltration prior to making the application.
2. The removal of any loose and unsound material.

3. The spray application of a pre blended cementitious mix to form a monolithic liner in a two (2) coat application.

## **405-4.1. MATERIALS**

### **405-4.1.1. PATCHING MIX**

Strong Seal shall be used as a patching mix according to the manufacturer's recommendations and shall have the following minimum requirements:

|                                      |                   |                   |
|--------------------------------------|-------------------|-------------------|
| 1. Compressive Strength (ASTM C-109) | 15 min., 200 psi  | 6 hrs., 1,400 psi |
| 2. Shrinkage (ASTM C-596)            | 28 days, 150 psi  |                   |
| 3. Bond (ASTM C-952)                 | 28 days, 150 psi  |                   |
| 4. Cement                            | Sulfate resistant |                   |
| 5. Density, when applied             | 105 +/- 5 pcf     |                   |

## **405-5. INFILTRATION CONTROL**

Strong Plug shall be used to stop minor water infiltration according to the manufacturer's recommendations and shall have the following minimum requirements:

1. Compressive strength (ASTM C-109) - 600 psi, 1 hr.; 1000 psi 24 hrs.
2. Bond (ASTM C-952) - 30 psi, 1 hr.; 80 psi, 24 hrs.

## **405-6. GROUTING MIX**

Strong-Seal Grout shall be used for stopping very active infiltration and filling voids according to the manufacturer's recommendations. The grout shall be volume stable and have a minimum twenty-eight (28) day compressive strength of 250 psi and a one (1) day strength of 50 psi.

## **405-7. LINER MIX**

Strong Seal MS 2 shall be used to form the monolithic liner covering all interior manhole surfaces and shall have the following minimum requirements at twenty-eight (28) days:

|                                      |                |
|--------------------------------------|----------------|
| 1. Compressive strength (ASTM C 109) | 3,000 psi      |
| 2. Tensile strength (ASTM C 496)     | 300 psi        |
| 3. Flexural strength (ASTM C 78)     | 600 psi        |
| 4. Shrinkage (ASTM C 596)            | 0% at 90% R.H. |
| 5. Bond (ASTM C 952)                 | 130 psi        |
| 6. Density, when applied             | 105 + pcf      |

Product must be factory blended requiring only the addition of water at the Project site. Bag weight shall be 50 to 51 pounds and contents shall have dry bulk density of 54 to 56 pounds per cubic foot. Fiberglass rods which are contained in the product shall be alkaline resistant and shall be one-

half inch (1/2") to five-eighths inch (5/8") long with a diameter of 635 to 640 microns. Products shall, in the unmixed state, have a lead content not greater than two percent (2%) by weight.

Strong Seal MS 2C shall be made with Calcium Aluminate Cement and shall be used according to the manufacturer's recommendations in applications where there is evidence of severe sulfide conditions.

Product must be factory blended requiring only the addition of water at job site.

Bag weight shall be 50 to 51 pounds and contents must have a dry bulk density of 50 to 56 pounds per cubic foot.

Cement content must be 65% to 75% of total weight of bag.

One bag of product when mixed with correct amount of water must have a wet density of 95 to 108 pounds per cubic foot and must yield a minimum of 0.67 cubic foot of volume.

Fiberglass rods must be alkaline resistant with rod lengths not less than one-half inch (1/2") in length nor greater than five-eighths inch (5/8") in height.

Product shall not include any basic ingredient that exceeds maximum allowable EPA limit for any heavy metal.

Manufacturer must provide MSDS sheets for product(s) to be used in reconstruction process.

A two (2) coat application of liner material will be required (no exceptions) with the first coat rough troweled to force materials into cracks and crevices to set the bond. The second coat to be spray applied to assure a minimum of one-half inch (1/2") thickness after troweling or brush finishing to a relatively smooth finish.

## **405-8. WATER**

Shall be clean and potable.

## **405-9. OTHER MATERIALS**

No other material shall be used with the mixes previously described without prior approval or recommendation from the manufacturer.

## **405-10. EQUIPMENT**

A specially designed machine consisting of an optimized progressive cavity pump capable of producing a minimum of 250 psi pumping pressure, contra blend mixer with twin ribbon paddles with discharge, and an air system for spray application of product. Equipment must be complete with water storage and metering system. Mixer and pump is to be hydraulically powered. Equipment is to be mounted to heavy duty construction tandem axle road worthy trailer complete with electric brakes and running lights. Internal combustion engine must be included to power the hydraulic system and air compressor.

## **405-11. INSTALLATION AND EXECUTION**

### **405-11.1. PREPARATION**

1. Place boards over inverts to prevent extraneous material from entering the sewer lines and to prevent up stream line from flooding the manhole.
2. All foreign material shall be removed from the manhole wall and bench using a high pressure water spray (minimum 1,200 psi). Loose and protruding brick, mortar and concrete shall be removed using a mason's hammer and chisel and/or scraper. Fill any large voids with quick setting patching mix.
3. Active leaks shall be stopped using quick setting specially formulated mixes according to the manufacturer's recommendations. Some leaks may require weep holes to localize the infiltration during the application after which the weep holes shall be plugged with the quick setting mix prior to the final liner application. When severe infiltration is present, drilling may be required in order to pressure grout using a cementitious grout. Manufacturer's recommendations shall be followed when pressure grouting is required.
4. Any bench, invert or service line repairs shall be made at this time using the quick setting mix and following the manufacturer's recommendations.
5. After all preparation has been completed, remove all loose material.

### **405-11.2. MIXING**

For each bag of product, use the amount of water specified by the manufacturer and mix using the Spray Mate Model 35C or 35D equipment for thirty (30) seconds to one (1) minute after all materials have been placed in the mixing hopper. Place the mix into the holding hopper and prepare another batch with timing such that the nozzleman can spray in a continuous manner without interruption until each application is complete.

### **405-11.3. SPRAYING**

The surface, prior to spraying, shall be damp without noticeable free water droplets or running water. Materials shall be sprayed, applied to a minimum uniform thickness to insure that all cracks, crevices and voids are filled and a somewhat smooth surface remains after light troweling. The light troweling is performed to compact the material into voids and to set the bond. Not before the first application has begun to take an initial set (disappearance of surface sheen which could be fifteen (15) minutes to one (1) hour depending upon ambient conditions) is the second application made to assure a minimum total finished thickness of one-half inch (1/2"). The surface is then troweled to a smooth finish being careful not to over trowel so as to bring additional water to the surface and weaken it. A brush finish may be applied to the finished coat to remove trowel marks. Manufacturer's recommendation shall be followed whenever more than twenty-four (24) hours have elapsed between applications. The wooden bench covers shall be removed, and the bench is sprayed such that a gradual slope is produced from the walls to the invert with the thickness at the edge of the invert being no less than one-half inch (1/2"). The wall bench intersection shall be rounded to a uniform radius, the full circumference of the intersection. The final application shall have a minimum of four (4) hours cure time before being subjected to active flow.

#### **405-11.4. PRODUCT TESTING**

At some point during the application, at least four (4) two inch (2") cubes may be prepared each day or from every fifty (50) bags of product used, identified and sent, in accordance with the Owner's or Manufacturer's directions, for compression strength testing as described in ASTM C 109.

#### **405-11.5. CURING**

Ambient manhole conditions are adequate for curing so long as the manhole is covered. It is imperative that the manhole be covered as soon as possible after the application has been completed.

#### **405-11.6. MANHOLE TESTING AND ACCEPTANCE**

Manhole may be vacuum tested from the top of manhole frame to the manhole base. All pipes entering the manhole shall be plugged, taking care to securely place the plug from being drawn into the manhole. The test head shall be placed, and the seal inflated in accordance with the manufacturers' recommendations. A vacuum pump of ten inches (10") of mercury shall be drawn and the vacuum pump shut off. With the valves closed, the time shall be measured for the vacuum to drop to nine inches (9"). The manhole shall pass if the time is greater than sixty (60) seconds for forty-eight inch (48") diameter, seventy five (75) seconds for sixty inch diameter (60"), and ninety (90) seconds for seventy-two inch (72") diameter manholes. If the manhole fails the initial test, necessary repairs shall be made. Retesting shall proceed until a satisfactory test is obtained. Tests shall be performed by the Contractor under the direction of the Project Engineer.

### **405-12. INNERLINE ENVIRONMENTAL SERVICES LINER PRODUCT SYSTEM**

#### **405-12.1. SCOPE**

Materials and application procedures for manhole rehabilitation for the purpose of restoring structural integrity, providing corrosion resistance, and stopping infiltration by means of:

1. Hydraulic grouting, where required, as a preliminary measure to stop high volume infiltration.
2. Hydrophilic grouting (positive side waterproofing), where required, as follows:
  - a. Hydrophilic foam-injected through wall of manhole to fill voids, and/or
  - b. Hydrophilic gel-injected through wall of manhole to stop active leaks
3. Cementitious waterproofing with crystallization (negative side waterproofing)
4. Calcium aluminate cement lining, minimum of one-half inch (1/2")
5. Epoxy coating, minimum of thirty (30) dry mils

## 405-12.2. MATERIALS

### 405-12.2.1. REPAIRING CEMENT

A quick setting hydraulic cement compound shall be used to plug all visible minor leaks and to instantly stop major leaks, so that further waterproofing processes may proceed unhindered. The repairing cement shall be nonshrinking, nonmetallic, and noncorrosive. The compound shall have the following properties:

|                             |  |
|-----------------------------|--|
| Set Time                    | 1-3 minutes  |
| Tensile Strength            | 1 day 510 psi  |
| ASTM C 307                  | 3 days 745 psi<br>28 days 855 psi                    |
| Compressive Strength        | 1 day 3,125 psi                                      |
| ASTM -C 109                 | 7 days 7,808 psi<br>28 days 9,543 psi                |
| Flexural Strength ASTM C 78 | 1 day 410 psi<br>3 days 855 psi<br>28 days 1,245 psi |

### 405-12.2.2. HYDROPHILIC GROUTING

Based on conditions found in and around the manhole, the applicator shall pressure inject either one or both of the following materials:

1. An expansive foam grout shall be used to stop major intrusion of water and fill cracks and voids behind the structure's surface. Physical properties are as follows:

|                  |             |                |
|------------------|-------------|----------------|
| Tensile Strength | 380 psi     | ASTM D 3574-86 |
| Elongation       | 400%        | ASTM D 3574-86 |
| Bonding Strength | 250-300 psi |                |

2. A hydrophilic gel grout shall be used for soil stabilization behind the manhole to prevent seepage, to provide a damming effect, and to place a hydrostatic barrier around exterior of manhole. Physical properties are as follows:

|                  |                   |             |
|------------------|-------------------|-------------|
| Density          | 8.75-9.17 lbs/gal | ASTM D-3574 |
| Tensile Strength | 150 psi           | ASTM D- 412 |
| Elongation       | 250%              | ASTM D-3574 |
| Shrinkage        | Less than 4%      | ASTM D-1042 |
| Toxicity         | Non Toxic         |             |

### 405-12.2.3. WATERPROOFING

A waterproofing component based on the crystallization process shall be applied. The system combines cementitious and silicate based materials that are applied to negative side surfaces to seal and stop leakage caused by hydrostatic pressure. A combination of five coats (using three components-two powders and a special liquid) react with moisture and the constituents of the substrate to form the crystalline structure. It becomes an integral part of the structure and blocks the passage of water. With moisture present, the crystallization process will continue for

approximately six (6) months. Upon completion, the color will be light grey. Physical properties are as follows:

|   |   |                         |
|---|---|-------------------------|
| Slant/Shear bond Strength to Calcium Aluminate Cement<br>ASTM C882 Modified | 1,200 1,800 psi   |                         |
| Tensile Strength<br>(7 day cure)<br>ASTM C 190                              | 380 psi (2.62 MPa)<br>325 psi (2.24 MPa)                        | at 100% RH<br>at 50% RH |
| Permeability<br>(3 day cure)<br>CRD 48 55                                   | 8.1x10 <sup>-10</sup> cm/sec to<br>7.6x10 <sup>-11</sup> cm/sec |                         |

#### 405-12.2.4. CEMENT LINING

A self-bonding calcium aluminate cement shall be applied to restore structural integrity and provide corrosion resistance qualities. The cement (before adding fibers) shall have the following properties:

| Calcium Aluminate Cement |                           | 12 Hrs | 24 Hrs                | 7 Days | 28 Days |
|--------------------------|---------------------------|--------|-----------------------|--------|---------|
| Astm C 495               | Compressive Strength, Psi | 7000   | 11000                 | 12000  | 13000   |
| Astm C 293               | Flexural Strength, Psi    | 1000   | 1500                  | 1800   | 2000    |
| Astm C 596               | Shrinkage At 90% Humidity | --     | <0.04                 | <0.06  | <0.08   |
| Astm C 666               | Freeze-Thaw Aft 300 Cycle |        | No Damage             |        |         |
| Astm C 990               | Pull - Out Strength       |        | 200 - 230 Psi Tensile |        |         |
| Astm C 457               | Air Void Content (7 Days) |        | 3%                    |        |         |
| Astm C 497               | Porosity/Adsorption Test  |        | 4 - 5%                |        |         |

Modules of Elasticity: 7.10 X 10 PSI after twenty-four (24) hours moist curing at 68 degrees Fahrenheit.

The calcium aluminate cement shall be reinforced with inert fibers which comply with ASTM C 1116 and ASTM C 1018, added at the rate of one (1) pound per cubic yard of concrete. The mixture shall be applied to a thickness of at least one half inch (1/2"), but no greater than two inches (2"). It will have a dark grey color.

#### 405-12.2.5. EPOXY COATING

A high build, flexible waterproofing epoxy shall be applied to a minimum of thirty (30) dry mils. This epoxy will seal structure from moisture and provide protective qualities to the surface, including excellent resistance to chemical attack and abrasion. The epoxy shall be 100% solids, can be applied to damp surfaces, cures to a tile like finish, is easy to clean, and has no toxic fumes. Its uses include sewage treatment plants and other sewer structures. The epoxy shall have the following properties at 75 degrees Fahrenheit:

|   |            |
|---|------------|
| Mixing Ratio (Parts A:B), by volume       | 1:1        |
| Color (other colors available on request) | Light Gray |

|  |        |
|--|--------|
| Pot Life, hrs                                  | 1      |
| Tensile Strength, psi, min                     | 2,000  |
| Tensile Elongation, %                          | 10 –20 |
| Water Extractable Substances, mg./sq. in., max | 5      |
| Bond Strength to Cement (ASTM 882) psi         | 1,800  |

#### 405-12.2.6. CHEMICAL RESISTANCE

The sanitary sewer liner shall be resistant to: Alcohols, Trichloroethylene, Nitric Acid (3%), Jet Fuels, Water, Sulfuric Acid (3% 10%), MEK, Wine, Butyl Acetate, Beer, Lactic Acid (3%), Gasoline, Corn Oil, Aluminum Sulfate, Paraffin Oil, Vegetable Juice, Sodium Chloride, Motor Oil, Hydrochloric Acid (3%), and many others.

#### 405-12.3. INSTALLATION AND EXECUTION

##### 405-12.3.1. PROCEDURAL OVERVIEW

Work shall proceed as follows:

1. Remove rungs (steps), if desired by client.
2. Clean manhole and remove debris.
  - a. Plug lines and/or screen out displaced debris.
  - b. Apply acid wash, if necessary, to clean and degrease.
  - c. Hydroblast and/or sand blast structure.
  - d. Remove debris from work area.
3. Repair minor defects in walls, benches, and invert, as required, with repairing cement. (Note: Major structural repairs, such as rebuilding of benches, will also be made as required by client.)
4. Inject hydrophilic grout through all surfaces, as needed, to eliminate infiltration.
5. Apply cementitious/crystallization waterproofing agents to all surfaces, repeating steps as needed.
6. Spray and/or hand apply calcium aluminate cement lining to all surfaces.
7. Spray apply epoxy coating to all surfaces.

**NOTE:** Steps 1-5 shall be executed consecutively with minimal delays; calcium aluminate (Step 6) shall require a cure time of at least twenty-four (24) hours for needed adhesion of epoxy (Step 7) to cement lining.

##### 405-12.3.2. PREPARATION

An acid wash shall be used (if needed) to clean and degrease. Then, if the client desires, the rungs shall be removed. Next, the entire structure is thoroughly water and/or sand blasted to remove any loose or deteriorated material. Care shall be taken to prevent any loose material from entering lines and other areas by either plugging the lines (where feasible) or inserting protective screens.

### **405-12.3.3. STRUCTURAL REPAIR**

Hand place or spray apply hydraulic cement material as necessary to prepared surface to fill cracks and voids in structure. Allow twenty (20) minutes before applying waterproofing/crystallization.

### **405-12.3.4. INFILTRATION CONTROL**

Pressure injection of hydrophilic gel and hydrophilic foam.

1. Drill five-eighths inch (5/8") holes through active leaking surface.
2. Install all zert fittings, as recommended by manufacturer.
3. Inject material until water flow stops.
4. Remove fittings (if necessary).

### **405-12.3.5. WATERPROOFING/CRYSTALLIZATION PROCESS**

1. Apply a slurry coat of powder #1 to moist wall using a stiff brush, forming an undercoat.
2. Apply dry powder #2 to slurry coat by hand.
3. Brush or spray on sealing liquid during the application to penetrate and initiate the crystal forming process.
4. Repeat steps 2 and 3, until there are no visible leaks.
5. Apply powder #1 as an overcoat.
6. Allow one (1) hour to cure before applying cement lining.

### **405-12.3.6. CEMENT LINING**

1. Dampen surface.
2. Mix material in mixer as recommended for spray or hand trowel application.
3. Apply cement until required build up of at least one half inch (1/2") (and no more than two inches (2")) has been achieved.
4. Trowel to smooth finish, restoring contours of manhole.
5. Texture brush surface to prepare for epoxy finish.
6. Allow for a twenty-four (24) hour cure time prior to epoxy coating.

NOTE: If conditions of heavy humidity prevail, a dry air blower shall be used to facilitate curing times.

### **405-12.3.7. EPOXY COATING**

Spray apply epoxy coating using airless spraying equipment until surface is visibly covered and a thickness of at least thirty (30) mils has been achieved. Manhole may be safely entered after six (6) hours, as epoxy will be hardened. Full cure strength will be achieved at forty eight (48) hours.

#### **405-12.3.8. CLEAN UP**

The work crew shall remove all debris and clean work area.

#### **405-12.3.9. MANHOLE TESTING AND ACCEPTANCE**

Manhole may be vacuum tested from the top of manhole frame to the manhole base. All pipes entering the manhole shall be plugged, taking care to securely place the plug from being drawn into the manhole. The test head shall be placed, and the seal inflated in accordance with the manufacturer's recommendations. A vacuum pump of ten inches (10") of mercury shall be drawn and the vacuum pump shut off. With the valves closed, the time shall be measured for the vacuum to drop to nine inches (9"). The manhole shall pass if the time is greater than sixty (60) seconds for a forty eight inch (48") diameter, seventy five (75) seconds for sixty (60) inches, and ninety (90) seconds for seventy-two inch (72") diameter manholes. If the manhole fails the initial test, necessary repairs shall be made. Retesting shall proceed until a satisfactory test is obtained. Tests shall be performed by the Contractor under the direction of the Project Engineer.

#### **405-12.3.10. WARRANTY**

All materials and workmanship shall be warranted to the Owner for a period of five (5) years, provided that all the above mentioned repair steps are used.

# **500 SERIES: POTABLE AND RECLAIMED WATER MAINS, FIRE LINES AND APPURTENANCES**

## **501. SCOPE**

The Contractor shall furnish all plant, labor, materials and equipment to perform all operations in connection with the construction of potable water mains, fire lines, reclaimed water mains and appurtenances including clearing, excavation, trenching, backfilling and clean up.

## **502. MATERIALS**

### **502-1. GENERAL**

Materials, equipment and supplies furnished and permanently incorporated into the project shall be of first quality in every respect and shall be constructed and finished to high standards of workmanship. Materials shall be suitable for service intended, shall reflect modern design and engineering and shall be fabricated in a first class workmanlike manner. All materials, equipment and supplies shall be new and shall have not been in service at any time previous to installation, except as required in tests or incident to installation. Machined metal surfaces, exposed bearings and glands shall be protected against grit, dirt, chemical corrosion and other damaging effects during shipment and construction.

### **502-2. PIPE MATERIALS AND FITTINGS**

#### **502-2.1. DUCTILE IRON PIPE**

Ductile Iron Pipe shall be in accordance with ANSI/AWWA C151/A21.51 81 or latest revision. Pipe thickness class, wall thickness and working pressure shall conform to the following table:

| Size | Class | Thickness<br>(In.) | Rated Water Working Pressure<br>(PSI) |
|------|-------|--------------------|---------------------------------------|
| 4"   | 51    | 0.26               | 350                                   |
| 6"   | 50    | 0.25               | 350                                   |
| 8"   | 50    | 0.27               | 350                                   |
| 12"  | 50    | 0.31               | 350                                   |

The trench laying condition shall be Type 2, Flat bottom trench backfill lightly consolidated to centerline of pipe.

Pipe shall be manufactured in accordance with ANSI/AWWA C151/A21.51 81 or latest revision.

Pipe shall be asphalt coated on the outside and standard cement lined and sealed coated with approved bituminous seal coat in accordance with ANSI/AWWA C104/A21.4 80 or latest revision.

Ductile iron pipe shall be used for all hydrant installations and for fire line installations from the main to the backflow preventer.

## **502-2.2. POLYVINYL CHLORIDE (PVC) PIPE**

Polyvinyl Chloride (PVC) Pipe four inch (4") through eight inch (8") shall be in accordance with ANSI/AWWA C900 or latest revision and the American Society for Testing Materials (ASTM) Standard D 2241 and PVC Resin Compound conforming to ASTM Specification D 1784.

Polyvinyl Chloride Pipe shall have the same O.D. as Cast and Ductile Iron Pipe and be compatible for use without special adapters with Cast Iron Fittings.

Pipe dimension ratio, working pressure and laying length shall conform to the following table:

| Size | Dimension Ratio<br>(OD/Thick.) | Rated Water Working Pressure<br>(PSI) | Laying Length<br>(Ft) |
|------|--------------------------------|---------------------------------------|-----------------------|
| 4    | 18                             | 150                                   | 20                    |
| 6    | 18                             | 150                                   | 20                    |
| 8    | 18                             | 150                                   | 20                    |

Pipe larger than eight inch (8") shall be ductile iron. The City Engineer reserves the right to require the use of ductile iron in sizes four inch (4") through eight inch (8") when needed due to laying conditions or usage.

The bell of four inch (4") and larger PVC pipe shall consist of an integral wall section with a solid cross section elastomeric ring which meets the requirements of ASTM D 1869.

Each length of pipe shall bear identification that will remain legible during normal handling, storage and installation and so designate the testing agency that verified the suitability of the pipe material for potable water service.

All polyvinyl chloride pipe shall be laid with two (2) strands of insulated twelve (12) gauge A.W.G. solid strand copper wire taped to the top of each joint of pipe with about eighteen inches (18") between each piece of tape. It is to be installed at every valve box through a two inch (2") PVC pipe to twelve inches (12") minimum above the top of the concrete slab. The two inch (2") PVC pipe shall be the same length as the adjustable valve box, and the two inch (2") PVC pipe shall be plugged with a two inch (2") removable brass plug with recessed nut. This wire is to be continuous with splices made only by direct bury 3M brand splice kit approved by the Engineer. This wire is to be secured to all valves, tees and elbows.

## **502-2.3. FITTINGS AND JOINTS**

Fitting from four inch (4") through sixteen inch (16") in size will be compact ductile iron cast in accordance with ANSI/AWWA C153/A 21.53 with mechanical joint bells. Bolts, nuts and gaskets shall be in accordance with requirements of ANSI/AWWA C153/A 21.53. The working pressure rating shall be 350 psi. Ductile iron fittings shall be coated and lined in accordance with requirements of ANSI/AWWA C104/A21.4. Mechanical joint glands shall be ductile iron in accordance with ANSI/AWWA C111/A 21.11. When reference is made to ANSI/AWWA

Standards, the latest revisions apply. Only those fittings and accessories that are of domestic (USA) manufacture will be acceptable.

#### **502-2.4. RESTRAINT**

Restraint of plugs, caps, tees, bends, etc., shall be accomplished by the use of approved mechanical restraining rings or glands installed per manufacturer's recommendations. Hydrants shall be restrained by the use of swivel connecting joints. Restraining mechanical joint glands on hydrants shall be used only where hydrant runout length precludes the use of swivel joint connectors.

#### **502-2.5. PIPE WITHIN CASING**

All pipe placed within casings shall be slip joint ductile iron restrained by the use of restraining gaskets designed for use with the particular joint being installed and have properly sized casing spacers (Cascade Series) installed on the pipe so that the pipe will be centered within the casing. Each end of the casing shall be properly sealed to prevent the intrusion of soil, water, or debris within the casing itself. It shall be sealed by brick and mortar, cement or any approved method by the Engineer.

### **502-3. GATE VALVES**

Discs of valves shall be operated by methods which will allow operation in any position with respect to the vertical. Gate valves for interior piping or exposed above grade outside structures, shall be hand wheel operated with rising stems. Valves four inches (4") and larger, buried in earth shall be equipped with two inch (2") square operating nuts, valve boxes and covers. Valves shall be fitted with joints suitable for the pipe with which they are to be used. The direction of opening for all valves shall be to the left (counter clockwise).

Unless otherwise shown or specified, valves for high pressure service shall be rated at not less than 150 psi cold water, non-shock.

The manufacturer's name and pressure rating shall be cast in raised letters on the valve body.

Installation shall be in accordance with good standard practice. Exposed pipelines shall be so supported that their weight is not carried through valves.

Two Inch (2") diameter and smaller are not allowed. These should be approved ball valves.

Three Inch (3") diameter are not allowed.

Gate Valves, four inch (4") to sixteen inch (16") diameter, inclusive, shall be resilient seated gate valves encapsulated with EPDM Rubber in conformance with ANSI/A.W.W.A. Standard Specification C509-515 latest revision. These valves shall include the following features consistent with C509-515, full opening unobstructed waterway, zero leakage at 200 psi differential pressure, all internal parts removable from bonnet without removing body from pressure main, corrosion resistant bronze or stainless steel nonrising stem with O-ring bonnet seal with epoxy coated inside and outside cast iron or ductile iron valve body.

Gate valves larger than sixteen inches (16") shall be suitable for the service intended and shall be resilient seated gate valves encapsulated with EPDM rubber in conformance with ANSI/AWWA. These valves shall include the following features consistent with C509-80, full opening unobstructed waterway, zero leakage at 200 psi differential pressure. All valves shall be equipped

with steel cut bevel gears, extended type gear case and rollers, bronze or babbitt tracks and scrapers and valved by-pass.

## **502-4. VALVE BOXES**

Valve boxes shall be of standard extension design and manufacture and shall be made of cast iron. No PVC Risers or Derisers are allowed as part of a valve box assembly. They are to be three-piece valve box assemblies. The lower part of the assembly can be ordered in various heights to accommodate different depths. Suitable sizes of valve boxes and extension pieces shall be provided where shown. The valve box cover shall be of cast iron. Valve boxes and their installation shall be included in the bid price for valves. Refer to City Index No. 402; Sheet 1 of 5 & Sheet 2 of 5 for potable water valve pad detail, and City Index No. 502; Sheet 1 of 2 & Sheet 2 of 2 for reclaimed water valve boxes and pad detail.

## **502-5. HYDRANTS**

No other hydrants, other than those listed below, may be used in extension to or replacement of the City of Clearwater potable water system:

- Kennedy Guardian #K 8ID Fire Hydrant,
- Mueller Super Centurion 25 Fire Hydrant
- AVK Nostalgic 2780.
- American Darling B-84-B.

No substitutions shall be allowed without the approval of the City of Clearwater.

Above hydrants shall be in accordance with the latest revision of the AWWA Specification C 502 and include the following modifications:

1. All shipments to be palletized and tailgate delivery.
2. Hydrants shall conform to A.W.W.A. Standard C-502 latest revision and must be UL/FM listed.
3. Hydrants shall be of the compression type, closing with line pressure.
4. The operating threads will be contained in an operating chamber sealed at the top and bottom with an O-ring seal. The chamber will contain a lubricating grease or oil.
5. Hydrants shall be of the traffic model breakaway type, with the barrel made in two sections with the break flange located approximately two inches (2") above the ground line. Breakaway bolts are not allowed.
6. Operating nut shall be of one-piece bronze or ductile iron construction.
7. A dirt shield shall be provided to protect the operating mechanism from grit buildup and corrosion due to moisture.
8. A thrust washer shall be supplied between the operating nut and stem lock nut to facilitate operation.
9. Operating nut shall be a #7 one and a half inch (1-1/2") pentagon nut.

10. Nozzles shall be of the tamper resistant, one quarter (1/4) turn type with O-ring seals or threaded into upper barrel. Nozzles shall be retained with a stainless steel locking device.
11. The main valve shall be of EPDM solid rubber.
12. The seat shall be of a bronze ring threaded to a bronze insert in the hydrant shoe, with O-rings to seal the barrel from leakage of water in the shoe.
13. The main valve stem will be 304 or higher grade stainless steel and made in two sections with a breakable coupling.
14. Hydrant shall have a six inch (6") Mechanical Joint epoxy lined elbow, less accessories.
15. Hydrant shall have a five and one quarter inch (5-1/4") valve opening, and shall be a left hand operation to open.
16. Hydrant shall be without drains.
17. Hydrant shall have two (2) two and one half inch (2-1/2") hose nozzles and one (1) four and one half inch (4-1/2") pumper nozzle. Threads shall be in accordance with the National Standard Hose Coupling Thread Specifications.
18. Hydrant body shall have a factory finish of yellow paint. All paints shall comply with AWWA standard C-502-85 or latest revision.

All hydrants will be shop tested in accordance with the latest AWWA Specification C 502.

Restrained joint assemblies shall be used which have bolted mechanical and swivel joints from the hydrant tee through to the hydrant. Restrained joints shall absorb all thrust and prevent movement of the hydrant.

All hydrants shall be provided with an auxiliary gate valve so that the water to the hydrant may be shut off without the necessity of closing any other valve in the distribution system.

No hydrants shall be installed on the reclaimed water system unless approved by the City of Clearwater's Engineering Department.

## **502-6. SERVICE SADDLES**

Service saddles shall be used on all service taps to four inch (4") P.V.C. water main. The largest service connection allowable on four inch (4") main shall be one and one half inch (1-1/2"). Service saddles shall be used on all two inch (2") service connections to six inch (6") and larger mains. Service saddles (JCM 406 series or Ford FC 202 series) shall be wide bodied ductile iron with epoxy or nylon coating and shall have stainless steel straps.

## **502-7. TESTS, INSPECTION AND REPAIRS**

1. All materials shall be tested in accordance with the applicable Federal, ASTM or AWWA Specification and basis of rejection shall be as specified therein. Certified copies of the tests shall be submitted with each shipment of materials.
2. All materials will be subject to inspection and approved by the Engineer after delivery; and no broken, cracked, misshapen, imperfectly coated or otherwise damaged or unsatisfactory material shall be used.

3. All material found during the progress of the work to have cracks, flaws, or other defects shall be rejected and promptly removed from the site.
4. If damage occurs to any pipe, fittings, valves, hydrants or water main accessories in handling, the damage shall be immediately brought to the Engineer's attention. The Engineer shall prescribe corrective repairs or rejection of the damaged items.

## **502-8. BACKFLOW PREVENTERS**

The City of Clearwater owns and maintains all backflow prevention devices that are installed within their system. Therefore, any and all devices must be purchased from the City and installed by City work forces.

Backflow prevention devices installed on customer's service lines at the point of delivery (service connection) shall be of a type in accordance with AWWA specification C506 or latest revision.

Two (2) different types of backflow prevention devices are allowed. Type of device, and when required, is determined by the degree of hazard presented to the municipal water system from possible backflow of water within the customer's private system. The types of devices allowed are:

1. Double Check Valve Assembly - a device composed of two (2) single, independently acting, approved check valves, including tightly closing shutoff valves located at each end of the assembly and suitable connections for testing the water tightness of each check valve.
2. Reduced pressure principle backflow prevention device - a device containing a minimum of two (2) independently acting, approved check valves, together with an automatically operated pressure differential relief valve located between the two check valves. The unit must include tightly closing shutoff valves located at each end of the device, and each device shall be fitted with properly located test cocks.

## **502-9. TAPPING SLEEVES**

Steel body tapping sleeves shall be JCM Industries Inc., JCM 412 or Smith-Blair 622. All steel body tapping sleeves shall have heavy welded ASTM A 285, Grade C steel body, stainless steel bolts, manufacturer's epoxy coated body, and three-quarter inch (3/4") bronze test plug.

## **502-10. BLOW OFF HYDRANTS**

Blow offs are not allowed.

# **503. CONSTRUCTION**

## **503-1. MATERIAL HANDLING**

1. Pipe, fittings, valves, hydrants and accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances shall such materials be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground.

2. Pipe shall be so handled that the coating and lining will not be damaged. If, however, any part of the coating or lining is damaged, the repair shall be made by the Contractor at their expense in a manner satisfactory to the Engineer.
3. In distributing the material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench.

## **503-2. PIPE LAYING**

### **503-2.1. ALIGNMENT AND GRADE**

The pipe shall be laid and maintained to the required lines and grades with fittings, valves and hydrants at the required locations, spigots centered in bells; and all valves and hydrant stems plumb. All pipe installed shall be pigged and properly blown off before any pressure testing and sterilization of the pipe can be completed.

The depth of cover over the water main shall be a minimum of thirty inches (30") and a maximum of forty-two inches (42") below finished grade, except where approved by the Engineer to avoid conflicts and obstructions. Whenever obstructions not shown on the plans are encountered during the progress of the work and interfere to such an extent that an alteration of the plans is required, the Engineer shall have the authority to change the plans and order a deviation from the line and grade or arrange with the Owners of the structures for the removal, relocation, or reconstruction of the obstructions.

### **503-2.2. INSTALLATION**

Proper implements, tools, and facilities satisfactory to the Engineer shall be provided and used by the Contractor for the safe and convenient performance of the work. All pipe, fittings, valves and hydrants shall be carefully lowered into the trench piece by piece by means of a derrick, ropes, or other suitable tools or equipment in such a manner as to prevent damage to materials and protective coatings and linings. Under no circumstances shall materials be dropped or dumped in the trench.

If damage occurs to any pipe, fittings, valves, hydrants or accessories in handling, the damage shall be immediately brought to the Engineer's attention. The Engineer shall prescribe corrective repairs or rejection of the damaged items.

All pipe and fittings shall be carefully examined for cracks and other defects while suspended above the trench immediately before installation in final position. Spigot ends shall be examined with particular care as this area is the most vulnerable to damage from handling. Defective pipe or fittings shall be laid aside for inspection by the Engineer who will prescribe corrective repairs or rejection.

All lumps, blisters, and excess coating shall be removed from the bell and spigot end of each pipe, and the outside of the spigot and the inside of the bell shall be wire brushed and wiped clean and dry and free from oil and grease before the pipe is laid. Pipe joints shall be made up in accordance with the manufacturer's recommendations.

Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the line. If the pipe laying crew cannot put the pipe into the trench and in place without getting earth into the pipe, the Engineer may require that, before lowering the pipe into the trench, a heavy, woven canvas bag of suitable size shall be placed over each end and left there until the

connection is to be made to the adjacent pipe. During laying operation, no debris, tools, clothing or other materials shall be placed in the pipe.

As each length of pipe is placed in the trench, the spigot end shall be centered in the bell and the pipe forced home and brought to correct line and grade. The pipe shall be secured in place with approved backfill material tamped under it except at the bells. Precautions shall be taken to prevent dirt from entering the joint space.

At times when pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other means approved by the Engineer.

The cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or cement lining and so as to leave a smooth end at right angles to the axis of the pipe.

Pipe shall be laid with bell ends facing in the direction of laying unless directed otherwise by the Engineer. Where pipe is laid on the grade of ten percent (10%) or greater, the laying shall start at bottom and shall proceed upward with the bell ends of the pipe upgrade.

Wherever it is necessary to deflect pipe from a straight line, either in the vertical or horizontal plane to avoid obstructions or to plumb stems, or where long radius curves are permitted, the amount of deflection allowed shall not exceed that allowed under the latest edition of ANSI/AWWA C600-82 and C900 81 or latest revisions.

No pipe shall be laid when, in the opinion of the Engineer, trench conditions are unsuitable.

## **503-3. SETTING OF VALVES, HYDRANTS AND FITTINGS**

### **503-3.1. GENERAL**

Valves, hydrants, fittings, plugs and caps shall be set and joined to pipe in the manner specified above for installation of pipe.

### **503-3.2. VALVES**

Valves in water mains shall, where possible, be located on the street property lines extended unless shown otherwise on the plans. All valves shall be installed at the tee in all cases, not to exceed eighteen inches (18") from the main line.

The valve box shall not transmit any shock or stress to the valve and shall be centered and plumb over the wrench nut of the valve, with the box cover flush with the surface of the finished pavement or such other level as may be directed. Refer to City Index No. 402; Sheet 1 of 5 & Sheet 2 of 5 for potable water valve pad detail, and City Index No. 502; Sheet 1 of 2 & Sheet 2 of 2 for reclaimed water valve box and pad detail.

### **503-3.3. HYDRANTS**

Hydrants shall be located as shown or as directed so as to provide complete accessibility and minimize the possibility of damage from vehicles or injury to pedestrians. All hydrants located ten feet (10') of more from the main shall have a gate valve at the main and another gate valve at the hydrant location. No valve can be located anywhere in the hydrant run to circumvent the use of two valves. Refer to City Index No. 402; Sheet 4 of 4 for potable water hydrants. No hydrants shall

be installed on the reclaimed water system unless approved by the City of Clearwater's Engineering Department.

All hydrants shall stand plumb and shall have their nozzles parallel with, or at right angles to, the curb, with the pumper nozzle facing the curb. Hydrants shall be set to the established grade, with nozzles as shown or as directed by the Engineer.

Each hydrant shall be connected to the main with a six inch (6") ductile iron branch controlled by an independent six inch (6") gate valve. If hydrant is placed greater than ten feet (10') from the main, an additional valve shall be installed at the hydrant and shall be included in the hydrant assembly cost.

### **503-3.4. ANCHORAGE**

Movement of all plugs, caps, tees, bends, etc., unless otherwise specified shall be prevented by attaching approved mechanical restraining rings or glands and installed per manufacturer's recommendations. Hydrants shall be held in place with restrained swivel joints. Restraining mechanical joint glands on hydrants may be used where hydrant run out length precludes the use of hydrant connecting swivel joints.

Where special anchorage is required, such anchorage shall be in accordance with details shown on the plans.

### **503-4. CONNECTIONS TO EXISTING LINES**

Where shown on the plans or directed by the Engineer, the water lines constructed under this contract shall be connected to the existing lines now in place. No such connection shall be made until all requirements of the specifications as to tests, flushing, and sterilization have been met and the plan of the cut in to the existing line has been approved by the Engineer.

Where connections are made between new work and existing work, the connections shall be made in a thorough and workmanlike manner using proper materials and fittings to suit the actual conditions. All fittings shall be properly sterilized, and pipe will be properly swabbed before connections to existing facilities. All connections to existing facilities will be completed under the supervision of the City of Clearwater.

## **504. TESTS**

### **504-1. HYDROSTATIC TESTS**

After installation of water mains, complete with all associated appurtenances including service taps, all sections of newly laid main shall be subject to a hydrostatic pressure test of 150 pounds per square inch for a period of two (2) hours and shall conform to AWWA C600 latest revision. All mains shall be pigged and flushed to remove all sand and other foreign matter before any hydrostatic test can or will be performed. The pressure test shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer. The pump, pipe connection and all necessary apparatus, together with operating personnel, shall be furnished by the Contractor at their expense.

The Contractor shall make all necessary taps into the pipe line. The Owner will furnish the water for the test. Before applying the test pressure, all air shall be expelled from the pipe line.

## **504-2. NOTICE OF TEST**

The Contractor shall give the City of Clearwater's Owner Representative forty-eight (48) hours advance notice of the time when the installation is ready for hydrostatic testing.

## **505. STERILIZATION**

Before the system is put into operation, all water mains and appurtenances and any item of new construction with which the water comes in contact, shall be thoroughly sterilized in accordance with AWWA C651.

### **505-1. STERILIZING AGENT**

The sterilizing agent shall be liquid chlorine, sodium hypochlorite solution conforming to Federal Specification O-S-602B, Grade D, or dry hypochlorite, commonly known as "HTH" or "Perchloron".

### **505-2. FLUSHING SYSTEM**

Prior to the application of the sterilization agent, all mains shall be thoroughly flushed. Flushing shall continue until a clean, clear stream of water flows from the hydrants. Where hydrants are not available for flushing, such flushing shall be accomplished at the installed blow off devices generally at the ends of the lines.

### **505-3. STERILIZATION PROCEDURE**

All piping, valves, fittings and all other appurtenances shall be sterilized with water containing a minimum chlorine concentration of 75 ppm at any point in the system. This solution shall then remain in the distribution system for a minimum contact period of eight (8) hours and never more than twenty-four (24) hours before it is flushed out. All valves in the lines being sterilized shall be opened and closed several times during the contact period.

### **505-4. RESIDUAL CHLORINE TESTS**

After the sterilization outlined above has been accomplished, flushing shall continue until free residual chlorine tests not less than 0.2 ppm nor more than 3.0 ppm. Residual chlorine test shall be in accordance with standard methods using a standard DPD test set.

### **505-5. BACTERIAL TESTS**

After the water system has been sterilized and thoroughly flushed as specified herein, City of Clearwater Water Division or the Owner's Representative personnel shall take samples of water from remote points of the distribution system in suitable sterilized containers. The City shall forward the samples to a laboratory certified by the Florida State Board of Health for bacterial examination in accordance with AWWA C651. If tests of such samples indicate the presence of coliform organisms, the sterilization as outlined above shall be repeated until tests indicate the absence of such pollution. The bacterial tests shall be satisfactorily completed before the system is placed in operation and it shall be the Contractor's responsibility to perform the sterilization as outlined above.

If methods of sterilization differ materially from those outlined above, such methods shall be in accordance with directives of the Florida State Board of Health and all methods employed shall have the approval of that agency. Definite instructions as to the collection and shipment of samples shall be secured from the laboratory prior to sterilization and shall be followed in all respects. The City of Clearwater shall secure clearance of the water main from the Florida Department of Environmental Protection before the water distribution system is put into operation.

## **506. MEASUREMENT AND PAYMENT**

### **506-1. GENERAL**

Bids must include all sections and items as specified herein and as listed on the Bid Form. Payment for the work of constructing the project will be made at the unit price or lump sum payment for the items of work as set forth in the Bid, which payment will constitute full compensation for all labor, equipment, and materials required to complete the work. No separate payment will be made for the following items and the cost of such work shall be included in the applicable pay items of work:

- Clearing and grubbing
- Excavation, including necessary pavement removal
- Shoring and/or dewatering
- Structural fill
- Backfill
- Grading
- Tracer wire
- Refill materials
- Joint materials
- Tests and sterilization
- Appurtenant work as required for a complete and operable system.

### **506-2. FURNISH AND INSTALL WATER MAINS**

#### **506-2.1. MEASUREMENT**

The quantity for payment shall be the actual number of feet of pipe of each size and type satisfactorily furnished and laid, as measured along the centerline of the completed pipe line, including the length of valves and fittings.

#### **506-2.2. PAYMENT**

Payment of the applicable unit price shall be full compensation for furnishing all plant, labor, materials and equipment, and constructing the water mains completely and ready for operation.

## **506-3. FURNISH AND INSTALL FITTINGS**

### **506-3.1. MEASUREMENT**

The quantity for payment will be the number of tons, or decimal part thereof, of ductile iron fittings satisfactorily furnished and installed. Fitting weights shall be based on weights stamped on the body of the fitting, provided such weights do not exceed the theoretical weights by more than the tolerances permitted in ANSI/AWWA C110/A 21.10 82, latest revision, in which case, the weight will be based upon the theoretical weight plus the maximum tolerance.

### **506-3.2. PAYMENT**

Payment of the applicable unit price shall be full compensation for furnishing all plant, labor, materials, and equipment required to furnish and install ductile iron fittings.

## **506-4. FURNISH AND INSTALL GATE VALVES COMPLETE WITH BOXES AND COVERS**

### **506-4.1. MEASUREMENT**

The quantity for payment shall be the number of gate valves of each size satisfactorily furnished and installed.

### **506-4.2. PAYMENT**

Payment of the applicable unit price for each size shall be full compensation for furnishing all plant, labor, material and equipment and installing the valve complete with box and cover.

## **506-5. FURNISH AND INSTALL FIRE HYDRANTS**

### **506-5.1. MEASUREMENT**

The quantity for payment shall be the number of fire hydrants satisfactorily furnished and installed. The only hydrants allowed to be installed in the City of Clearwater utilities system are listed in Article 501-2.5 of these Technical Specifications. No exceptions.

### **506-5.2. PAYMENT**

Payment of the applicable unit price shall be full compensation for furnishing all plant, labor, material and equipment and installing the fire hydrant completely including necessary thrust anchorage, six inch (6") pipe between the main and the hydrant and gate valve and valve box on the hydrant lead.

## **600 SERIES: STORMWATER**

### **601. RAISING OR LOWERING OF STORM DRAINAGE STRUCTURES**

Storm Drainage Structures shall be raised or lowered as indicated on the plans or as indicated by the Engineer.

#### **601-1. BASIS OF PAYMENT**

Payment, unless covered by a bid item, shall be included in the cost of the work.

### **602. UNDERDRAINS**

The Contractor shall construct sub-surface drainage pipe as directed in the Scope of Work and detail drawings contained in the Project construction plans. In general, underdrain pipe shall be embedded in a bed of #6 FDOT aggregate, located behind the back of curb and aggregate surface covered with a non-degradable fibrous type filter material. A #57 aggregate may be used in lieu of #6 if it is washed and screened to remove fines. The aggregate may be stone, slag or crushed gravel. Unless otherwise noted on the plans, underdrain pipe shall be eight inches (8") in diameter, polyvinyl chloride pipe, in conformance with ASTM F-758 "Standard Specification For Smooth Wall PVC Underdrain Systems for Highways" latest revision, minimum stiffness of 46 in conformance with ASTM D2412, perforations in conformance with AASHTO M-189 described in FDOT Section 948-1.5 or latest revision and in conformance with ASTM D3034 - SDR 35.

Alternate acceptable underdrain pipe material is Contech A-2000 which is a rigid PVC pipe that exceeds ASTM Specifications D1784, minimum cell classification of 12454B or 12454C, manufactured per ASTM F949-93a, minimum pipe stiffness of 50 psi, with no evidence of splitting, cracking or breaking when pipe is tested in accordance with ASTM D2412 at 60% flattening and with a double gasket joint.

Underdrain pipe placed beneath existing driveways and roadways shall be non-perforated pipe with compacted backfill. All poly-chloride pipe which has become deteriorated due to exposure to ultra violet radiation shall be rejected. Where ductile iron pipe is specified, pipe material shall be the same as specified for potable water pipe in these technical specifications. All underdrain aggregate shall be fully encased in a polyester filter fabric "sock" (Mirafi 140-N or approved equal) per the construction detail drawings.

Filter aggregate for underdrains shall be as specified in the FDOT Standard Specifications, Section 901 – Course Aggregate, and shall be either #6 or #57. If #57 is used, it must be washed and screened to remove fines. The aggregate may be stone, slag, or crushed gravel.

#### **602-1. BASIS OF MEASUREMENT**

Measurement shall be the number of linear feet of eight inch (8") Sub-drain in place and accepted.

## **602-2. BASIS OF PAYMENT**

Payment shall be based upon the unit price per linear foot for underdrain as measured above, which shall be full compensation for all work described in this section of the specifications and shall include all materials, equipment, and labor necessary to construct the underdrain (specifically underdrain pipe, aggregate and filter fabric). Underdrain clean-outs, sod, driveway, road and sidewalk restoration shall be paid by a separate bid item.

## **603. STORM SEWERS**

All storm drain pipe installed within the City of Clearwater shall be steel reinforced concrete unless otherwise approved by the City Engineer. Said pipe shall comply with Section 430 of FDOT Standard Specifications.

All reinforced concrete pipe joints shall be wrapped with Mirafi 140N filter fabric or equivalent (as approved by the City Engineer). The cost for all pipe joint wraps shall be included in the unit price for the pipe.

All pipe, just before being lowered into a trench, is to be inspected and cleaned. If any difficulty is found in fitting the pieces together, this fitting is to be done on the surface of the street before laying the pipe, and the tops plainly marked in the order in which they are to be laid. No pipe is to be trimmed or chipped to fit. Each piece of pipe is to be solidly and evenly bedded, and not simply wedged up. Before finishing each joint, some suitable device is to be used to find that the inverts coincide and pipe is clear throughout.

## **603-1. TESTING AND INSPECTION**

The Contractor shall take all precautions to secure a watertight sewer under all conditions.

The work under this Article shall include the internal video recording of new stormwater drainage pipes and drainage structures. The Contractor shall provide the City with a video of the completed stormwater drainage system, and a written report. The Contractor shall pump down and clean the pipes and drainage structures, to the satisfaction of the City, prior to video recording. The video shall be of the standard DVD format, in color, with all the pertinent data and observations recorded as audio on the DVD. The data should include:

- 1) An accurate recorded footage of the pipe lengths.
- 2) The drainage structure number and pipe size.
- 3) The run of the pipe and direction of flow (i.e. from S-1 to S-2).
- 4) Details of structural defects, broken pipes, sags, dips, misalignments, obstructions and infiltration.

The written report shall include the four (4) items listed previously.

All visual and video recording inspections shall be completed by the Contractor and be in accordance with Section 430-4.8 of FDOT Standard Specifications. Any deficient or damaged pipe discovered during the video recording process shall be the responsibility of the Contractor to repair or replace at their own expense within the contractual duration.

As a complement to the video report, the Contractor shall also provide digital photos of areas of concern in electronic (computer CD/DVD) and hard copy form (in color).

All known pipe breaks or those breaks discovered after the video inspection shall be repaired by the Contractor regardless of the test allowances. Faulty sections of drainage pipes or drainage structures rejected by the Engineer shall be removed and re-laid by the Contractor. Sections of pipe that are repaired, re-laid or replaced shall be accompanied with a corresponding post construction video inspection at the Contractor's expense. In all cases that a leak is found, re-inspection shall be required at the Contractor's expense, to confirm that the problem has been resolved.

## **603-2. BASIS OF PAYMENT**

Payment shall be the unit price per linear foot for storm sewer pipe in place and accepted, measured along the centerline of the storm sewer pipe to the inside face of exterior walls of storm manholes or drainage structures and to the outside face of endwalls. Said unit price includes all work required to install the pipe (i.e. all materials, equipment, filter fabric wrap, gravel bedding if needed for stabilization, labor and incidentals, etc.).

# **604. STORM MANHOLES, INLETS, CATCH BASINS OR OTHER STORM STRUCTURES**

For details on specific design of a type of storm structure refer to Index Numbers 201 to 231.

When required, inlets, catch basins or other structures shall be constructed according to the plans and applicable parts of the specifications, Articles 301, 302, 303 and 202, and as approved by the Engineer. Said structures shall be protected from damage by the elements or other causes until acceptance of the work.

## **604-1. BUILT UP TYPE STRUCTURES**

Built up type manholes shall be constructed of brick with cast iron frames and covers as shown on Index Numbers 201. Invert channels shall be constructed smooth and semi circular in shape conforming to inside of adjacent sewer section. Changes in direction of flow shall be made in a smooth curve of as large a radius as possible. Changes in size and grade of channels shall be made gradually and evenly. Invert channels shall be built up with grout.

The storm structure floor outside of channels shall be made smooth and sloped toward channels.

Manhole steps shall not be provided. Joints shall be completely filled and the mortar shall be smoothed from inside of the manholes.

The entire exterior of brick manholes shall be plastered with a skim coat of one half inch (1/2") of mortar.

Brick shall be laid radially with every sixth course being a stretcher course.

In cases where a storm pipe extends inside a structure, the excess pipe will be cut off with a concrete saw and shall not be removed with a sledge hammer.

## **604-2. PRECAST TYPE**

Precast manholes shall be constructed as shown on Index 202. The manhole base shall be set on a pad of dry native sand approximately five inches (5") thick to secure proper seating and bearing.

Precast Manholes and Junction Boxes: The Contractor may substitute precast manholes and junction boxes in lieu of cast in place units unless otherwise shown on the plans. Precast Inlets will not be acceptable. When precast units are substituted, the construction of such units must be in accordance with ASTM C 478, or the standard specifications at the manufacturer's option.

Precast structures must also meet the requirement that on the lateral faces, either inside or outside, the distance between precast openings for pipe or precast opening and top edge of precast structure be no less than wall thickness. A minimum of four courses of brick will be provided under manhole ring so that future adjustment of manhole lid can be accommodated. Manhole steps shall not be provided.

## **604-3. BASIS OF PAYMENT**

Payment for Junction Boxes, Manholes or other structures shall be on a unit basis.

# **605. GABIONS AND MATTRESSES**

## **605-1. MATERIAL**

### **605-1.1. PVC COATED WIRE MESH GABIONS & MATTRESSES**

#### **605-1.1.1. GABION & MATTRESS BASKETS**

Gabion and mattress baskets units shall conform to ASTM A975, be of non-raveling construction and fabricated from a double twist by twisting each pair of wires through three half turns developing the appearance of a triple twist. The galvanized wire core shall have a diameter of 0.106 inches.

#### **605-1.1.2. PVC (POLYVINYL CHLORIDE) COATING**

The coating shall be gray in color and shall have a nominal thickness of 0.0216 inches but not less than 0.015 inches in thickness. The protective PVC plastic shall be suitable to resist deleterious effects from exposure to light, immersion in salt or polluted water and shall not show any material difference in its initial compound properties. The PVC compound is also resistant to attack from acids and resistant to abrasion.

The PVC coating shall be extruded and adhere to the wire core prior to weaving. The PVC coated wire shall be woven into a double twisted hexagonal mesh having uniform openings of 3 1/4 inches by 4 1/2 inches. The overall diameter of the mesh wire (galvanized wire core plus PVC coating) shall be 0.146 inches. Selvedge and reinforcing wire shall be of heavily galvanized wire core, 0.134 inches in diameter, coated with PVC and having an overall diameter (galvanized wire core plus PVC coating) of 0.174 inches. Lacing and connecting wire shall be of soft tensile strength (75,000 PSI max), heavily galvanized wire core, 0.087 inches in diameter, coated with PVC and having an overall diameter (galvanized wire core plus PVC coating) of 0.127 inches. The use of alternate wire fasteners shall be permitted in lieu of tie wire providing the alternate fastener

produces a four (4) wire selvedge joint with a strength of 1200 lbs. per linear foot while remaining in a locked and closed condition. Properly formed interlocking fasteners shall be spaced from 4 to 6 inches and have a minimum 3/4 square inch inside area to properly confine the required selvedge wires.

#### **605-1.1.3. GABION AND MATTRESS FILLER MATERIAL:**

The filler stone shall be from a source approved by the Engineer before delivery is started. Representative preliminary samples of the stone shall be submitted by the contractor or supplier for examination and testing by the Engineer. The stone shall have a minimum specific gravity of 2.3 and be of a quality and durability sufficient to insure permanency in the structure. The individual stones shall be free of cracks, seams, and other defects that would tend to promote deterioration from natural causes, or which might reduce the stones to sizes that could not be retained in the gabion or mattress baskets.

All filler material shall be uniformly graded between 4 inch and 8 inch (equivalent spherical diameter) and shall be angular in form. Rounded stones shall not exceed 10% of the stone, by weight and 70% of the stone, by weight, shall exceed the largest dimension of the mesh opening. Crushed concrete shall not be used for filler material.

#### **605-1.1.4. GEOTEXTILE FABRIC**

Fabric shall conform to FDOT Standard Specifications, Section 985.

### **605-2. PERFORMANCE**

Gabions and Reno Mattresses shall be installed according to the manufacturer's recommendations and as shown on the Drawings. Fabrication of gabion baskets shall be in such a manner that the sides, ends, lid and diaphragms can be assembled at the construction site into rectangular baskets of the sizes specified and shown on the Drawings. Gabions and mattresses shall be of single unit construction; the base, lid ends and sides shall be either woven into a single unit or one edge of these members connected to the base section of the gabion in such a manner that the strength and flexibility at the connecting point is at least equal to that of the mesh. Where the length of the gabion and mattress exceeds one and one-half its horizontal width, they shall be equally divided by diaphragms of the same mesh and gauge as the mattresses shall be furnished with the necessary diaphragms secured in proper position on the base so that no additional tying is required at this juncture. The wire mesh is to be fabricated so that it will not ravel. This is defined as the ability to resist pulling apart at any of the twists or connections forming the mesh when a single wire strand in a section of mesh is cut.

Each gabion or mattress shall be assembled by tying all untied edges with binding wire. The binding wire shall be tightly looped around every other mesh opening along seams so that single and double loops are alternated.

A line of empty gabions shall be placed into position according to the contract drawings and binding wire shall be used to securely tie each unit to the adjoining one along the vertical reinforced edges and the top selvedges. The base of the empty gabions placed on top of a filled line of gabions shall be tightly wire to the latter at front and back.

To achieve better alignment and finish in retaining walls, gabion stretching is recommended.

Connecting wires shall be inserted during the filling operation in the following manner: Gabions shall be filled to one third full and one connecting wire in each direction shall be tightly tied to opposite faces of each cell at one third height. The gabion shall then be filled to two thirds full and one connecting wire in each direction shall be tightly tied to opposite face of each cell at one two third height. The cell shall then be filled to the top.

Filler stone shall not be dropped more than twelve inches (12") into the gabions and mattresses.

Geotextile fabric shall be installed at locations shown in the Drawings. The surface to receive the cloth shall be prepared to a relatively smooth condition free of obstructions which may tear or cut the cloth. The panel shall be overlapped a minimum of 30 inches and secured against movement. Cloth damaged or displaced during installation, gabion work, or backfill shall be replaced or repaired to the satisfaction of the Engineer at the contractor's expense. The work shall be scheduled so that the fabric is not exposed to ultraviolet light more than the manufacturer's recommendations or five days, whichever is less.

In wet conditions, a base shall be established by spreading and compacting #57 stone prior to placement of geotextile fabric and gabions or mattresses.

## **700 SERIES: STREETS AND SIDEWALKS**

### **701. RESTORATION OR REPLACEMENT OF DRIVEWAYS, CURBS, SIDEWALKS AND STREET PAVEMENT**

Driveways, sidewalks, and curbs destroyed or damaged during construction shall be replaced and shall be the same type of material as destroyed or damaged, or to existing City Standards, whichever provides the stronger repair. All street pavement destroyed or damaged shall be replaced with the same type of material, to existing City Standards, unless the existing base is unsuitable as determined by the Engineer, then the base shall be replaced with City approved material. All replaced base shall be a minimum eight inches (8") compacted thickness, or same thickness as base destroyed plus two inches (2"), if over six inches (6"), and compacted to 98% of maximum density per AASHTO T-180.

Unless called for in the proposal as separate bid items, cost of the above work including labor, materials and equipment required shall be included in the bid price per linear foot of main or square yard of base.

The bid price for street pavement, restoration or replacement when called for in the proposals, shall include all materials, labor and equipment required to complete the work, and shall be paid for on a square yard basis. When replacement is over a trench for utilities, the area of replacement shall be limited to twice the depth of the cut plus twice the inside diameter of the pipe. All necessary restoration exceeding this footprint will be at the Contractor's expense.

The bid price for restoration or placement of driveways, curbs and sidewalks, when called for in the proposals, shall include all materials, labor and equipment required to complete the work and shall be paid for on the basis of the following units: Driveways, plant mix - per square yard; concrete - per square foot; curbs - per linear foot; sidewalk four inches (4") or six inches (6") thick - per square foot. Concrete walks at drives shall be a minimum of six inches (6") thick and be reinforced with 6/6 X 10/10 welded wire mesh (also see Articles 303 and 707). The Contractor shall notify the Project Inspector a minimum of twenty-four (24) hours in advance of all driveway, curb, sidewalk and street restoration and replacement work.

### **702. ROADWAY BASE AND SUBGRADE**

#### **702-1. BASE**

This specification describes the construction of roadway base and subgrade. The Contractor shall refer to Section IV, Article 101 "Scope of Work" of the City's Contract Specifications for additional roadway base and subgrade items.

Roadway base shall be eight inches (8") compacted minimum thickness unless otherwise noted on the plans or directed by the Engineer. The subgrade shall be twelve inches (12") compacted minimum thickness with a minimum Limerock Bearing Ratio (LBR) of 40 unless otherwise noted on the plans or directed by the Engineer. The Contractor shall obtain from an independent testing laboratory a Proctor and an LBR for each type material. The Contractor shall also have an independent testing laboratory perform all required density testing. Where unsuitable material is

found within the limits of the base, Section IV, Article 204 (Unsuitable Material Removal) of the City's Technical Specifications will apply.

Once the roadway base is completed, it shall be primed that same day (unless otherwise directed by the Engineer) per Section 300 of FDOT's Standard Specifications. Repairs required to the base that result from a failure to place the prime in a timely manner shall be done to the City's satisfaction, and at the Contractor's expense. No paving of the exposed base can commence until the City approves the repaired base. The cost for placement of prime material shall be included in the bid item for base.

The Contractor shall notify the Project Inspector a minimum of twenty-four (24) hours in advance of all base and subgrade placement or reworking.

The following base materials are acceptable:

1. **Shell Base:** Shell base shall be constructed in accordance with Sections 200 and 913 of FDOT's Standard Specifications and shall have a minimum compacted thickness as shown on the plans. The shell shall be FDOT approved. The cost of the prime coat shall be included in the bid item price for base.
2. **Limerock Base:** Limerock base shall be constructed in accordance with Sections 200 and 911 of FDOT's Standard Specifications and shall have a minimum compacted thickness as shown on the plans. The limerock shall be from a FDOT approved certified pit. The cost of the prime coat shall be included in the bid item price for base.
3. **Crushed Concrete Base:** Crushed concrete base shall be constructed in accordance with Sections 204 and 901 of FDOT's Standard Specifications and shall have a minimum compacted thickness as shown on the plans. The crushed concrete material shall be FDOT approved. The Contractor shall provide certified laboratory tests on gradation to confirm that the crushed concrete base material conforms to the above specifications. The LBR shall be a minimum of 100. LBR and gradation tests shall be provided to the City by the Contractor once a week for continuous operations, or every 1000 tons of material, unless requested more frequently by the City Engineer or designee. The cost of the prime coat shall be included in the bid item price for base.
4. **Superpave Asphalt Base:** Full depth asphalt base shall be constructed in accordance with Section 234 of FDOT's Standard Specifications and shall have a minimum compacted thickness as shown on the plans. The cost for preparation, placement, and compaction shall be included in the per ton unit cost for asphalt unless otherwise noted in the project scope and plans. The cost of the tack coat shall be included in the bid item price for asphalt or base.
5. **Reclaimed Asphalt Pavement Base:** Reclaimed asphalt pavement base shall be constructed in accordance with Section 283 of FDOT's Standard Specifications and shall have a minimum compacted thickness as shown on the plans. As per FDOT Section 283, RAP material shall be used as a base course only on non-limited access paved shoulders, shared use paths, or other non-traffic bearing applications. The cost for preparation, placement, and compaction shall be included in the per ton unit cost for asphalt unless otherwise noted in the project scope and plans. The cost of the tack coat shall be included in the bid item price for asphalt or base.

## **702-1.1. BASIS OF MEASUREMENT FOR BASE AND REWORKED BASE**

The basis of measurement shall be the number of square yards of base in place and accepted as called for on the plans. The maximum allowable deficiency shall be a half-inch (1/2"). Areas deficient in thickness shall either be fixed by the Contractor to within acceptable tolerance, or if so approved in writing by the City Engineer, may be left in place. No payment, however, will be made for such deficient areas that are left in place.

## **702-1.2. BASIS OF PAYMENT FOR BASE AND REWORKED BASE**

The unit price for base shall include: all materials, roadbed preparation, placement, spreading, compaction, finishing, prime, base, subgrade (unless the plans specify a separate pay item), stabilization, mixing, testing, equipment, tools, hauling, labor, and all incidentals necessary to complete the work. Payment for asphalt base shall be included in the per ton unit cost for asphalt unless otherwise noted in the project scope and plans.

## **702-2. SUBGRADE**

All subgrade shall be stabilized and constructed in accordance with Sections 160 and 914 of FDOT's Standard Specifications unless otherwise noted herein. All subgrade shall have a minimum compacted thickness of 12" unless otherwise shown on the plans or directed by the Engineer. If limerock is used, it shall also meet the requirements of Section 911 of FDOT's Standard Specifications. Where unsuitable material is found within the limits of the subgrade, Section IV, Article 204 (Unsuitable Material Removal) of the City's Contract Specifications will apply. The extent of said removal shall be determined by the Engineer in accordance with accepted construction practices. The Contractor is responsible for clearing, grading, filling, and removing any trees or vegetation in the roadbed below the subgrade to prepare it per the plans. The cost of this work shall be included in the unit price for base or subgrade. The Contractor shall obtain from an independent testing laboratory the bearing value of the subgrade after the materials are mixed for the stabilized subgrade.

### **702-2.1. BASIS OF MEASUREMENT**

The basis of measurement shall be the number of square yards of stabilized subgrade in place and accepted as called for on the plans. The maximum allowable deficiency for mixing depth shall be per Section 161-6.4 of FDOT's Standard Specifications. Acceptable bearing values shall be per Section 160-7.2 of FDOT's Standard Specifications. Areas deficient in thickness or bearing values shall either be corrected by the Contractor to within acceptable tolerance, or if so approved in writing by the City Engineer, may be left in place. No payment, however, will be made for such deficient areas that are left in place.

### **702-2.2. BASIS OF PAYMENT**

The unit price for subgrade shall include roadbed preparation, placement, spreading, compaction, finishing, testing, stabilizing, mixing, materials, hauling, labor, equipment and all incidentals necessary to complete the work. If no pay item is given, subgrade shall be included in the bid item for base.

## **703. ASPHALTIC CONCRETE MATERIALS**

This specification is for the preparation and application of all asphaltic concrete materials on roadway surfaces unless otherwise noted.

### **703-1. ASPHALTIC CONCRETE**

#### **703-1.1. AGGREGATE**

All aggregates shall be obtained from an approved FDOT source and shall conform to Sections 901 through 915 of FDOT's Standard Specifications.

#### **703-1.2. BITUMINOUS MATERIALS**

All bituminous materials shall conform to Section 916 of FDOT's Standard Specifications.

### **703-2. HOT BITUMINOUS MIXTURES – PLANT, METHODS, EQUIPMENT & QUALITY ASSURANCE**

The plant and methods of operation used to prepare all asphaltic concrete and bituminous materials shall conform to the requirements of Section 320 of FDOT's Standard Specifications. Unless otherwise noted, all acceptance procedures and quality control/assurance procedures shall conform to the requirements of Section 330 of FDOT's Standard Specifications.

The City shall have the right to have an independent testing laboratory select, test, and analyze, at the expense of the City, test specimens of any or all materials to be used. The results of such tests and analyses shall be considered, along with the tests or analyses made by the Contractor, to determine compliance with the applicable specifications for the materials so tested or analyzed. The Contractor hereby understands and accepts that wherever any portion of the work is discovered, as a result of such independent testing or investigation by the City, which fails to meet the requirements of the Contract documents, all costs of such independent inspection and investigation as well as all costs of removal, correction, reconstruction, or repair of any such work shall be borne solely by the Contractor.

Payment reductions for asphalt related items shall be determined by the following:

1. Density per FDOT's Standard Specifications.
2. Final surface or friction course tolerances per FDOT's Standard Specifications.
3. Thickness will be determined from core borings. Deficiencies of  $\frac{1}{4}$ " or greater shall be corrected by the Contractor, without compensation, by either replacing the full thickness for a length extending at least twenty-five feet (25') from each end of the deficient area, or when the Engineer allows for an overlay per FDOT's Standard Specifications. In addition, for excesses of one-quarter inch ( $\frac{1}{4}$ ") or greater, the Engineer will determine if the excess area shall be removed and replaced at no compensation, or if the pavement in question can remain with payment to be made based on the thickness specified in the contract.

The Contractor shall notify the Project Inspector a minimum of twenty-four (24) hours in advance of the placement of all asphalt.

## **703-3. ASPHALT MIX DESIGNS AND TYPES**

All asphalt mix designs, acceptance procedures and quality control/assurance procedures shall conform to the requirements of Sections 330 and 334 of FDOT Standard Specifications. All asphalt mix designs shall be approved by the Engineer prior to the commencement of the paving operation. Reclaimed asphalt pavement (RAP) material may be substituted for aggregate in the asphaltic concrete mixes up to 25% by weight.

## **703-4. ASPHALT PAVEMENT DESIGNS AND LAYER THICKNESS**

All asphalt pavement designs shall conform to the following requirements:

Type SP/Spec 334-1

Type FC/Spec 337-8

Type B/Spec 234-8

ATPB/287-8

## **703-5. GENERAL CONSTRUCTION REQUIREMENTS**

The general construction requirements for all hot bituminous pavements (including limitations of operations, preparation of mixture, preparation of surface, placement and compaction of mixture, surface requirements, correction of unacceptable pavement, Quality Control Testing, etc.) shall be in accordance with Section 330 of FDOT's Standard Specifications.

## **703-6. CRACKS AND POTHOLE PREPARATION**

### **703-6.1. CRACKS**

Cracks in roadway pavement shall be repaired prior to the application of asphaltic concrete by the following steps:

1. All debris to be removed from cracks by compressed air or other suitable method.
2. Apply a multiple layered application of bituminous binder and fine aggregate, as appropriate to the depth of the crack until the void of the crack is completely filled to the level of the surrounding roadway surface.
3. If application of asphaltic concrete is not to begin immediately after crack repair, cracks are to be sanded to prevent vehicular tracking.
4. Payment for crack filling shall be included in the unit price for asphaltic concrete.

### **703-6.2. POTHOLES**

Potholes shall be repaired prior to the application of asphaltic concrete by the following steps:

1. All debris is to be removed from potholes by hand, sweeping, or other suitable method.
2. A tack coat is to be applied to the interior surface of the pothole.

3. The pothole is to be completely filled with asphaltic concrete, and thoroughly compacted.
4. Payment for pothole preparation shall be included in the unit price for asphaltic concrete.

## **703-7. ADJUSTMENT OF MANHOLES**

The necessary adjustments of sanitary sewer and storm drain manholes and appurtenances shall be accomplished by the Contractor. The Contractor shall be paid on a per unit basis for each item.

The use of manhole adjustment risers is acceptable under the following conditions:

The riser shall meet or exceed all FDOT material, weld, and construction requirements. The riser shall consist of an A-36 hot rolled steel meeting or exceeding the minimum requirements of A.S.T.M. A-36. The riser shall be a single piece with a stainless steel adjustment stud and shall have a rust resistant finish. The use of cast iron, plastic, or fiberglass risers is not permitted. In addition, the installation of each riser shall be per manufacturer's specifications. Each manhole shall be individually measured, and each riser shall be physically marked to ensure that the proper riser is used. Also, the ring section shall be cleaned, and a bead of chemically resistant epoxy applied to the original casting, prior to installation of the riser. It is the Contractor's responsibility to ensure that the manholes are measured, the risers are physically marked, the ring sections are thoroughly cleaned, and that the epoxy is properly applied prior to installation of each riser.

If risers are not used, the adjustment of manholes shall be accomplished by the removal of pavement around manhole, grade adjustment of ring and cover, and acceptable replacement and compaction of roadway materials prior to paving. A full depth backfill using asphalt is acceptable. The use of Portland cement for backfill is not acceptable.

All manhole and valve adjustments shall be accomplished prior to the application of final asphaltic concrete surface. Unless otherwise noted in the specs or on the plans, the paving operation shall occur within seven (7) calendar days from the completion of the adjustment. On arterial roadways, the manholes are to be ramped with asphalt during the time period between initial adjustment and final resurfacing. Water and gas valves, sewer cleanouts, valve boxes, tree aeration vents, etc., will be adjusted by the Contractor with the cost for this work to be included in the unit cost of the asphalt. Care must be taken around said appurtenances to ensure that they are not paved over. It is the Contractor's responsibility to inform the owners of all utilities of impending work and coordinate their adjustments, so they are completed prior to the scheduled paving.

## **703-8. ADDITIONAL ASPHALT REQUIREMENTS**

1. All impacted radius returns within project limits shall be paved unless otherwise directed by the Construction Inspector or Engineer, with payment to be included in the per ton bid item for asphalt.
2. All pavement markings impacted by placement of asphalt shall be replaced prior to the road being open to traffic unless otherwise noted in the contract scope and plans.
3. All project related debris shall be hauled off the job site by the Contractor in a timely manner and at their own expense in conformance with all regulatory requirements.
4. The Contractor shall pay particular attention to sweeping when paving. Prior to paving, all construction areas shall be swept with a Municipal type sweeper (either vacuum or

mechanical type) that picks up and hauls off, dust and dirt. The sweeper must be equipped with its own water supply for pre-wetting to minimize dust. Moreover, the Contractor shall sweep debris off of sidewalks, driveways, curbs and roadways each day before leaving the job site.

5. The application of tack and prime coats (either required or placed at the Engineer's discretion) shall be placed per Section 300 of FDOT's Standard Specifications. Tack shall also be applied to the face of all curbs and driveways. The cost (including heating, hauling and applying) shall be included in the per ton bid item for asphalt, unless otherwise noted in the project scope and plans.
6. Leveling course and spot patching shall be applied to sections of the road as noted on the plans, or as directed by the Engineer, per Section 330 of FDOT's Standard Specifications. The cost shall be included in the per ton unit cost for asphalt, unless otherwise noted in the project scope and plans.
7. If an asphalt rubber binder is required, it shall conform to the requirements of Section 336 of FDOT's Standard Specifications.
8. On all streets with curb and gutter, the final compacted asphalt shall be one-quarter inch ( $\frac{1}{4}$ ") above the lip or face of said curb per City Index 101.

## **703-9. BASIS OF MEASUREMENT**

Basis of measurement will be the number of tons of asphaltic concrete completed, in place and accepted. Truck scale weights will be required for all asphaltic concrete used.

## **703-10. BASIS OF PAYMENT**

Payment shall be made at the contract unit price for asphaltic concrete surface as specified and measured above. This price shall include all materials, preparation, hauling, placement, tack and/or prime coat either required or placed at Engineer's discretion, leveling, spot patching, filling of cracks, pothole repair, sweeping, debris removal, labor, equipment, tools, and incidentals necessary to complete the asphalt work in accordance with the plans and specifications.

## **704. ADJUSTMENT TO THE UNIT BID PRICE FOR ASPHALT**

When this Article applies to the contract, the unit bid price for asphalt will be adjusted in accordance with the following provisions:

1. Price adjustment for asphalt shall only be made when the current FDOT Asphalt Price Index varies more than ten percent (10%) from the bid price at the time of the bid opening.
2. The Bituminous Material Payment Adjustment Index published monthly by the FDOT shall be used for the adjustment of unit prices. This report is available on FDOT's internet site. The address is: <http://www.dot.state.fl.us/construction/fuel&bit/fuel&bit.shtm>. For additional information, call FDOT at (850) 414-4252.
3. The FDOT Payment Adjustment Index in effect at the time of the bid opening will be used for the initial determination of the asphalt price.

4. The FDOT Payment Adjustment Index in effect at the time of placement of the asphalt will be used for payment calculation.
5. The monthly billing period for contract payment will be the same as the monthly period for the FDOT Payment Adjustment Index.
6. No adjustment in bid prices will be made for either tack coat or prime coat.
7. No price adjustment reflecting any further increases in the cost of asphalt will be made for any month after the expiration of the allowable contract time.
8. The City reserves the right to make adjustments for decreases in the cost of asphalt.

## **705. ASPHALT DRIVEWAYS**

New driveways or existing asphalt driveways that must be altered for project construction shall be constructed or replaced in accordance with the specifications for paving the street with the exception that the base shall be six inches (6"). Remove only enough to allow adequate grade for access to the street. Use Article 703 Asphaltic Concrete, of these Technical Specifications, as specified for the street paving.

When the finished surface of the existing drive is gravel, replacement shall be of like material. Payment shall be the same as Asphalt Driveways.

### **705-1. BASIS OF MEASUREMENT**

Measurement shall be the number of square yard of Asphalt Driveways in place and accepted.

### **705-2. BASIS OF PAYMENT**

Payment shall be the unit price per square yard for Asphalt Driveways as measured above, which price shall be full compensation for all work described in this section of the specifications and shall include all materials, equipment, tools, labor and incidentals necessary to complete the work.

## **706. CONCRETE CURBS**

Concrete Curbs shall be constructed to the line, grade and dimensions as shown on the plans. Unless otherwise noted, all concrete curbs shall have fiber mesh reinforcement and have a minimum strength of 3000 psi at 28 days. Expansion joints shall be placed at intervals not to exceed 100 feet, and scored joints shall be placed at intervals not to exceed ten feet (10'). In addition, all the requirements of City Articles 301, 302 and 303 shall also apply. The Contractor shall notify the Project Inspector a minimum of twenty-four (24) hours in advance of the placement of all concrete curbs.

### **706-1. BASIS OF MEASUREMENT**

The basis of measurement shall be linear feet of curb in place and accepted.

## **706-2. BASIS OF PAYMENT**

Payment shall be the unit price per linear foot of curb, which price shall be full compensation for all work described in this and other applicable parts of the specifications and shall include all materials, equipment, tools, labor and incidentals necessary to complete the work.

# **707. CONCRETE SIDEWALKS AND DRIVEWAYS**

## **707-1. CONCRETE SIDEWALKS**

Concrete sidewalks shall be constructed to the line, grade and dimensions as shown on the plans or herein specified. Unless otherwise noted, all concrete sidewalks shall have fiber mesh reinforcement and have a minimum strength of 3000 psi at 28 days. Unless otherwise specified, all concrete sidewalks shall have a minimum width of four feet (4'). Concrete sidewalks shall have a minimum thickness of four inches (4"), except at driveway crossings where a minimum thickness of six inches (6") is required. Also, 6/6 X 10/10 welded wire mesh reinforcement is required for all sidewalk that crosses driveways. The welded wire mesh shall be positioned in the middle to upper third of the placement. No compensation shall be given if the welded wire mesh is not properly placed. Expansion joints shall be placed at intervals of not more than 100 hundred feet, and scoring marks shall be made every five feet (5'). Concrete shall be poured only on compacted subgrade. In addition, all the requirements of Articles 301, 302 and 303 of these Technical Specifications shall also apply.

## **707-2. CONCRETE DRIVEWAYS**

Concrete driveways, whether new construction or replacement, shall be a minimum of six inches (6') in thickness with 6/6 x 10/10 welded wire mesh reinforcement and a minimum horizontal distance between expansion joints of no less than four feet (4') measured in any direction. The welded wire mesh shall be positioned in the middle to upper third of the placement. No compensation shall be given if the welded wire mesh is not properly placed. Concrete shall be poured only on compacted subgrade. In addition, all the requirements of Articles 301, 302 and 303 of these Technical Specifications shall also apply.

The Contractor shall notify the Project Inspector a minimum of twenty-four (24) hours in advance of the placement of all concrete sidewalks and driveways.

## **707-3. CONCRETE CURB RAMPS**

The contractor is responsible for constructing ADA compliant concrete curb ramps per the plans and installing detectable warning surfaces on said ramps as called for in the plan set. Concrete curb ramps and detectable warning surfaces are to be constructed per FDOT Standards and Specifications.

## **707-4. BASIS OF MEASUREMENT**

The basis of measurement shall be the number of square feet of four inch (4") concrete sidewalk, six inch (6") concrete sidewalk, and six inch (6") concrete driveways in place and accepted.

## **707-5. BASIS OF PAYMENT**

Payment shall be the unit price per square foot for each item as measured above, which shall be full compensation for all work described in this section and other applicable parts of the specifications and shall include all materials, equipment, tools, welded wire mesh where required, labor and incidentals necessary to complete the work.

## **708. MILLING OPERATIONS**

### **708-1. EQUIPMENT, CONSTRUCTION & MILLED SURFACE**

Unless otherwise noted in the specs, plans or this Article, the milling operation shall be performed in accordance with Section 327 of FDOT's Standard Specifications. The Contractor shall notify the City of Clearwater Project Representative a minimum of twenty-four (24) hours in advance of all milling.

### **708-2. ADDITIONAL MILLING REQUIREMENTS**

1. If the milling machine is equipped with preheating devices, the Contractor is responsible to secure any necessary permits, and for complying with all local, state and federal environmental regulations governing operation of this type of equipment.
2. All milled surfaces must be repaved within seven (7) days from the time it was milled, unless otherwise noted in the contract documents.
3. Prior to paving, all milled areas shall be swept with a Municipal type sweeper either of the vacuum or the mechanical type that picks up and hauls off, dust and dirt. The sweeper must be equipped with its own water supply for pre-wetting to minimize dust. Moreover, the Contractor shall sweep debris off of sidewalks, driveways and curbs in addition to the roadways before leaving the job site.
4. In cases where concrete valley swales are present, the adjoining pavement shall be milled to allow for the new asphalt grade to be flush with the concrete surface.
5. The Contractor shall be responsible for removing any asphalt that remains in the curb line and/or median curbs after the milling operation of a street is complete. The cost of this removal shall be included in the bid item for milling.
6. All radius returns on streets to be milled shall also be milled unless otherwise directed by the Engineer, with payment to be included in the bid item for milling.
7. Any leveling or base replacement required after milling shall be applied to sections of the road as noted on the plans, or directed by the Engineer, per Section 330 of FDOT's Standard Specifications. The cost shall be included in the per ton unit cost for asphalt, unless otherwise noted in the project scope and plans.
8. Any roadway base material exposed as a result of the milling operation shall be primed that same day (unless otherwise directed by the Engineer) per Section 300 of FDOT's Standard Specifications. Repairs required to said base that result from a failure to place the prime in a timely manner shall be done to the City's satisfaction, and at the Contractor's

expense. No paving of the exposed base can commence until the City approves the repaired base. The cost of said prime shall be included in the bid item for milling.

9. Prior to the placement of asphalt, the face of all curbs and driveways shall be tacked after the milling operation is complete.

### **708-3. SALVAGEABLE MATERIALS**

Unless otherwise specified, all salvageable materials resulting from milling operations shall remain the property of the City. The transporting and stockpiling of salvageable materials shall be performed by the Contractor. The Contractor shall contact the City Project Representative to schedule delivery of material at least 48 hours prior to starting work.

### **708-4. DISPOSABLE MATERIALS**

All surplus materials not claimed by the City shall become the responsibility of the Contractor. The Contractor shall dispose of the material in a timely manner and in accordance with all regulatory requirements in areas provided by the Contractor at no additional expense to the City.

### **708-5. ADJUSTMENT AND LOCATION OF UNDERGROUND UTILITIES**

All private utilities and related structures requiring adjustment shall be located and adjusted by their owners at the owner's expense. City-owned utilities and structures shall be located by the Owner/City and adjusted by the contractor. The Contractor shall arrange their schedule to allow utility owners the time required for such adjustments (minimum 48 hours' notice per State Statute). All utility adjustments shall be completed prior to the commencement of milling and resurfacing operations.

### **708-6. ADJUSTMENT OF UTILITY MANHOLES**

The necessary adjustments of sanitary sewer and stormwater utility manholes and appurtenances shall be accomplished by the Contractor in accordance with Section IV, Article 703-7 of the City's Technical Specifications.

### **708-7. TYPES OF MILLING**

There are two types of milling used by the City:

- A. Wedge – This will consist of milling a six foot (6') wide strip along the curb line of the pavement adjacent to the curb so the new asphalt will align with the original curb height and pavement cross section.
- B. Full Width – This will consist of milling the entire roadway (i.e. curb line/edge of pavement to curb line/edge of pavement). All existing horizontal and vertical geometry shall remain unless otherwise indicated or approved by the Engineer.

### **708-8. MILLING OF INTERSECTIONS**

Intersections, as well as other areas (including radius returns) are to be milled and repaved to restore and/or improve the original drainage characteristics. Said work should extend

approximately fifty (50) to one hundred (100) feet in both directions from the low point of the existing swale.

## **708-9. BASIS OF MEASUREMENT**

The quantity to be paid for will be the area milled, in square yards, completed and accepted.

## **708-10. BASIS OF PAYMENT**

The unit price for milling shall include: all materials, preparation, hauling, transporting and stockpiling of salvageable materials, disposal of all surplus material, any required milling of radius returns and intersections, prime and/or tack coat either required or placed at Engineer's discretion, removal of asphalt from curbs, sweeping, labor, equipment, and all incidentals necessary to complete the milling in accordance with the plans and specifications.

## **800 SERIES: TRAFFIC SIGNALS, SIGNS AND MARKINGS**

### **801. TRAFFIC SIGNAL EQUIPMENT AND MATERIALS**

All traffic signal work shall be performed per FDOT's Standard Specifications (Sections 603 through 699), unless otherwise specified in the contract documents and plans.

This specification includes, but is not limited to, the following items: all necessary equipment, materials, guaranties, acceptance procedures, signal timings, field tests, grounding, conduit, signal and interconnect cable, span wire assemblies, pull and junction boxes, electrical power service assemblies, poles, signal assemblies, pedestrian assemblies, inductive loop detectors, pedestrian detectors, traffic controller assemblies, controller cabinets and accessories, removal of existing traffic signal equipment, and internally illuminated signs.

All traffic signal installations shall be mast arms and conform to the requirements of FDOT's Mast Arm Assembly standard and shall be signed and sealed by a professional engineer registered in the State of Florida. All mast arm calculations, as well as the geotechnical report, shall also be signed and sealed by a professional engineer registered in the State of Florida. All mast arm colors shall be determined and approved by the City prior to ordering from the manufacturer.

All traffic signal indicators for vehicles and pedestrians shall be LEDs and, approved by both the City and FDOT. In addition to this, all pedestrian signal indicators shall utilize countdown features.

Contractor changes to the operation of an existing signal is prohibited unless directed by the City's Traffic Engineering Division.

All damaged inductive loop detectors shall be restored by the contractor per FDOT Index 17781.

#### **801-1. BASIS OF MEASUREMENT AND PAYMENT**

The basis of measurement and payment shall be specified in the contract documents and/or plans and shall include all equipment, preparation, materials, testing and incidentals required to complete the work per the plans.

### **802. SIGNING AND MARKING**

All signing and marking work shall be performed per FDOT's Standard Specifications, unless otherwise specified in the contract documents and plans.

This specification includes the following work: RPM's (Section 706), painted traffic stripes and markings (Section 710), thermoplastic stripes and markings (Section 711) and tubular delineators/flex posts (Sections 705 and 972).

The Contractor is responsible to ensure that striping is correctly placed. Errors in striping or markings shall be "blacked-out" with paint, unless otherwise directed by the Engineer. No payment will be made for these incorrect or "blacked-out" areas. Omissions in striping or markings shall be corrected to the City's satisfaction prior to any payment being made.

The Contractor is responsible for restoring all striping in paint and reflective beading per the FDOT indices mentioned above. The City's Traffic Engineering department shall follow up with thermoplastic striping at a later date unless otherwise specified.

## **802-1. BASIS OF MEASUREMENT AND PAYMENT**

The basis of measurement and payment shall be specified in the contract documents and/or plans and shall include all equipment, preparation, materials and incidentals required to complete the work per the plans.

## **803. ROADWAY LIGHTING**

All roadway lighting shall be constructed per Sections 715 and 992 of FDOT's Standard Specifications, unless otherwise specified in the contract documents and plans.

## **803-1. BASIS OF MEASUREMENT AND PAYMENT**

The basis of measurement and payment shall be specified in the contract documents and/or plans and shall include all equipment, materials, testing and incidentals required to complete the work per the plans.

## **900 SERIES: LANDSCAPING/RESTORATION**

### **901. WORK IN EASEMENTS OR PARKWAYS**

Restoration is an important phase of construction, particularly to residents affected by the construction progress.

The Contractor will be expected to complete restoration activities within a reasonable time following primary construction activity. Failure by the Contractor to accomplish restoration within a reasonable time shall be justification for a temporary stop on primary construction activity or a delay in approval of partial payment requests.

Reasonable care shall be taken for existing shrubbery. Contractor shall replace all shrubbery removed or disturbed during construction. No separate payment shall be made for this work.

The Contractor shall make provision and be responsible for the supply of all water, if needed, on any and all phases of the contract work. The Contractor shall not obtain water from local residents or businesses except as the Contractor shall obtain written permission.

Reuse water is available for the Contractor's use without charge from the City's Water Reclamation Facilities, provided the water is used on City of Clearwater contractual work. Details for Contractor to obtain and reuse water from the Water Reclamation Facilities will be coordinated at the pre-construction conference. The Contractor's use of reuse water must conform to all regulatory requirements.

### **902. GENERAL PLANTING SPECIFICATIONS**

#### **902-1. IRRIGATION**

##### **902-1.1. DESCRIPTION**

- A. The work specified in this Section consists of the installation of an automatic underground irrigation system as shown or noted in the plans. Provide all labor, materials, equipment, services and facilities required to perform all work in connection with the underground sprinkler irrigation system, complete, as indicated on the drawings and/or specified. Work noted as "NIC", "existing", or "by others" is not included in this pay item.
- B. The irrigation plans are schematic in nature. Valves and pipes shall be located in the turf/landscape areas except at road/paving crossings. All piping under paving shall be sleeved. Changes in the irrigation system layout shall be modified with the approval of the Engineer.

##### **902-1.1.1. QUALITY ASSURANCE**

- A. The irrigation work shall be installed by qualified personnel or a qualified irrigation subcontracting company that has experience in irrigation systems of similar size, scope, mainline, system pressure, controls, etc.
- B. All applicable ANSI, ASTM, FED.SPEC. Standards and Specifications, and all applicable building codes and other public agencies having jurisdiction upon the work shall apply.

- C. Workmanship: All work shall be installed in a neat, orderly and responsible manner with the recognized standards of workmanship. The Engineer reserves the right to reject material or work which does not conform to the contract documents. Rejected work shall be removed or corrected at the earliest possible time at the Contractor's expense.
- D. Operation and Maintenance Manuals: The Contractor shall prepare and deliver to the Engineer within ten (10) calendar days prior to completion of construction a minimum of three (3) hard cover binders, with three rings, containing the following information:
  - 1. Index sheet stating the Contractor's address and business telephone number, twenty-four (24) hour emergency phone number, person to contact, list of equipment with name(s) and address(es) of local manufacturer's representative(s) and local supplier where replacement equipment can be purchased.
  - 2. Catalog and part sheet on every material and equipment installed under this contract.
  - 3. Complete operating and maintenance instructions on all major equipment.
  - 4. Provide the Engineer and the City of Clearwater maintenance staff with written and "hands on" instructions for major equipment and show evidence in writing to the Engineer at the conclusion of the project that this service has been rendered.
    - a. Four-hour instruction (minimum) for the Drip Emitter equipment operation and maintenance.
    - b. Two-hour instruction (minimum) for automatic control valve operation and maintenance.

### **902-1.1.2. PROJECT CONDITIONS**

- A. The Contractor shall coordinate the work with all other trades, all underground improvements, the location and planting of trees and all other planting. Verify planting requiring excavation of twenty-four inch (24") diameter and larger with the Engineer prior to installation of main lines.
- B. Provide temporary irrigation at all times to maintain plant materials.
- C. The Contractor is responsible to maintain the work area and equipment until final acceptance by the Engineer. Repairs and replacement of equipment broken, stolen, or missing as well as regular maintenance operations shall be the obligation of the Contractor.
- D. The Contractor shall submit a traffic control plan (per FDOT specifications) to the Engineer prior to initiating construction on the site. The Contractor shall be responsible for the maintenance of traffic signs, barriers, and any additional equipment to comply with the FDOT standards and to ensure the safety of its employees and the public.

### **902-1.1.3. WARRANTY**

- A. The Manufacturer(s) shall warrant the irrigation system components to give satisfactory service for one (1) year period from the date of acceptance by the Engineer and the City of Clearwater. Should any problems develop within the warranty period due to inferior or faulty materials, they shall be corrected at no expense to the City of Clearwater.

## **902-1.2. PRODUCTS**

### **902-1.2.1. GENERAL**

- A. All materials throughout the system shall be new and in perfect condition. No deviations from the specifications shall be allowed except as noted.

### **902-1.2.2. PIPING**

- A. The irrigation system pipe shall be as stated herein and shall be furnished, installed and tested in accordance with these specifications.
- B. All pipe is herein specified to be Polyvinyl Chloride (PVC) Pipe, 1120, Schedule 40, conforming to ASTM D2665 and D1785.
- C. All nipples, pipe connections, bushings, swing joints, connecting equipment to the mainline is required to be threaded Polyvinyl Chloride (PVC) Pipe, Schedule 80.

### **902-1.2.3. PIPE FITTINGS**

- A. All pipe fittings for Schedule 40 PVC pipe shall be as follows: Fittings shall conform to the requirements of ASTM D2466, Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80. All fittings shall bear the manufacturer's name or trademark, material designation, size, applicable IPS schedule and NSF seal of approval. The connection of mainline pipe to the automatic control valve shall be assembled with threaded Schedule 80 fittings and threaded Schedule 80 nipples.

### **902-1.2.4. PVC PIPE CEMENT AND PRIMER**

- A. Provide solvent cement and primer for PVC solvent weld pipe and fittings as recommended by the manufacturer. Pipe joints for solvent weld pipe to be belled end.
- B. Purple primer shall be applied after the pipe and fittings has been cut and cleaned. The Primer shall be of contrasting color and be easily recognizable against PVC pipe.

### **902-1.2.5. THREADED CONNECTIONS**

- A. Threaded PVC connections shall be made using Teflon tape or Teflon pipe sealant.

### **902-1.2.6. GATE VALVES**

#### **902-1.2.6.1. MANUAL GATE VALVES TWO INCHES (2") AND SMALLER**

- A. Provide the following, unless otherwise noted on Drawings:
  1. 200-250 psi Ball Valve
  2. PVC body - with Teflon Ball Seals
  3. Threaded-Dual end Union Connectors
  4. Non-Shock Safe-T-Shear Stem
  5. Safe-T-Shear True Union Ball Valve as manufactured by Spears Manufacturing Company, Sylmar, California, or approved equal.

#### **902-1.2.6.2. GATE VALVES TWO AND A HALF INCHES (2½") AND LARGER**

- A. Provide the following, unless otherwise noted on Drawings:
  - 1. AWWA-C-509
  - 2. 200 lb. O.W.G.
  - 3. Cast Iron body - ASTM A 126 Class B
  - 4. Deep socket joints
  - 5. Rising stem
  - 6. Bolted bonnet
  - 7. Double disc
  - 8. Equipped with two inch (2") square operating key with tee handle
- B. Provide two (2) operating keys for gate valve three inches (3") and larger. The "street key" shall be five feet (5') long with a two inch (2") square operating nut.

#### **902-1.2.7. SLEEVES**

- A. Sleeves: (Existing by City of Clearwater)

#### **902-1.2.8. REMOTE CONTROL VALVES**

- A. The remote control valve shall be a solenoid actuated, balance-pressure across-the diaphragm type capable of having a flow rate of 25-30 gallons per minute (GPM) with a pressure loss not to exceed 6.1 pounds per square inch (PSI). The valve pressure rating shall not be less than 150 psi.
- B. The valve body and bonnet shall be constructed of high impact weather resistant plastic, stainless steel and other chemical/UV resistant materials. The valve's one-piece diaphragm shall be of durable santoprene material with a clog resistant metering orifice.
- C. The valve body shall have a one inch (1") (FNPT) inlet and outlet or a one inch (1") slip by slip inlet and outlet for solvent weld pipe connections.
- D. The valve construction shall be as such to provide for all internal parts to be removable from the top of the valve without disturbing the valve installation.
- E. The valve shall be as manufactured by Rain Bird Sprinkler Mfg. Corp., Glendora, California, or approved equal.
- F. Identify all control valves using metal I.D. tags numbered to match drawings.

#### **902-1.2.9. VALVE BOXES**

- A. For remote control drip valve assembly and UNIK control timer use a Brooks #36 concrete valve box with #36-T cast iron traffic bearing cover or approved equal.
- B. For flush valve assembly use an Ametek #181014 ten inch (10") circular valve box with #181015 cover comparable to Brooks, or approved equal.

- C. For air relief assembly use an Ametek #182001 (6") economy turf box with #182002 cover comparable to Brooks or approved equal.

### **902-1.2.10. DRIP IRRIGATION**

#### **902-1.2.10.1.CONSTRUCTION**

- A. Techline shall consist of nominal sized one-half inch (1/2") low-density linear polyethylene tubing with internal pressure compensating, continuously self-cleaning, integral drippers at a specified spacing (12", 18", or 24" centers). The tubing shall be brown in color and conform to an outside diameter (O.D.) of 0.67 inches and an inside diameter (I.D.) of 0.57 inches. Individual pressure compensating drippers shall be welded to the inside wall of the tubing as an integral part of the tubing assembly. These drippers shall be constructed of plastic with a hard plastic diaphragm retainer and a self-flushing/cleaning elastomer diaphragm extending the full length of the dripper.

#### **902-1.2.10.2. OPERATION**

- A. The drippers shall have the ability to independently regulate discharge rates, with an inlet pressure of seven to seventy (7-70) pounds per square inch (PSI), at a constant flow and with a manufacturer's coefficient of variability (Cv) of 0.03. Recommended operating pressure shall be between 15-45 PSI. The dripper discharge rate shall be 0.4, 0.6, or 0.9 gallons per hour (GPH) utilizing a combination turbulent flow/reduced pressure compensation cell mechanism and a diaphragm to maintain uniform discharge rates. The drippers shall continuously clean themselves while in operation. The dripperline shall be available in 12", 18" and 24" spacing between drippers unless otherwise specified. Techline pipe depth shall be under mulch unless otherwise specified on Plans. Maximum system pressure shall be 45 PSC. Filtration shall be 120 mesh or finer. Bending radius shall be seven inch (7").
- B. For on-surface or under mulch installations, six inch (6") metal wire staples (TLS6) shall be installed three feet (3') to five feet (5') on center, and two staples installed at every change of direction.

#### **902-1.2.10.3. LINE FLUSHING VALVES**

- A. The sub-surface system shall utilize Automatic Line Flush Valves at the end of each independent zone area. This valve shall be capable of flushing one gallon at the beginning of each irrigation cycle. The valves shall match the dripline manufacturer and connect directly to the dripline.

#### **902-1.2.10.4. AIR/VACUUM RELIEF VALVE**

- A. Each independent irrigation zone shall utilize an Air/Vacuum Relief Valve at its high point(s). The air and vacuum relief valve shall seal effectively from 2 to 110 psi.

#### **902-1.2.10.5. PRESSURE REGULATORS**

- A. The pressure regulator shall be designed to handle steady inlet pressures over 150 pounds per square inch (psi) and maintain a constant outlet pressure of 25 psi. Regulating accuracy shall be within +/-6%. The pressure regulator shall be manufactured from high-impact

engineering grade thermoplastics. Regulation shall be accomplished by a fixed stainless steel compression spring which shall be enclosed in a chamber separate from the water passage.

#### **902-1.2.10.6. FILTERS**

- A. The filter shall be a multiple disc type filter with notation indicating the minimum partial size to travel through or the mesh size of the element being used. The discs shall be constructed of chemical resistant thermoplastic for corrosion resistance.

#### **902-1.2.10.7. FITTINGS**

- A. All connections shall be made with barb or compression type fitting connections. Fittings and dripline shall be as manufactured by the manufacturer of the dripline to ensure the integrity of the subsurface irrigation system.

#### **902-1.2.11. AUTOMATIC CONTROL TIMER**

- A. The irrigation controller (control module) shall be programmable by a separate transmitter device only. The program shall be communicated to the Control Module from the Field Transmitter via an infrared connection. The controller shall be of a module type which may be installed in a valve box underground. The controller shall function normally if submerged in water and the communication from the transmitter shall function if submerged in water.
- B. The control module shall be housed in an ABS plastic cabinet and shall be potted to insure waterproof operation. The control module shall have two mounting slots for screws allowing the module to be securely mounted inside a valve box.
- C. The controller shall operate on one nine volt (9V) alkaline battery for one full year regardless of the number of stations utilized. The controller shall operate 1, 2, or 4 stations either sequentially or independently.
- D. The controller shall have three (3) independent programs with eight (8) start times each, station run time capability from one (1) minute to twelve (12) hours in one (1) minute increments, and a seven (7) day calendar. The controller shall turn on stations via latching solenoids installed on the valves. Manual operations shall be initiated by attaching the Field Transmitter to the Control Module and programming a manual start. The controller shall be capable of manual single station or manual program operation.
- E. The controller shall be as manufactured by Rain Bird Sprinkler Mfg. Corp., Glendora, California USA.

#### **902-1.2.12. FIELD TRANSMITTER**

- A. The irrigation controller shall be programmable by a separate transmitter device (Field Transmitter) only. The Field Transmitter shall communicate to the Control Module via an infrared connection. The Field Transmitter shall be water resistant and housed in ABS plastic and have a removable, reversible protective sheath. The Field Transmitter shall operate on one nine volt (9V) alkaline battery.

- B. The Field Transmitter shall have a large LCD screen and a seven-key programming pad. A beep sound shall confirm every key stroke. The screen shall automatically turn off after one minute when not in use.
- C. The Field Transmitter shall be capable of programming an unlimited number of UNIK Control Modules.
- D. The Field Transmitter shall be as manufactured by Rain Bird Sprinkler Mfg. Corp., Glendora, California USA.

### **902-1.2.13. LATCHING SOLENOID**

- A. The Latching Solenoid shall be supplied with an installed, filtered adapter allowing installation of the solenoid onto any Rain Bird DV, PGA, PEB, PES-B, GB, or EFB series valve.
- B. The Latching Solenoid shall be as manufactured by Rain Bird Sprinkler Mfg. Corp., Glendora, California USA.

## **902-1.3. EXECUTION**

### **902-1.3.1. GENERAL INSTALLATION REQUIREMENTS**

- A. Before work is commenced, hold a conference with the Engineer to discuss general details of the work.
- B. Verify dimensions and grades at job site before work is commenced.
- C. During the progress of the work, a competent superintendent and any assistants necessary shall be on site, all satisfactory to the Engineer. This superintendent shall not be changed, except with the consent of the Engineer. The superintendent shall represent the Contractor in Contractor's absence and all directions given to the superintendent shall be as binding as if given to the Contractor.
- D. Obtain and pay for all irrigation and plumbing permits and all inspections required by outside authorities.
- E. All work indicated or notes on the Drawings shall be provided whether or not specifically mentioned in these Technical Specifications.
- F. If there are ambiguities between the Drawings and Specifications, and specific interpretation or clarification is not issued prior to bidding, the interpretation or clarification will be made only by the Engineer, and the Contractor shall comply with the decisions. In the event the installation contradicts the directions given, the installation shall be corrected by the Contractor at no additional cost.
- G. Layout of sprinkler lines shown on the Drawing is diagrammatic only. Location of sprinkler equipment is contingent upon and subject to integration with all other underground utilities. Contractor shall employ all data contained in the contract Documents and shall verify this information at the construction site to confirm the manner by which it relates to the installation.

- H. Do not proceed with the installation of the sprinkler system when it is apparent that obstructions or grade differences exist or if conflicts in construction details, legend, or specific notes are discovered. All such obstructions, conflicts, or discrepancies shall be brought to the attention of the Engineer.
- I. The disturbance of existing paving will not be permitted. Install all required sleevings prior to roadway base.

### **902-1.3.2. EXCAVATING AND BACKFILLING**

#### **902-1.3.2.1. TRENCHING - GENERAL**

- A. Dig sides of trenches straight. Provide continuous support for pipe on bottom of trenches. Lay pipe to uniform grade. Trenching excavation shall follow layout indicated on Drawings.
- B. Maintain six inch (6") horizontal and minimum clearance between sprinkler lines and between all lines of other trades.
- C. Do not install sprinkler lines directly above another line of any kind.
- D. Maintain six inch (6") vertical minimum between sprinkler lines which cross at angles of 45 degrees to 90 degrees.
- E. Exercise care when excavating, trenching and working near existing utilities.

#### **902-1.3.2.2. BACKFILLING**

- A. All pressure supply lines (mainline) shall have eighteen inches (18") of fill placed over the pipe.
- B. Initial backfill on all lines shall be of a fine granular material with no foreign matter larger than one half inch ( $\frac{1}{2}$ ").
- C. Compact backfill according to Section 125 of FDOT Standard Specifications.
- D. Do not, under any circumstances, use equipment or vehicle wheels for compacting soil.
- E. Restore grades and repair damages where settling occurs.
- F. Compact each layer of fill with approved equipment to achieve a maximum density per AASHTO T 180. Under landscaped area, compaction shall not exceed 95% of maximum density.
- G. Compaction shall be obtained by the use of mechanical tampers or approved hand tampers. When hand tampers are used, the materials shall be deposited in layers not more than six inches (6") thick. The hand tampers shall be suitable for this purpose and shall have a face area of not more than 100 square inches. Special precautions shall be taken to prevent damage to the irrigation system piping and adjacent utilities.

#### **902-1.3.2.3. ROUTING OF PIPING:**

- A. Routing of pressure and non-pressure piping lines are indicated diagrammatically on Drawings.

- B. Coordinate specimen trees and shrubs with routing of lines.
  - 1. Planting locations shall take precedence over sprinkler and piping locations.
  - 2. Report to Owner any major deviation from routing indicated.
- C. Conform to Drawings layout without offsetting the various assemblies from the pressure supply line.
- D. Layout drip tube and make any minor adjustments required due to differences between site and Drawings. Any such deviations in layout shall be within the intent of the original Drawings, and without additional cost.
- E. Layout all systems using an approved staking method and maintain the staking of approved layout.

### **902-1.3.3. INSTALLATION**

#### **902-1.3.3.1. WATER SUPPLY**

- A. Connections to the water sources shall be at the approximate locations indicated on the Drawings. Make minor changes caused by actual site conditions without additional cost to the Owner.

#### **902-1.3.3.2. ASSEMBLIES**

- A. Routing or pressure supply lines as indicated on Drawings is diagrammatic only. Install lines and required assemblies in accordance with details on Drawings.
- B. Do not install multiple assemblies on plastic lines. Provide each assembly with its own outlet. When used, the pressure relief valve shall be the last assembly.
- C. Install all assemblies in accord with the respective detail Drawings and these Technical Specifications.
- D. Plastic pipe and threaded fittings shall be assembled using Teflon tape, applied to the male threads only.

#### **902-1.3.3.3. SLEEVES: (EXISTING BY CITY OF CLEARWATER)**

- A. The Contractor shall verify the location of all existing sleeves as shown on the roadway, utility and/or irrigation plans and notify the Engineer of any discrepancies.

#### **902-1.3.3.4. PLASTIC PIPE**

- A. Install plastic pipe in accord with manufacturer's recommendations.
- B. Prepare all welded joints with manufacturer's cleaner prior to applying solvent.
  - 1. Allow welded joints at least fifteen (15) minutes setup/curing time before moving or handling.
  - 2. Partially center load pipe in trenches to prevent arching and shifting when water pressure is on.

3. Do not permit water in pipe until a period of at least four (4) hours has elapsed for solvent weld setting and curing, unless recommended otherwise by solvent manufacturer.

C. Curing

1. When the temperature is above 80 degrees F., allow soluble weld joints at least twenty-four (24) hours curing time before water is introduced under pressure.

D. Flushing the system:

1. After all sprinkler pipe lines and risers are in place and connected, open the control valves and flush out the system with a full head of water.

E. Installing piping under existing pavement:

1. Piping under existing pavement may be installed by jacking & boring.
2. Secure permission from the Engineer before cutting or breaking any existing pavement. All repairs and replacements shall be approved by Engineer and shall be accomplished at no additional cost.

**902-1.3.3.5. CONTROLLERS**

A. Install all automatic controllers as shown in the plans.

1. The location of all controllers shall be approved by the Engineer's representative prior to installation.

**902-1.3.3.6. REMOTE CONTROL VALVES**

A. Install at sufficient depth to provide not more than six inches (6"), nor less than four inches (4") cover from the top of the valve to finish grade.

B. Install valves in a plumb position with twenty-four inch (24") minimum maintenance clearance from other equipment, three feet (3') minimum from edges of sidewalks, buildings, and walls, and no closer than seven feet (7') from the back of curb or edge of pavement along roadways.

C. Contractor shall adjust the valve to provide the proper flow rate or operating pressure for each sprinkler zone.

**902-1.3.3.7. GATE VALVES**

A. Install where indicated and with sufficient clearance from other materials for proper maintenance.

B. Check and tighten valve bonnet packing before backfill.

## **902-2. LANDSCAPE**

### **902-2.1. GENERAL**

#### **902-2.1.1. REQUIREMENTS OF REGULATORY AGENCIES**

- A. Comply with Federal, State, Local, and other duly constituted authorities and regulatory agencies, without additional cost to the Owner in matters pertaining to codes, safety, and environmental matters.
- B. Any permits for the installation or construction of any of the work included under the contract, which are required by any of the legally constituted authorities having jurisdiction, shall be arranged for by the Contractor and paid for directly by the Contractor, unless otherwise agreed upon in writing.

#### **902-2.1.2. SCOPE OF WORK**

- A. All provisions of Contract, including General and Special Provisions and Plans, apply to the work specified in this Article. The Scope of Work includes everything for and incidental to executing and completing all landscape work shown on the Plans, Schedules, Notes and as specified herein.
- B. Furnish and provide all labor, plants and materials tools and equipment necessary to prepare the soil for plantings, to install and care for all plant materials (including finish grading if necessary); to remove and/or transplant existing plants if indicated; to furnish, plant, fertilize, guy and brace, water, mulch and prune all new plant materials; and to execute all other Work as described herein or indicated on the Plans.
- C. Work under this Article shall include labor and materials for final grading and raking to prepare the site for sodding, sprigging, or seeding, so finished lawn or playing field will appear even and uniform, will drain adequately, and will comply with the intent of the landscape drawings.
- D. Initial maintenance of landscape materials as specified in this document.

#### **902-2.1.3. QUALITY ASSURANCE**

- A. Landscape work shall be contracted to a single firm specializing in landscape work, who shall in turn subcontract no more than 40% of the work specified. All subcontractors under the control of the Contractor involved in the completion of the landscape work, shall be made known to the Owner and the Landscape Architect prior to their commencement of work on the project.
- B. All work of this Article shall conform to the highest standard of landscape practices.
- C. The Plant Material Schedule included with these Plans is provided only for the Contractor's convenience; it shall not be construed as to conflict or predominate over the Plans. If conflict between the Plans and Specifications exists, the Plans shall predominate and be considered the controlling document.
- D. During this work, the Contractor shall be responsible for maintaining safety among persons in their employ in accordance with the standards set by The Occupational Safety and Health

Act of 1970 (and all subsequent amendments). Owner and Landscape Architect shall be held harmless from any accident, injury or any other incident resulting from compliance or non-compliance with these standards.

- E. The Contractor shall cooperate with and coordinate with all other trades whose work is built into or affects the work in this Article.
- F. All appropriate utility companies and agencies shall be contacted 72 hours prior to excavation. Call “One Call”/“Sunshine 811” at 8-1-1; “Sunshine 811” administrative offices may be reached at (800) 638-4097.
- G. The Contractor shall carefully examine the site and all existing conditions affecting the work, such as: soil, obstructions, existing trees, utilities, etc. Report any conditions in conflict with the work to the Landscape Architect.

#### **902-2.1.4. SUBMITTALS**

- A. The Contractor is required to submit prior to the expiration of the required maintenance period, two (2) copies of typewritten instructions recommending procedures to be established by the Owner for maintenance of landscape work for a period of one (1) year.
- B. Furnish unit prices for all plant materials and inert materials, including labor for all specified work.

#### **902-2.1.5. ALTERNATES, ADDITIONS, DELETIONS, SUBSTITUTIONS**

- A. If there are additions/alternates included in these Plans and Specifications, the Contractor must propose prices to accomplish the work stated as additions/alternates at the time of bidding.
- B. The Owner, through their Project Representative, reserves the right to add or deduct any of the work stated herein without rendering the Contract void.
- C. The Contractor must have written approval by the Project Representative for any substitutions not previously agreed to in the purchase agreement: installation without approval is entirely at the Contractor’s risk.
- D. All material acquired through additions or substitutions shall be subject to all conditions and warranties stated herein.

#### **902-2.1.6. ABBREVIATIONS/DEFINITIONS**

*O.A. or HT.*: The over-all height of the plant measured from the ground to the natural, untied state of the majority of the foliage, not including extreme leaves, branches or fronds.

*C.T.*: Clear trunk is measured from the ground to the bottom of the first leaf or frond stem with no foliage from ground to specified height. For example, on Canary Island Date Palms or similar, the clear trunk measurement includes the “nut” at the base of the fronds.

*C.W.*: Clear wood is measured from the ground to the bottom of the base of the lowest leaf sheath or boot, trimmed in a natural manner. For example, on Canary Island Date Palms or similar, the clear wood measurement does not include the “nut” at the base of the fronds.

*SPR.*: Spread, branches measured in natural untied position to the average crown diameter, not including extreme leaves, branches or fronds.

*STTR.*: Straight trunk.

*MIN.*: Minimum.

*GAL.*: Gallon container size, i.e., 1 gallon, 3 gallon, 7 gallon, etc.

*O.C.*: On center, distance between plant centers.

*DIA.*: Diameter.

*LVS.*: Leaves.

*D.B.H.*: Diameter or caliper of main trunk of tree as measured at breast height at 4-1/2 feet above grade.

*CAL.*: Caliper, the outside diameter of up to a four inch tree is measured six inches above grade, larger trees are measured at 12 inches above grade.

*B&B*: Balled and burlapped in accordance with horticultural standards of the American Association of Nurserymen.

*PPP*: Plants per pot.

*FG*: Field grown.

*STD.*: Standard, single, straight trunk.

*Owner*: To be known as that entity which holds title or control to the premises on which the work is performed.

*Owner's Representative*: Owner's on-site representative shall be responsible for approval of quantity and quality of *materials specified and execution of installation*.

*Contractor*: Shall refer to that person or enterprise commonly known as the Landscape Contractor.

*Landscape Architect*: This person or firm is the responsible representative of the Owner who produces the landscape Plans and Specifications.

## **902-2.1.7. PRODUCT DELIVERY, STORAGE, AND HANDLING**

### **902-2.1.7.1. PLANT MATERIALS**

- A. Provide container-grown or, if appropriate, freshly dug trees and shrubs. Do not prune prior to delivery. Do not bend or bind trees or shrubs in such a manner as to damage bark, break branches or destroy natural shape. Provide protective covering during delivery. If plant delivery is made in open vehicles, the entire load shall be suitably covered.
- B. All plants are to be handled at all times so that roots or root balls are adequately protected from sun, cold, or drying winds. No root balls for trees and container plants that have been cracked or broken shall be planted except upon special approval. Plants shall not be pulled by the tops or stems, nor handled in a rough or careless manner at any time.

- C. Balled and burlapped (“B & B”) plants shall be moved with firm, natural, balls of soil, not less than one foot (1') diameter of ball to every one inch (1") caliper of trunk; root ball depth shall not be less than two-thirds (2/3) of root ball diameter. B & B plants which cannot be planted upon delivery shall have their root balls covered with moist soil or mulch.
- D. Trees shall be dug with adequate balls, burlapped, and wire bound if needed. Root pruning to be done a minimum of four (4) weeks before removal from the field and planting at the site. Root balls may not be encased in “grow bags” or other synthetic material, except plastic shrink wrap for transport only.
- E. Remove all fronds from sabal palms prior to planting, but leave a minimum of twelve inches (12") of new frond growth above the bud. Do not damage bud. On all other palms, only a minimum of palm fronds shall be removed from crown to facilitate moving and handling. Clear trunk shall be determined after minimum fronds have been removed. Boots shall be removed from trunk unless otherwise specified. Palms shall be planted within twenty-four (24) hours of delivery.
- F. Deliver trees and shrubs after preparations for planting have been completed and plant immediately. If planting is delayed more than 6 hours after delivery, set trees and shrubs in shade, protect from weather and mechanical damage, and cover to keep the roots moist.
- G. Label at least one tree and one shrub of each variety with a securely attached waterproof tag bearing legible designation of botanical and common name.
- H. Time delivery so that sod will be placed within twenty-four (24) hours after stripping. Protect sod against drying and breaking by covering palettes of sod or placing in a shaded area.

### **902-2.1.8. JOB CONDITIONS**

#### **902-2.1.8.1. ACCEPTANCE OF JOB CONDITIONS.**

- A. The Contractor shall examine the sub-grade, verify elevations, observe the conditions under which work is to be performed and notify the Landscape Architect or Project Representative in writing of unsatisfactory conditions prior to beginning work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Landscape Architect. Start of work shall indicate acceptance of conditions and full responsibility for the completed work.
- B. Proceed with and complete the landscape work as rapidly as portions of the site become available, working within the seasonal limitations for each kind of landscape work and following the approved schedule. If seasonal limitations apply, notify the Landscape Architect for adjustments to the Schedule.
- C. Determine locations of all underground utilities and review for conflicts with planting procedures.
- D. When adverse conditions to plant growth are encountered, such as rubble fill, drainage conditions or obstruction, the Contractor shall notify the Landscape Architect in writing prior to planting.

- E. Plant trees and shrubs after final grades are established and prior to sod installation or seeding lawns. Protect existing lawn, trees, and promptly repair damages from planting operations.

### **902-2.1.8.2. SCHEDULING OF WORK**

- A. The work shall be carried out to completion with the utmost speed. Immediately upon award of contract, the Contractor shall prepare a construction schedule and furnish a copy to the Owner's Representative and/or the Landscape Architect for approval. The Contractor shall carry out the work in accordance with the approved schedule.
- B. If the Contractor incurs unforeseen costs, such as overtime hours, holidays, etc., in order to complete the work within the time stated in the Contract, and/or to maintain the progress schedule, all said costs shall be borne by the Contractor at no additional cost to the Owner.
- C. The Owner's Representatives may request work stoppage in writing. Upon written request from the Owner's Representative, the Landscape Contractor shall suspend delivery of material and stop all work for such a period as deemed necessary by the Owner, the Owner's Representative, or the General Contractor, with respect to any additional costs which may result from work stoppage.

### **902-2.1.8.3. UTILITIES**

- A. The Contractor shall perform work in a manner which will avoid conflicts with utilities. Hand excavate, as required, to minimize possibility of damage to underground utilities. Maintain grade stakes set by others until removal is mutually agreed upon by all parties concerned.

## **902-2.2. PRODUCTS**

### **902-2.2.1. MATERIALS**

#### **902-2.2.1.1. PLANT MATERIALS: NOMENCLATURE**

- A. Plant species, sizes, etc., shall be per Plans and Specifications on Plant Material Schedule. Nomenclature is per Manual of Cultivated Plant, Standard Encyclopedia of Horticulture, L.H. Bailey, or Standardized Plant Names Dictionary, American Joint Committee on Horticultural Nomenclature (latest editions) or conforms with names accepted in the nursery trade.

#### **902-2.2.1.2. PLANT MATERIALS: QUALITY ASSURANCE**

- A. Provide healthy, vigorous stock grown under climatic conditions similar to conditions in the locality of the project. Plants shall have a habit of growth that is normal for the species and be sound, healthy, vigorous and free from insects, pests or their eggs, plant diseases, defects and injuries. Plants shall be well branched and densely foliated when in leaf and shall have healthy, well-developed root systems.
- B. Trees shall be heavily branched or, in the case of palms, be heavily leafed. Some plant materials may be collected stock with the approval of the Landscape Architect. Provided

tree species that have a single main trunk (central leader), unless otherwise stated. Trees that have the main trunk forming a “Y” shape or parallel branching are not acceptable.

- C. Plant materials shall be specified and shall be Florida #1 or better as to shape and quality for the species as outlined in Grades and Standards for Nursery Plants Part I and II, Florida Department of Agriculture and Consumer Services (latest edition).
- D. The Owner or Landscape Architect reserves the right to inspect plant materials either at the place of growth or at the project site prior to planting for compliance with requirements for name, variety, size, quality, or designated area.
- E. Landscape materials shall be shipped with certificates of inspection as required by governmental authorities. The Contractor shall comply with all governing regulations that are applicable to landscape materials.
- F. Do not make substitutions. If specified landscape material is not available, submit to the Landscape Architect proof of it being non-available. In such event, if the Landscape Architect designates an available source, such shall be acquired from designated source. When authorized, a written change order for substitute material will be made by adjustment to Contract amount.
- G. Height and/or width of trees shall be measured from ground up; width measurement shall be normal crown spread of branches with plants in the normal position. This measurement shall not include immediate terminal growth. All measurements shall be taken after pruning for specified sizes. All trees and shrubs shall conform to measurements specified in the plant material schedule, except that plant material larger than specified may be used with the approval of the Owner or Landscape Architect, with no increase to the Contract price. Plant materials shall not be pruned prior to delivery.
- H. Plant Material shall be symmetrical, typical for variety and species. Plants used where symmetry is required shall be matched as nearly as possible.
- I. Balled and burlapped plants shall have firm, natural balls of earth of sufficient diameter and depth to encompass the feeding root system necessary for full development of the plant and to conform with the standards of the American Association of Nurserymen. Root balls and tree trunks shall not be damaged by improper binding and B & B procedures.
- J. Container-grown plants may be substituted for balled and burlapped plants or vice-versa provided the quality is equal or better than specified and the Landscape Architect approves the substitution.
- K. Container-grown stock shall have been grown in containers for at least four months, but not over two years. If requested, samples must be shown to prove no root bound condition exists.

#### **902-2.2.1.3. GRASSES: SOD OR SEED**

- A. Sod or seed (as/if specified) shall be a species as stated on the Plan. Solid sod shall be of even thickness and with a good root structure, 95% free of noxious weed, freshly mowed before cutting, and in healthy condition when laid. It must not be stacked more than twenty-four (24) hours before laying and it must be grown in soil compatible to that in which it will be installed. Sod must be kept moist prior to and after installation.

- B. Seed shall be delivered to the site in unopened bags with certification tags in place. Purity, germination and weed content shall be as certification requirements.

#### **902-2.2.1.4. MULCH**

- A. Mulch shall be as specified in the plans or by the project manager.
- B. Install mulch to an even depth of three inches (3") before compaction, as shown in the PLANTING DETAILS in the plans.

#### **902-2.2.1.5. FERTILIZER**

- A. Granular fertilizer shall be uniform in composition; free flowing and suitable for application with approved equipment; received at the site in full, labeled, unopened bags bearing the name, trade name or trademark and warranty of the producer; fully conforming to State of Florida fertilizer laws.
- B. All fertilizer shall bear the manufacturer's statement of analysis and shall contain the appropriate minimum amounts of elements for the type of use specified herein.
- C. Agriform 20-10-5 fertilizer tablets or approved equal, shall be placed in planting pit for all plant materials at time of installation and prior to completion of pit backfilling.
- D. Ground cover and annual areas shall receive fertilization with Osmocote Time Release Fertilizer according to product instructions and rate.
- E. For sod and seeded areas, fertilize with a complete granular fertilizer on Bahia and St. Augustine grasses at the rate of one pound (1 lb.) of nitrogen per one thousand square feet (1000 sq ft). Fertilizer shall be commercial grade, mixed granules, with 30% to 50% of the nitrogen being in slow or controlled release form. The ratio of nitrogen to potash will be 1:1 or 2:1 for complete fertilizer formulations. Phosphorus shall be no more than one-fourth ( $\frac{1}{4}$ ) the nitrogen level. They shall also contain magnesium and micronutrients (i.e. manganese, iron, zinc, copper, etc.).

#### **902-2.2.1.6. STAKES AND GUYS**

- A. For trees, approved plastic or rubber guys shall be used between the stakes and the tree trunk. Galvanized steel guy wire shall not be used.
- B. Stakes shall be cut from 2" x 4" pressure treated (p.t.) stock for trees over two inch (2") caliper. Stakes shall be 2" x 2" pressure treated (p.t.) stock for trees two inch (2") caliper and under. A minimum of two (2) stakes per tree or an optional three (3) stakes per tree shall be used.
- C. For single trunk palms, stakes shall be cut from 2" x 4" pressure treated (p.t.) stock, with a minimum of three (3) stakes per palm. Batten consisting of 5 layers of burlap and 5 - 2" x 4" by 16" wood connected with two – three-quarter inch ( $\frac{3}{4}$ ") steel bands shall be used around the palm trunk.
- D. Other tree staking systems may be acceptable if approved.

**902-2.2.1.7. PLANTING SOIL**

- A. Unless stated on the plans or in the specifications, install plant material in tilled and loosened native soil backfill. It is the responsibility of the Landscape Contractor to test, prior to planting and at no additional cost to the City, any soils which may be unsuitable for the vigorous growth of plants. Unsuitable conditions shall be reported to the Landscape Architect immediately in writing.
- B. When required, planting soil media shall be provided by the Contractor and shall consist of one-third (1/3) peat and two-thirds (2/3) sandy loam, with no lumps over one inch (1").
- C. Backfill and clean fill dirt provided by the Contractor shall be in a loose, friable soil. There must be slight acid reaction to the soil (about 6.0 – 6.5 pH) with no excess of calcium or carbonate, and it shall be free from excess weeds, clay lumps, stones, stumps, roots and toxic substances or any other materials that might be harmful to plant growth or a hindrance to grading, planting, and maintenance procedures and operations. No heavily organic soil, such as muck or peat shall be used as fill dirt.
- D. Bed preparation for annual beds under one (1) gallon container size shall consist of three inches (3") of Florida peat or other approved organic soil amendment spread over full length and width of planting area. Rototil organic layer six inches (6") to eight inches (8") into native soil.

**902-2.2.1.8. SOIL AMENDMENTS**

- A. Terra-Sorb AG or approved equal, soil amendment shall be mixed with native or planting soil for all trees, shrubs, ground cover, and annuals according to manufacturer's recommended application rates and methods, if specified on the Plans.

**902-2.2.1.9. TREE PROTECTION**

- A. Wood fencing shall be 2" x 4" pressure treated (p.t.) stock with flagging on horizontal members. Space vertical members six feet (6') to eight feet (8') on center. The barricade shall be placed so as to protect the critical protection zone area, which is the area surrounding a tree within a circle described by a radius of one foot (1') for each inch of the tree's diameter at breast height DBH (four and one half feet)' above grade.

**902-2.2.1.10. ROOT BARRIER SYSTEM**

- A. Root barrier fabric shall be installed when specified in the plans and/or specifications for protection of adjacent paved surfaces according to specific product name or equal. Install as directed by the manufacturer.

**902-2.2.1.11. PACKAGED MATERIALS**

- A. Deliver packaged materials in containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery and while stored at the site.

**902-2.2.1.12. PESTICIDES**

- A. Pesticides shall be only approved, safe brands applied according to manufacturer's directions.

**902-2.3. EXECUTION****902-2.3.1. PREPARATION****902-2.3.1.1. OBSTRUCTIONS BELOW GROUND**

- A. It shall be the responsibility of the Contractor to locate and mark all underground utilities, irrigation lines and wiring prior to commencement of the work.
- B. If underground construction, utilities or other obstructions are encountered in excavation of planting areas or pits, the Landscape Architect shall be immediately notified to select a relocated position for any materials necessary.

**902-2.3.1.2. GRADING AND PREPARATION FOR PLANT MATERIALS**

- A. All proposed landscape areas containing existing turf grass or weeds shall be treated with Monsanto's "Round-Up" per manufacturer's specifications. All proposed landscape areas adjacent to water bodies shall be treated with "Rodeo" per the manufacturer's specifications.
- B. New plant materials will not be installed until a 98% weed/turf eradication has been achieved. More than one application may be required to produce an acceptable planting bed.
- C. Pre-emergent herbicides are not a substitute for spray treatment of "Round-Up" or "Rodeo" and may be used only with the written approval of the Landscape Architect.
- D. Should any plant material in the same or adjacent beds be damaged by these chemicals, the same size, quantity and quality of plants shall be immediately replaced by the Contractor at no cost to the Owner.
- E. Any necessary corrections or repairs to the finish grades shall be accomplished by the Contractor. All planting areas shall be carefully graded and raked to smooth, even finish grade, free from depressions, lumps, stones, sticks or other debris and such that they will conform to the required finish grades and provide uniform and satisfactory surface drainage without puddling.
- F. The Contractor shall remove debris (sticks, stones, rubbish) over one and one half inches (1½") in any dimension from individual tree, shrub and hedge pits and dispose of the excavated material off the site.

**902-2.3.1.3. PREPARATION FOR ANNUAL BED PLANTING**

- A. Prepare native subgrade by rototilling or loosening by hand methods. Spread three inches (3") of one-third (1/3) Florida peat and two-thirds (2/3) sandy, or other approved organic soil amendment over the full length and width of planting area for annuals. Rototill organic layer six inches (6") to eight inches (8") into the native soil. Grade the planting bed by

“crowning” to ensure that surface drainage, percolation, and aeration occur at rapid rates. Add Osmocote time release fertilizer according to product instructions and rate.

#### **902-2.3.1.4. PREPARATION FOR SEEDING AND SOD AREAS**

- A. All proposed sod areas containing existing turf grass or weeds shall be treated with Monsanto’s “Round-Up” per manufacturer’s specifications. All proposed sod areas adjacent to water bodies shall be treated with “Rodeo” per the Manufacturer’s Specifications.
- B. Limit preparation to areas which will be planted promptly after preparation. Loosen sub-grade of seed and sod areas to a minimum depth of four inches (4”).
- C. Immediately prior to any turf work, the Contractor shall finish grade the soil to a smooth, even surface assuring positive drainage away from buildings and the subsequent turf flush to the tops of adjacent curbs and sidewalks. The surface shall be sloped to existing yard drains.
- D. A complete fertilizer shall be applied to St. Augustine or Bahia grass at a rate of one pound (1 lb.) of nitrogen per one thousand square feet (1000 sq ft). Fertilizer shall be commercial grade, mixed granules, with 30% to 50% of the nitrogen being in slow or controlled release form. Thoroughly work fertilizer into the top four inches (4”) of soil.
- E. Moisten prepared seed and sod areas before planting if soil is dry. Water thoroughly and allow surface moisture to dry before planting lawns. Do not create a muddy soil condition.

#### **902-2.3.2. INSTALLATION**

##### **902-2.3.2.1. BERM CONSTRUCTION (IF SPECIFIED)**

- A. Install berms at location and design shown on Plans and at the height and slope indicated. Height stated is for finished berm with soil at natural compaction.
- B. Exact location and configuration of berms may require modification to allow proper drainage; such changes will be coordinated with the Landscape Architect.
- C. If shown on the Plan, construct berms using clean sandy loam fill dirt which is well-drained, free of rocks, roots, or other debris, with a soil pH of an acid Nature (about 6.0 - 6.5). No heavily organic soil, such as muck or peat shall be used in berm construction.

##### **902-2.3.2.2. LAYOUT OF PLANT MATERIALS**

- A. Unless otherwise stipulated, plant materials shall be approximately located per the plans by scale measurements using established building, columns, curbs, screen walls, etc., as the measuring reference point. Slight shifting may be required to clear wires, prevent blockage of signage, etc.
- B. Shrubs and ground covers shall be located and spaced as noted on the plant material schedule (if provided), otherwise plants will be placed in the planting beds at the normally accepted spacing for each species.

- C. Leave an eighteen inch (18") (450 millimeters) border of mulched space between outer leaves of installed plant material and the bed line, curb, or building foundation wall for all plant sizes.
- D. Any necessary “minor” adjustments in the layout of planting shall be made by the Contractor with the approval of the Landscape Architect in order to conform as nearly as possible to the intent of the Plans.

#### **902-2.3.2.3. PLANTING PROCEDURES**

- A. All shrubs, trees and ground covers or vines shall be planted in pits having vertical sides and being circular in outline. Planting pit shall be three (3) to five (5) times the width of the root ball.
- B. Plants shall be set straight or plumb, in the locations shown, at such level that after settlement normal or natural relationship of the top of the root ball with the ground surface will be established. With regards to proper nursery practices, plants under certain conditions (i.e. low and wet areas) will benefit from being planted “high” with the root ball about one inch (1") higher than the surrounding grade.
- C. All plant materials shall be fertilized with Agriform 20-10-5 planting tablets, or approved equal, at time of installation and prior to completion of pit backfilling. Agriform planting tablets shall be placed uniformly around the root mass at a depth that is between the middle and the bottom of the root mass.

Application rate:

|          |   |
|----------|---|
| 1 gallon | 1 - 21 gram tablet                                      |
| 3 gallon | 2 - 21 gram tablet                                      |
| 5 gallon | 3 - 21 gram tablet                                      |
| 7 gallon | 4 - 21 gram tablet                                      |
| Trees    | 3 tablets each $\frac{1}{2}$ " (12 millimeters) caliper |
| Palms    | 7 - 21 gram tablets                                     |

- D. Native soil shall be used in back-filling plant pits or as specified. The Contractor shall be responsible for providing additional soil for building tree saucers.
- E. When balled and burlapped plants are set, undisturbed native soil shall be left under the base of the root ball to prevent voids. Backfill tilled and loosened native soil around the sides of the root ball. Remove the top 4 four inches (4") (100 millimeters) of burlap wire, and all tie-down material from the root ball. Do not remove these materials from the bottom of the root ball. Thoroughly water-in before bringing the back-fill up to the proper grade. Roots of bare plants shall be properly spread out, and planting soil carefully worked in among them. Failure to comply is cause for rejection.
- F. Containerized plants shall be installed with undisturbed native soil left under the base of the root ball to prevent voids. Planting pit shall be three (3) to five (5) times the width of the root ball. Backfill tilled and loosened native soil around the sides of the root ball. Thoroughly water-in before bringing the backfill up to the proper grade.
- G. Plant spacing shall be “on center” and varies with the different plant species. Space each variety of plant equally in the planting areas. Shrubs and ground covers adjacent to straight

or curved edges shall be triangular - spaced in rows parallel to those edges. Plant a minimum of eighteen inches (18") from the back of the curb to the outside edge of the plant.

- H. All azaleas shall be placed into a prepared bed of amended soil containing 50% weed-free Florida peat or approved equivalent. Root balls shall be scarified vertically at 120 degree angles in a triangular pattern.
- I. Sabal palms may be planted deeper than normal if conditions warrant and if approved.

#### **902-2.3.2.4. SODDING**

- A. During periods of drought, sod shall be watered sufficiently at its origin to moisten the soil adequately to the depth to which it is to be cut.
- B. An application of 6-6-6, 40% organic, slow or controlled release fertilizer shall be made to all lawn areas just prior to the laying of the sod at a rate of one pound (1 lb.) of nitrogen per one thousand square feet (1000 sq ft). The ground shall be moistened before the sod is laid in place.
- C. Solid sod shall be laid tightly with closely abutting staggered joints with an even surface edge and sod edge, in a neat and clean manner to the edge of all the paving and shrub areas. Cut down soil level to one inch (1") to one and one half inches (1-1/2") below top of walks prior to laying sod.
- D. Within two (2) hours after installing sod and prior to rolling, irrigate the sod. Sufficient water shall be applied to wet the sod thoroughly and to wet the sod to a depth of two inches (2") (50 millimeters). Watering shall be done in a manner that will avoid erosion due to the application of excessive quantities, and the watering equipment shall be a type that will prevent damage to the finished sod surface. Watering shall be repeated as necessary to keep sod moist until rooted to subgrade.
- E. The sod shall be pressed firmly into contact with the sod bed using a turf roller or other approved equipment so as to eliminate air pockets, provide a true and even surface and insure knitting without any displacement of the sod or deformation of the surfaces of sodded areas. After the sodding operation has been completed, the edges of the area shall be smooth and shall conform to the grades indicated.
- F. If, in the opinion of the Landscape Architect, top dressing is necessary after rolling, clean silica sand shall be used to fill voids. Evenly apply sand over the entire surface to be leveled, filling-in dips and voids and thoroughly washing into the sod areas.
- G. On slopes 3:1 or steeper, and as required, a geotextile fabric shall be installed per manufacturer's specifications prior to placing sod. The sod shall be fastened in place with suitable wooden pins or by other approved method.

#### **902-2.3.2.5. SEEDING**

- A. Seed shall be installed per the specifications of the State of Florida Department of Transportation. See plan for type of seed.

**902-2.3.2.6. TREE GUYING, BRACING AND STAKING**

- A. Tree guying, staking and bracing shall be the responsibility of the Contractor per sound nursery practices, and shall be done per details shown on the Plans. For trees, a minimum of two (2) stakes per tree or an optional three (3) stakes per tree at 120 degree spacing shall be used. Stakes shall be driven in at an angle, then tightened to vertical supported by approved plastic or rubber guys. Trees shall be staked with a minimum of four feet (4') height of stake above grade and a minimum of thirty inches (30") of stake below grade.
- B. For single trunk palms, a minimum of three (3) stakes per palm at 120 degree spacing shall be used. Toenail the stakes to batten consisting of five (5) layers of burlap and five (5) - 2 inch x 4 inch x 16 inch wood connected with two (2) three-quarter inch (3/4") steel bands. Palms shall be staked with a minimum of five feet (5') of stake above grade.
- C. Contractor shall remove all tree guying, staking, and bracing from trees six (6) months after the date of final acceptance of the landscape work.
- D. Stake only trees that require support to maintain a plumb position or are in potentially hazardous areas.

**902-2.3.2.7. MULCHING**

- A. All planting beds shall be weed-free prior to mulching.
- B. All curb, roadway, and bed line edges will be “trenched” to help contain the applied mulch. Mulch should be below top of curb and resistant to washout from stormwater run-off.
- C. All plant beds and tree rings shall be mulched evenly with a three inch (3") layer (before compaction) of 100% Grade B recycled cypress bark mulch, or other mulch as specified on the Plans or General Notes.
- D. Mulch shall not be placed against the trunks of plant materials or foundations of buildings. Maintain a minimum three inch (3") clearance for trees and shrub trunks and a minimum six inch (6") clearance for the walls of buildings.
- E. For beds of annual flowers, a 12 inch wide x 3 inch deep band of mulch shall be installed in front of the first row of annuals. Maintain a minimum six inches (6") of non-mulched clearance from the outside edge of annuals.

**902-2.3.2.8. PRUNING**

- A. Pruning shall be done by an experienced certified Arborist to maintain the natural shape and form of the plant.
- B. Upon acceptance by the Owner, prune any broken branches, remove crossed branches, and branches hanging below the clear trunk of the tree.

**902-2.3.2.9. CLEAN-UP**

- A. During landscape work, store materials and equipment where directed by the Owner.
- B. The Contractor shall promptly remove any materials and equipment used on the job, keeping the area neat at all times. Upon completion of all planting, dispose of all excess soil and debris leaving pavements and work areas in safe and orderly condition.

- C. The clean-up of the site shall include the removal and proper disposal of the tree guying, staking, and bracing materials as described in specifications.

#### **902-2.3.2.10. PROTECTION**

- A. The Contractor shall provide safeguards for the protection of workmen and others on, about, or adjacent to the work, as required under the parameters of the Occupational Safety and Health Administration (O.S.H.A.) standards.
- B. The Contractor shall protect the Owner's and adjacent property from damage.
- C. The Contractor shall protect the landscape work and materials from damage due to landscape operations. Maintain protection during installation and maintenance periods.
- D. The Contractor shall provide protection (tree barricades) for all existing trees and palms as specified.

#### **902-2.3.2.11. REPAIR OF DAMAGES**

- E. The Contractor shall repair all damage caused by their operations to other materials, property, or trades to a level equal in quality to the existing condition prior to damage.
- F. The Contractor shall be held responsible for all damage done by their work or employees to other materials or trades' work. Patching and replacement of damaged work may be done by others, at the Owner's direction, but the cost of same shall be paid by the Contractor who is responsible for the damage.

#### **902-2.3.3. MAINTENANCE**

- A. The Contractor shall maintain all plant materials in a first class condition from the beginning of landscape construction until Final Acceptance.
- B. Operations:
  1. Maintenance shall include, but not be limited to, watering of turf and planting beds, mowing, fertilizing, cultivation, weeding, pruning, disease and pest control, replacement of dead materials, straightening, turf or planter settlement corrections, replacement of rejected materials, staking and guying repair and tightening, wash-out repairs and regrading, and any other procedures consistent with the good horticultural practice necessary to insure normal, vigorous and healthy growth of all work under the Contract. Mowing shall be consistent with the recommended height per the University of Florida Cooperative Extension Service.
  2. Within the warranty period, the Contractor shall notify the Owner of any maintenance practices being followed or omitted which would be detrimental to the healthy, vigorous growth of the landscape.
  3. The Contractor shall be responsible for the final watering of not less than one inch (1") of water for all planted materials before leaving the site.

## **902-2.3.4. INSPECTION, REJECTION, AND ACCEPTANCE**

### **902-2.3.4.1. INSPECTION**

- A. Upon completion of the installation, the Contractor will notify the Owner or the Owner's Representative that the job is ready for inspection. Within fifteen (15) days of notifications, the installation will be inspected by the Landscape Architect. A written and/or graphic inspection report will be sent to the Owner and/or Landscape Contractor.

### **902-2.3.4.2. REJECTION AND REPLACEMENT**

- A. The Landscape Architect shall be final judge as to the suitability and acceptability of any part of the work. Plant material will be rejected if it does not meet the requirements set forth in the Plans and Specifications.
- B. Replace any rejected materials immediately or within fifteen (15) days and notify the Landscape Architect that the correction has been made.

### **902-2.3.4.3. ACCEPTANCE**

- A. After replacement of rejected plant material, if any, have been made, and completion of all other correction items, the Owner or Project Representative will accept the project in writing.
- B. Upon Final Acceptance, the Owner assumes responsibility for maintenance within the terms of the Contract. Acceptance will in no way invalidate the Contractor's warranty period.
- C. The Contractor's warranty period will begin after final acceptance of the project by the Owner.
  1. If evidence exists of any lien or claim arising out of or in connection with default in performance of this Contract, the Owner shall have the right to retain any payment sufficient to discharge such claim and all costs in connection with discharging such claim.
  2. Where the Specifications call for any stipulated item or an "approved equivalent", or in words to that effect, the Contractor shall indicate the price of the type and species specified in the proposal, giving the price to be added or deducted from their Contract price. The final selection rests with the Owner or their representative.
  3. Where plants installed do not meet specifications, the Owner reserves the right to request plant replacement or an appropriate deduction from the Contract amount to compensate for the value not received from the under-specified plant materials. No additional compensation will be made to the Contractor for plants installed that exceed specifications.

## **902-2.3.5. WARRANTY**

- A. The Contractor shall warranty all palms and trees furnished under this contract for a period of one (1) year and all shrubs for a period of six (6) months. Material which is either dead or in poor health during this period or at completion will be replaced at no charge to the

Owner. Should any of the plant materials show 50% or more defoliation during the warranty period, due to the Contractor's use of poor quality or improper materials or workmanship, the Contractor upon notice, shall replace without delay same with no additional cost to the Owner. Should any plant require replacing, the new plant shall be given the equal amount of warranty.

## **903. SODDING**

Unless otherwise noted herein, the Contractor shall place all sod, either shown on the plans or at the direction of the Engineer, in conformance with Sections 575, 981, 982 and 983 of FDOT's Standard Specifications. The area for sod application shall be loosened and excavated to a suitable depth and finished to a grade compatible with existing grass and structures. Sod shall be placed with edges in close contact and shall be compacted to uniform finished grade with a sod roller immediately after placement. In sloped areas, the sod shall be graded and placed so as to prohibit erosion and undermining of the adjacent sidewalk. No sod that has been cut for more than seventy-two (72) hours can be used unless authorized by the Engineer in advance. The sod shall be thoroughly watered immediately after placement. The Contractor shall continue to water sod as needed and/or directed by the Engineer as indicated by sun exposure, soil, heat and rain conditions, to establish and assure growth, until termination of the contract. Dead sod, or sod not acceptable to the Engineer, shall be removed and replaced by the Contractor at no additional compensation. Any questions concerning the type of existing sod shall be determined by the Engineer.

Unless otherwise noted on the plans, payment for sod (including labor, equipment, materials, placement, rolling, watering, etc.) shall be included in other bid items. Payment for these associated bid items may be withheld until the Contractor provides the City a healthy, properly placed stand of grass. When this work is given as a separate bid item, it shall cover all labor, equipment and materials, (including water) required for this work and shall be paid for on the basis of each square foot in place and accepted. No payment for sod shall be made until the Contractor provides the City a healthy, properly placed stand of grass.

## **904. SEEDING**

Seed, or seed and mulch, shall only be used when specified for certain demolition projects. The seed and/or mulch shall be placed as called for on the plans in the following manner. The area to be seeded shall be brought to the required line and grade, fertilized and seeded in basic conformance with FDOT's Standard Specifications Sections 570, 981, 982 and 983. However, no wildflower seed shall be used, and Argentine Bahia Seed shall be used instead of Pensacola Bahia. No sprigging will be required. Also, the addition of 20 lb. of Rye Seed (to total 60 lb. of seed per acre) will be required during the stated periods. It is also required that the Contractor maintain said seed until growth is assured.

When this work is given as a bid item, the item shall cover all labor, material, equipment (including water), required for this work, and shall be paid for on the basis of each square yard in place and accepted. If called for on the plans, but not shown as a bid item, then the cost of such work as stated above shall be included in the cost of other work.

## **905. LAWN MAINTENANCE SPECIFICATIONS**

### **905-1. SCOPE**

To remove trash and debris from landscape and paved area; maintenance and fertilization of plant beds and landscape materials; maintenance, repair, and operation of irrigation systems; ornamental pest control; palm pruning; maintenance of traffic; and the cleaning of hard surfaces at designated areas. The Contractor is to work with the City in coordinating maintenance activities and reporting irregularities in the work zone.

The Contractor(s) will provide the labor and materials required to maintain the specified landscaped street areas including:

- Traffic safety and Maintenance of Traffic;
- Trash and debris removal from the job site;
- Removal of weeds in landscaped areas and hard surfaces;
- Proper trimming and pruning of landscape plants and palms;
- Proper fertilization and pest control of landscape and palms (may be subcontracted);
- Irrigation service and repair;
- Mulch replacement;
- Cleaning of hard surfaces; and the
- Reporting of irregularities at the job site.

### **905-2. SCHEDULING OF WORK**

The Contractor(s) shall accomplish all landscape maintenance required under the contract between the hours of 7:00 a.m. and 6:00 p.m. Monday through Saturday, excluding observed holidays. The City may grant, on an individual basis, permission to perform contract maintenance at other hours.

All work shall be completed in a continuous manner, such as cleanup, weeding, trimming, etc., be completed before leaving the job site.

### **905-3. WORK METHODS**

#### **905-3.1. MAINTENANCE SCHEDULING**

The Contractor(s) will adhere to a work schedule provided by the City (see Level of Service). Any variations to that schedule, requested by either party, must be approved, either verbally or in writing by an authorized representative of the other party.

#### **905-3.2. DUTIES PER SERVICE VISIT**

The Contractor(s) shall provide the following service at each scheduled visit to the designated location:

##### **905-3.2.1. LITTER AND DEBRIS**

Remove trash and debris from the project site. Proper disposal of collected trash and debris is the Contractor's responsibility. Extraordinary amounts of debris caused by hurricanes, tornadoes, vandalism, etc., would be the responsibility of the City to clean up. The Contractor should report

such accumulations of debris when they are encountered. Bids for the extraordinary cleanup from the Contractor would be considered. Work sites should be left in a clean and neat appearance upon completion. All debris from pruning process is to be removed from the job site and disposed of by the Contractor.

#### **905-3.2.2. VISUAL CHECK**

The site should be checked for irregularities, such as irrigation leaks, vehicle damage, dead or damaged plant material, vandalism, etc., which should be reported to the City within twenty-four (24) hours after providing the service.

#### **905-3.2.3. PLANT TRIMMING AND PALM PRUNING**

All plant material should be trimmed in a manner that promotes the natural shape and mature size of the particular species. Trimming should be performed at intervals that will maintain plants in a neat appearance. Trimming should be performed to promote fullness of the plants, while maintaining height restrictions in Clear Sight Zones as established on the landscape plans. Plants shall be kept trimmed to the back of curb. Brown foliage shall be removed from Liriope.

Palm pruning to be performed at least once per year, preferably in late June or July following flower formation, consistent with the following specification:

##### **905-3.2.3.1. PHOENIX SPECIES (CANARY DATE, INDIA DATE, PYGMY DATE, ETC.)**

Remove all descending fronds, to the base of the frond; all parallel and ascending fronds are to remain in order to leave a full, rounded head; seed heads may remain, but remove old faded heads that are encountered in the pruning process; and remove loose frond boots; remove vegetation, such as strangler figs, Brazilian Pepper, Asparagus fern, etc., growing in the frond boots or on the trunk. Provide the rounded, classic cut on all Medjool palm boots. No climbing spikes allowed on palms.

##### **905-3.2.3.2. TRAFFIC CONTROL**

Proper and safe work zones in vehicular traffic areas are to be set up and maintained by the Contractor, according to the approved Maintenance of Traffic specifications.

##### **905-3.2.3.3. PEDESTRIAN SAFETY**

Contractor is responsible for maintaining safe work zones in areas where pedestrian and park users are present. The City reserves the right to limit the hours of operation in certain high pedestrian use areas.

#### **905-3.2.4. PLANT FERTILIZATION**

All tree and plant material should be fertilized with the appropriate amount of 20-6-12 sulfur coated, slow release, ornamental fertilizer, three times per year. Applications should be made in mid-February, early June, and mid-September, for the first two years. Fertilizer types and amounts will change with requirements of maturing landscape materials.

### **905-3.2.5. WEED REMOVAL IN LANDSCAPED AREA**

Weeds should be removed on a regular basis in order to keep them from being visibly noticeable. Weed control with the use of appropriate herbicides is allowable, given they are properly applied by a certified applicator. Herbicide damage to landscape material will be remedied by Contractor at their expense.

### **905-3.2.6. MULCH CONDITION**

Should be maintained at a thickness that will discourage weed growth as well as help retain soil moisture, usually three inches (3").

### **905-3.2.7. IRRIGATION SERVICE AND REPAIR**

Should be performed at each visit to assure the system's proper operation and timing. Drip tubing should be kept covered with mulch. Timer should be checked for proper time of day and operating schedule. Leaks or breaks in the system should be repaired before the next scheduled system running time.

### **905-3.2.8. LAWN AND ORNAMENTAL PEST CONTROL**

Should be performed by a properly licensed and certified applicator to keep pest populations at a less than damaging level. Landscape materials lost to or extensively damaged by pests will be replaced by the Contractor at the Contractor's expense. Diazinon products are not to be used on City properties.

### **905-3.2.9. PALM FERTILIZATION**

Apply three (3) pounds of Magnesium sulfate and one pound of Potassium evenly, per tree, across the root zone (typically within the dripline), annually in early February.

### **905-3.2.10. FREEZE PROTECTION**

The City will provide a freeze/frost protection fabric for the Contractor to install over freeze/frost sensitive plants (Lantana and Pentas). The covering material will be stored at a City facility. Contractor will remove the covering material from storage and install over the sensitive plants, securely fastening edges of the material to the ground per manufacturer's directions. The City will furnish metal pins needed for securing fabric to the ground. The City will notify the Contractor one (1) day or twenty-four (24) hours minimum prior to the need to protect plant material. After uses, the Contractor will prepare the fabric for storage and return it to the designated City facility. Protective covering shall be removed the following afternoon or remain in place as directed by the City. The City shall notify the Contractor by 11:00 a.m. about removing the cover or keeping it in place due to continued freezing temperatures. The City may cancel the freeze protection event at any time prior to the end of the scheduled installation day (5:00 p.m.) The Contractor will be compensated for the number of hours mobilization or on-site work at the contracted rate per man-hour unit price. The Contractor shall provide a unit price for the installation and removal of the covering fabric on a per event basis, as well as an hourly rate per employee required. The City and Contractor will coordinate appropriate irrigation operations with weather conditions. Should freeze/frost damage occur, the Contractor shall perform remedial work as per unit basis, as directed by the City.

## **906. LEVEL OF SERVICE**

The Project Site is to be serviced weekly. Repairs to damage or vandalism to be made within seven (7) working days of reported irregularity. Weekly visits should occur no closer than six (6) and no further than ten (10) calendar days apart.

## **907. COMPLETION OF WORK**

Within twenty-four (24) hours of completing work the City either in person or by phone of said completion. It is acceptable to leave a phone message.

## **908. INSPECTION AND APPROVAL**

Upon receiving notification from the Contractor, the City shall inspect the serviced location the following business day. If, upon inspection, the work specified has not been completed, the City shall contact the Contractor to indicate the necessary corrective measures. The Contractor will be given forty-eight (48) hours from this notification to make appropriate corrections. If the work has been completed successfully then the City will pay for services billed.

## **909. SPECIAL CONDITIONS**

1. This location will be newly installed and under warranty by the installer for a twelve (12) month period on plants, trees and palms. Landscape installer will coordinate irrigation operation with the Maintenance contractor to assure adequate irrigation to the landscape materials. Installer will also be responsible for the untying of palm heads/fronds as they feel appropriate.
2. All listed acreage or square footage figures are estimates.
3. All work shall be performed in a good and workmanlike manner, consistent with trade practices and standards which prevail in the industry.
4. The Contractor shall be responsible for damage to any plant material or site feature caused by the Contractor or their employees. The Contractor shall be notified in writing of the specific nature of the damage and cost of repair. The City shall, at its option, invoice the Contractor for the payment, or reduce by the amount of the repairs on the next regular payment to the Contractor.
5. Occasionally circumstances (standing water, prolonged inclement weather, parked vehicles, etc.) may make all or portions of a location unserviceable during the regular schedule. The Contractor shall notify the City Supervisor of such occurrences and shall schedule to perform the required work to the location as soon as the pertaining circumstances are relieved.

## 910. TREE PROTECTION

### 910-1. TREE BARRICADES

- A. A protective barrier shall be placed around all protected trees and palms prior to land preparation or construction activities within or adjacent to the work zone, including all staging and/or lay down areas. Protective barriers shall be installed as follows:
  1. At or greater than the full dripline of all species of Mangroves and Cabbage Palms.
  2. At or greater than the full dripline of all protected native pine trees and other conifer species.
  3. At or greater than two-thirds (2/3) of the dripline of all other protected species
  4. At or greater than the full dripline of trees within a specimen tree stand.
- B. Protective barriers are to be constructed using no less than two inch (2") lumber for upright posts. Upright posts are to be at least four feet (4') in length with a minimum of one foot (1') anchored in the ground. Upright posts are to be placed at a maximum distance of eight feet (8') apart. Horizontal rails are to be constructed using no less than one inch (1") by four-inch (4") lumber and shall be securely attached to the top of the upright post. The City's representative must approve any variation from the above requirements.
- C. Whenever a protective barrier is required, it shall be in place until all construction activity is terminated. The area within the barrier limits shall remain undisturbed by any activity during construction. Native ground cover and understory vegetation existing within the barriers shall remain throughout construction. Exotic plant species may only be removed by manual labor utilizing hand tools or by other means if authorized in writing by the City's representative.
- D. Prior to the erection of any required protective barrier, all surface foreign material, trash or debris shall be removed from the area enclosed by the barrier, and after erection of the barrier no such material or litter shall be permitted to remain within the protected area. No equipment, chemicals, soil deposits or construction materials shall be placed within such protective barriers.
- E. No signs, building permits, wires, or other attachments of any kind shall be attached to any protected tree or palm.
- F. At all times, due care shall be taken to protect the critical root zone of trees protected by this section, and root pruning requirements shall apply to such trees.

### 910-2. ROOT PRUNING

- A. Where proposed construction improvements involve excavation and/or impacts to the critical root zone of protected trees, the Contractor shall be required to have an International Society of Arboriculture (ISA) certified arborist perform, or directly supervise root pruning to reduce the impacts of construction. The critical root zone is equivalent to the tree's dripline. Prior to any clearing, grubbing or excavation activities, the affected roots must be severed by clean pruning cuts at the point where grubbing or excavation impacts the root system. Roots can be pruned utilizing specified root pruning equipment designed for that purpose or by hand digging a trench and pruning roots with a pruning saw, chain saw or other equipment designed for tree

pruning. Root pruning by trenching equipment or excavation equipment is strictly prohibited. Roots located in the critical root zone that will be impacted by construction activities shall be pruned to a minimum depth of eighteen inches (18") below existing grade or to the depth of the proposed impact if less than eighteen inches (18") from existing grade. The City's Representative on Engineering Department projects for Root Pruning issues is the Senior Landscape Architect and can be reached at (727) 562-4747, or through the construction inspector assigned to the project.

- B. Root pruning shall only be performed by or under the direct supervision of an International Society of Arboriculture (ISA) certified arborist.
- C. Any proposed root pruning trenches shall be identified on site (i.e. staked or painted) inspected and approved by the City's representative prior to actual root pruning.
- D. Root pruning shall be performed as far in advance of other construction activities as is feasible, but at a minimum shall be performed prior to ANY impacts to the soil. Associated tree protection measures should be implemented upon completion of said root pruning.
- E. If there is a likelihood of excessive wind and/or rain exceptional care shall be taken on any root pruning activities.
- F. Root pruning shall be limited to a minimum of ten inches (10") per one inch (1") of the trunk diameter from the tree base. Any exception must be approved by the City's representative prior to said root pruning.
- G. Roots shall be cut cleanly, as far from the trunk of the tree as possible. Root pruning shall be done to a minimum depth of eighteen inches (18") from existing grade, or to the depth of the disturbance if less than eighteen inches (18").
- H. Root pruning shall be performed using a root cutting machine specifically designed for this purpose. Alternate equipment or techniques must be approved by the City's representative, prior to any work adjacent to trees to be preserved.
- I. Root pruning shall be completed, inspected and accepted prior to the commencement of any excavation or other impacts to the critical root zones of trees to be protected.
- J. Excavations in an area where root are present shall not cause the tearing or ripping of tree roots. Roots must first be cleanly severed prior to continuing with the excavation, or tunneled around to prevent damage to the root.
- K. Tree roots shall not be exposed to drying out. Root ends shall be covered with native soil or burlap and kept moist until final backfill or final grades has been established.
- L. When deemed appropriate (e.g., during periods of drought) the City representative may require a temporary irrigation system be utilized in the remaining critical root zones of root pruned trees.
- M. When underground utility lines are to be installed within the critical root zone, the root pruning requirement may be waived if the lines are installed via tunneling or directional boring as opposed to open trenching.

### **910-3. PROPER TREE PRUNING**

- A. All tree pruning and/or root pruning on existing trees to remain shall only be performed by or under the direct supervision of an International Society of Arboriculture (ISA) certified arborist. Furthermore, all tree work shall conform to the American National Standards Institute (ANSI) 2001, American National Standard for tree care operations – Tree, Shrub and other Woody Plant Maintenance – Standard practices (pruning) ANSI A-300.
- B. Proper pruning techniques for all lateral branches of protected trees are required. Flush cuts (pruning cuts that remove the branch collar) and stub cuts (cuts that leave a stub on the tree) are improper techniques. Any protected tree that has been improperly pruned will not be recognized as a tree left on the project in a healthy growing condition, and will require replacement consistent with the current City Code of Ordinances and Community Development Code.
- C. No protected tree shall have more than thirty percent (30%) of its foliage removed.
- D. No protected tree shall be topped, hat racked or lion-tailed. Any protected tree that has been improperly pruned will not be recognized as a tree left on the project in a healthy growing condition, and will require replacement consistent with the current City Code of Ordinances and Community Development Code.
- E. Tree Trunks and limbs shall be protected. The use of tree spikes or other devices that damage trunk and bark tissue on protected trees shall be prohibited. Any protected tree that has been damaged in such a manner will not be recognized as a tree left on the project in a healthy growing condition and will require replacement consistent with the current City Code of Ordinances and Community Development Code.

**SECTION IVa**

**SUPPLEMENTAL TECHNICAL SPECIFICATIONS**

**CITY OF CLEARWATER  
MS WRF BLEND TANK MIXER**

**BIDDING AND CONSTRUCTION  
CONTRACT DOCUMENTS AND  
TECHNICAL SPECIFICATIONS**

City Project No. 18-0057-UT  
Jones Edmunds Project No. 03720-054-01

*Owner:*

**CITY OF CLEARWATER**  
100 S. Myrtle Avenue  
Clearwater, Florida 33756-5520

*Engineer:*

**JONES EDMUNDS & ASSOCIATES, INC.**  
324 S. Hyde Park Avenue, Suite 250  
Tampa, Florida 33606

Professional Engineering Certificate of Authorization #1841

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**DIVISION 1**

**GENERAL REQUIREMENTS**

**SECTION 01000  
PROJECT REQUIREMENTS**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. The Work to be done consists of the furnishing of all labor, materials, and equipment and the performance of all Work included in this Contract. The summary of the Work is presented in Section 01100, Summary of Work.
- B. Work Included:
  - 1. The Contractor shall furnish all labor, superintendence, materials, plant power, light, heat, fuel, water, tools, appliances, equipment, supplies, and means of construction necessary for proper performance and completion of the Work. The City will provide the Contractor with plant reclaimed water for testing and filling tanks, pumps, and pipelines. The Contractor shall obtain and pay for all necessary local permits. The Contractor shall perform and complete the Work in the manner best calculated to promote rapid construction consistent with safety of life and property and to the satisfaction of the Engineer and in strict accordance with the Contract Documents. The Contractor shall clean up the Work and maintain it during and after construction, until accepted, and shall do all Work and pay all costs incidental thereto. He shall repair or restore all structures and property that may be damaged or disturbed during performance of the Work.
  - 2. The cost of incidental work described in these Project Requirements for which there are no specific Contract Items shall be considered as part of the general cost of doing the Work and shall be included in the prices for the various Contract Items. No additional payment will be made therefore.
  - 3. The Contractor shall provide and maintain such modern plant, tools, and equipment as may be necessary, in the opinion of the Engineer, to perform in a satisfactory and acceptable manner all the Work required by this Contract. Only equipment of established reputation and proven efficiency shall be used. The Contractor shall be solely responsible for the adequacy of his workmanship, materials, and equipment, prior approval of the Engineer notwithstanding.
- C. Public Utility Installations and Structures: Public utility installations and structures shall be understood to include all poles, tracks, pipes, wires, conduits, vaults, manholes, and all other appurtenances and facilities pertaining thereto whether owned or controlled by the Owner, other governmental bodies, or

privately owned by individuals, firms, or corporations used to serve the public with transportation, traffic control, gas, electricity, telephone, sewerage, drainage, water, or other public or private property which may be affected by the Work shall be deemed included hereunder.

1. The Contract Documents contain data relative to existing public utility installations and structures above and below the ground surface. These data are not guaranteed as to their completeness or accuracy and it is the responsibility of the Contractor to make his own investigations to inform himself fully of the character, condition, and extent of all such installations and structures as may be encountered and as may affect the construction operations.
2. The Contractor shall protect all public utility installations and structures from damage during the Work. Access across any buried public utility installation or structure shall be made to avoid any damage to these facilities. All required protective devices and construction shall be provided by the Contractor at his expense. All existing public utilities damaged by the Contractor shall be repaired by the Contractor, at his expense. No separate payment shall be made for such protection or repairs to public utility installations or structures.
3. Public utility installations or structures owned or controlled by the Owner or other governmental body which are shown on the Contract Drawings to be removed, relocated, replaced, or rebuilt by the Contractor shall be considered as a part of the general cost of doing the Work and shall be included in the prices bid for the various Contract Items. No separate payment shall be made therefor.
4. Where public utility installations or structures owned or controlled by the Owner or other governmental body are encountered during the Work and are not indicated on the Contract Drawings or in the Project Specifications, and when, in the opinion of the Engineer, removal, relocation, replacement, or rebuilding is necessary to complete the Work under this Contract, such Work shall be accomplished by the utility having jurisdiction, or such Work may be ordered, in writing by the Engineer, for the Contractor to accomplish. If such work is accomplished by the utility having jurisdiction it will be carried out expeditiously, and the Contractor shall give full cooperation to permit the utility to complete the removal, relocation, replacement, or rebuilding as required. If such work is accomplished by the Contractor, it will be paid for as extra work as provided in the Agreement.
5. At all times in performance of the Work the Contractor shall employ acceptable methods and exercise reasonable care and skill so as to avoid unnecessary delay, injury, damage, or destruction of public utility installations and structures and shall at all times in the performance of the

- Work avoid unnecessary interference with or interruption of public utility services and cooperate fully with the owners thereof to that end.
6. The Contractor shall give written notice to the Owner and other governmental utility departments and other owners of public utilities of the location of his proposed construction operations at least 48 hours in advance of breaking ground in any area or on any unit of the Work.
  7. The maintenance, repair, removal, relocation, or rebuilding of public utility installations and structures, when accomplished by the Contractor as herein provided, shall be done by methods approved by the owners of such utilities.

## 1.02 RELATED WORK

- A. Section 01100, Summary of Work.
- B. Section 01650, Delivery, Storage, and Handling.
- C. Section 01780, Warranties and Bonds.

## 1.03 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

## 1.04 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

## 1.05 DRAWINGS AND PROJECT MANUAL

- A. Contract Drawings: When obtaining data and information from the Contract Drawings, figures shall be used in preference to scaled dimensions and large-scale drawings in preference to small-scale drawings.
- B. Contractor to Check Drawings and Data:
  1. The Contractor shall verify all dimensions, quantities, and details shown on the Contract Drawings, Supplementary Drawings, Schedules, Specifications, or other data received from the Engineer, and shall notify the Engineer of all errors, omissions, conflicts, and discrepancies found therein. Failure to discover or correct errors, conflicts, or discrepancies shall not relieve the Contractor of full responsibility for unsatisfactory work, faulty construction, or improper operation resulting therefrom, nor from rectifying such conditions at his own expense. He will not be

allowed to take advantage of any errors or omissions, as full instructions will be furnished by the Engineer should such errors or omissions be discovered.

2. All schedules are given for the convenience of the Engineer and the Contractor and are not guaranteed to be complete. The Contractor shall assume all responsibility for making estimates of the size, kind, and quantity of materials and equipment included in the Work to be done under the Contract.

- C. Specifications: The Technical Specifications each consist of three parts: General, Products, and Execution. The General part of a Specification contains General Requirements which govern the Work. The Products and Execution parts modify and supplement the General Requirements by detailed requirements for the Work and shall always govern whenever there appears to be a conflict.

- D. Intent:

1. All Work called for in the Specifications applicable to this Contract, but not shown on the Contract Drawings in their present form, or vice versa, shall be of like effect as if shown or mentioned in both. Work not specified in either the Contract Drawings or in the Specifications but involved in carrying out their intent or in the complete and proper execution of the Work is required and shall be performed by the Contractor as though it were specifically delineated or described.
2. The apparent silence of the Specifications as to any detail or the apparent omission from them of a detailed description concerning any work to be done and materials to be furnished shall be regarded as meaning that only the best general practice is to prevail and that only material and workmanship of the best quality is to be used. The interpretation of these Specifications shall be made upon that basis.

## 1.06 MATERIALS AND EQUIPMENT

- A. Manufacturer:

1. All transactions with the manufacturers or subcontractors shall be through the Contractor, unless the Contractor shall request and at the Engineer's option that the manufacturer or subcontractor deal directly with the Engineer. Any such transactions shall not in any way release the Contractor from his full responsibility under this Contract.
2. Any two or more pieces of material or equipment of the same kind, type, or classification, and being used for identical types of service, shall be made by the same manufacturer.

B. Delivery:

1. The Contractor shall deliver materials in ample quantities to ensure the most speedy and uninterrupted progress of the Work so as to complete the Work within the allotted time.
2. The Contractor shall also coordinate deliveries in order to avoid delay in or impediment of the progress of the work of any related Contractor.

C. Tools and Accessories:

1. Unless otherwise stated in the Contract Documents, the Contractor shall furnish with each type, kind, or size of equipment, one complete set of suitably marked high-grade special tools and appliances which may be needed to adjust, operate, maintain, or repair the equipment. Such tools and appliances shall be furnished in approved painted steel cases, properly labeled and equipped with good-grade cylinder locks and duplicate keys.
2. Spare parts shall be furnished as specified herein and as recommended by the manufacturer necessary for the operation of the equipment, not including materials required for routine maintenance.
3. Each piece of equipment shall be provided with a substantial nameplate, securely fastened in place and clearly inscribed with the manufacturer's name, year of manufacture, serial number, weight, and principal rate data.

D. Service of Manufacturer's Engineer:

1. The Contract Prices for equipment shall include the cost of furnishing a competent and experienced engineer or superintendent who shall represent the manufacturer and shall help the Contractor, when required, install, adjust, test, and place in operation the equipment in conformity with the Contract Documents.
2. After the equipment is placed in permanent operation by the Owner, the engineer or superintendent shall make all adjustments and tests required by the Engineer to prove that the equipment is in proper and satisfactory operating condition and shall instruct such personnel as may be designated by the Owner in the proper operation and maintenance of such equipment.

## 1.07 INSPECTION AND TESTING

A. General:

1. For tests specified to be made by the Contractor, the testing personnel shall make the necessary inspections and tests, and the reports thereof shall be in such form as will facilitate checking to determine compliance with the Contract Documents. Five copies of the reports shall be

- submitted, and authoritative certification thereof must be furnished to the Engineer as a prerequisite for the acceptance of any material or equipment.
2. If, in the making of any test of any material or equipment, the Engineer ascertains that the material or equipment does not comply with the Contract Documents, the Contractor will be notified thereof, and he will be directed to refrain from delivering said material or equipment, or to remove it promptly from the site or from the Work and replace it with acceptable material without cost to the Owner.
  3. Tests of electrical and mechanical equipment and appliances shall be conducted in accordance with the recognized test codes of the ANSI, ASME, or the IEEE, except as may otherwise be stated herein.
  4. The Contractor shall be fully responsible for the proper operation of equipment during testing and instruction periods and shall neither have nor make any claim for damage which may occur to equipment before the time when the Owner formally takes over the operation thereof.

B. Costs:

1. The Contractor shall provide all inspection and testing of materials furnished under this Contract, unless otherwise expressly specified.
2. The Contractor shall bear the cost of shop and field tests of equipment and of certain other tests specifically called for in the Contract Documents, and such costs shall be deemed to be included in the Contract Price.
3. The Owner may test materials and equipment submitted by the Contractor as the equivalent to those specifically named in the Contract for compliance. The Contractor shall reimburse the Owner for the expenditures incurred in making such tests of materials and equipment which are rejected for non-compliance.

C. Certificate of Manufacture:

1. The Contractor shall furnish the Engineer with authoritative evidence in the form of a certificate of manufacture that the materials to be used in the Work have been manufactured and tested in conformity with the Contract Documents.
2. These certificates shall be notarized and shall include copies of the results of physical tests and chemical analyses, where necessary, that have been made directly on the product or on similar products of the manufacturer.

D. Shop Tests:

1. Each piece of equipment for which pressure, duty, capacity, rating, efficiency, performance, function, or special requirements are specified shall be tested in the shop of the maker in a manner which shall

conclusively prove that its characteristics comply fully with the requirements of the Contract Documents.

2. Five copies of the manufacturer's actual test data and interpreted results thereof, accompanied by a certificate of authenticity sworn to by a responsible official of the manufacturing company and/or independent laboratory, shall be submitted to the Engineer for approval.
3. The Contractor shall bear the cost of shop tests and of furnishing manufacturer's preliminary and shop test data of operating equipment.

E. Start-up Tests:

1. As soon as conditions permit, the Contractor shall furnish all labor, materials, and instruments and shall make start-up tests of equipment.
2. If the start-up tests disclose any equipment furnished under this Contract which does not comply with the requirements of the Contract Documents, the Contractor shall, before demonstration tests, make all changes, adjustments, and replacements required. The furnishing contractor shall assist in the start-up tests as applicable.

F. Demonstration Tests:

1. Before the Contractor's request for a Substantial Completion inspection, all equipment and piping installed under this Contract shall be subjected to demonstration tests as specified or required to prove compliance with the Contract Documents.
2. The Contractor shall furnish labor, fuel, energy, water, and all other materials, equipment, and instruments necessary for all demonstration tests at no additional cost to the Owner. The Contractor shall assist in the demonstration tests as applicable.

## 1.08 LINES AND GRADES

A. Grade:

1. All work under this Contract shall be constructed in accordance with the lines and grades shown on the Contract Drawings or as given by the Engineer. The full responsibility for keeping alignment and grade shall rest upon the Contractor.
2. Reference marks for lines and grades as the Work progresses shall be located by the Contractor to cause as little inconvenience to the prosecution of the Work as possible. The Contractor shall place excavation and other materials so as to cause no inconvenience in the use of the reference marks provided. He shall remove any obstructions he places contrary to this provision.

B. Surveys:

1. At his own expense the Contractor shall furnish and maintain stakes and other such materials.
2. The Contractor shall check such reference marks by such means as he may deem necessary and, before using them, shall call the Engineer's attention to any inaccuracies.
3. At his own expense the Contractor shall establish all working or construction lines and grades as required from the reference marks set by the Engineer and shall be solely responsible for the accuracy of these lines and grades. He shall, however, be subject to check and review by the Engineer.

C. Safeguarding Marks:

1. The Contractor shall safeguard all points, stakes, grade marks, monuments, and bench marks made or established on the Work, bear the cost of re-establishing them if disturbed, and bear the entire expense of rectifying work improperly installed due to not maintaining or protecting or to removing without authorization such established points, stakes, and marks.
2. The Contractor shall safeguard all existing and known property corners, monuments, and marks adjacent to but not related to the Work and shall bear the cost of re-establishing them if they are disturbed or destroyed.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01100**  
**SUMMARY OF WORK**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

Unless otherwise expressly provided in the Contract Documents, the Work must be performed in accordance with best modern practice, with materials and workmanship of the highest quality to the satisfaction of the Owner.

- A. The Project title is City of Clearwater Marshall Street Water Reclamation Facility Blend Tank Mixer Project.
- B. This Work shall be performed in accordance with the Contract Documents and generally includes, but is not limited to, the following:
  - 1. Demolish the following to the extents shown in the Contract Drawings (Contractor to coordinate which items are to be salvaged with the Owner and Engineer before beginning demolition):
    - a. Sludge Holding Tank FRP covers with associated hardware.
    - b. Sludge Holding Tank walkway, stairs, handrail, fiberglass stair treads, and associated supports.
    - c. Progressing cavity dewatering pumps with all associated piping, valves, supports, equipment pads, electrical equipment, and appurtenances.
    - d. Centrifugal recirculation pump with all associated piping, valves, supports, equipment pad, electrical equipment, and appurtenances.
    - e. 8-inch DIP anaerobic digester feed piping to the extents shown between Digester and Sludge Holding Tank.
    - f. 6-inch stainless steel piping in Sludge Holding Tank penetration as shown in the demolition photographs from previous air/diffuser piping.
    - g. 6-inch PVC piping as required for drain piping modifications, dewatering feed piping modifications, and belt filter press meter installation.
    - h. Concrete slabs and associated 6-inch-high concrete curb.
    - i. Hose bibbs and associated effluent water piping to the extents indicated in the Contract Drawings.
    - j. VFD cabinets from the electrical room in the dewatering building and all associated Allen Bradley PLC and associated wiring to the extents shown in the Contract Drawings.

2. Salvage plug valves (as shown in the Contract Drawings).
3. Remove any remaining grit, sludge, and rags from the existing Sludge Holding Tank and dispose of offsite in accordance with FDEP Regulations.
4. Temporarily remove, store, and protect FRP odor-control pipe for reconnection to new Sludge Holding Tank cover.
5. Clean and coat the interior (walls and grouted floor) and exterior (walls) of the existing Sludge Holding Tank.
6. Install a new mixer in the Sludge Holding Tank.
7. Install a new aluminum stairs and cover with access ladders, handrails, and harness tie-off points from the walkway on the Sludge Holding Tank.
8. Install truck off-loading and recirculation pump station (as shown in the Contract Drawings).
9. Remove and replace the pumps, piping, and concrete slab at the dewatering feed pump station (as shown in the Contract Drawings).
10. Provide temporary piping and bypass pumping as indicated in Section 01815, Maintenance of Plant Operation and Sequence of Construction, and the Contract Drawings.
11. Clean, pressure wash, and refurbish existing concrete sidewalk (as shown in the Contract Drawings), leaving appropriate base and support for stair landing and stair column supports.
12. Remove and replace process and drain piping (as shown in the Contract Drawings).
13. Replace the two noted existing light poles with LED capability and install two LED light poles on the Sludge Holding Tank stairs and walkway (as shown in the Contract Drawings).
14. Incorporate all electrical, instrumentation and controls (I&C), and SCADA integration for the proposed improvements.
15. Perform all arc flash requirements on any electrical equipment installed as part of this construction.

- C. The Project Specifications and Contract Drawings are an integrated part of the Contract Documents and, as such, will not stand alone if used independently as individual sections, divisions, or drawing sheets. The Project Specifications and Contract Drawings establish minimum standards of quality for this project. They do not purport to cover all details regarding the design and construction of materials and equipment.

## 1.02 REFERENCE STANDARDS

Reference standards and recommended practices referred to herein shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American Association of State Highway and Transportation Officials (AASHTO) Formerly (AASHO)
- B. American Concrete Institute (ACI)
- C. American Institute of Steel Construction (AISC)
- D. American Iron and Steel Institute (AISI)
- E. American National Standards Institute (ANSI)
- F. American Standards Association (ASA)
- G. American Society of Mechanical Engineers (ASME)
- H. American Society of Testing and Material (ASTM)
- I. American Water Works Association (AWWA)
- J. American Welding Society (AWS)
- K. Anti-Friction Bearing Manufacturer's Association (AFBMA)
- L. Building Officials and Code Administrators International, Inc. (BOCA)
- M. Construction Specifications Institute (CSI)
- N. Federal Specification (FS)
- O. Florida Department of Transportation (FDOT) Standard Specifications for Road and Bridge Construction, Latest English Edition (Standard Specifications)
- P. FDOT Roadway and Traffic Design Standards Latest English Edition (FDOT Index)
- Q. Geosynthetics Institute (GSI)
- R. National Bureau of Standards (NBS)
- S. National Electrical Manufacturer's Association (NEMA)
- T. National Fire Protection Association (NFPA)
- U. Portland Cement Association (PCA)
- V. Occupational Safety and Health Act (Public Law 91-596), U.S. Department of Labor (OSHA)
- W. Steel Structures Painting Council (SSPC)
- X. Southern Standard Building Code (SSBC)
- Y. Underwriters' Laboratories, Inc. (UL)
- Z. United States of America Standards Institute (USASI)

- AA. Regulations of Florida Industrial Commission Regarding Safety
- BB. All local, state, county, or municipal building codes requirements of the Owner's Insurance

#### 1.03 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

#### 1.05 GENERAL REQUIREMENTS

- A. Unless otherwise specified on the Contract Documents, all work and the quality of materials shall conform to the referenced sections of the Florida Department of Transportation (FDOT) *Standard Specifications for Road and Bridge Construction, Supplementary Specifications, and Roadway and Traffic Design Standards*. The Contractor shall retain on the job site copies of these standard FDOT documents. The basis of payment shall conform to Section 01200, Measurement and Payment, of the General Requirements.

#### 1.06 WORKING HOURS

- A. Working hours shall be in accordance with City of Clearwater Section III, Item 6.2, Section IV, Item 905-2, and as described below.
- B. Work under this contract shall not be prosecuted on Sundays or on State and/or National holidays, except in time of emergency, and then only under written permission from the Owner who shall be the sole judge as to the urgency of that situation. On weekdays and Saturdays, the workday shall be limited to daylight hours between 7:00 a.m. and 6:00 p.m.
- C. If the Contractor deems it necessary to work on Sundays, holidays, or beyond daylight hours to comply with his construction schedule or because of an emergency, the Contractor shall request permission of the Owner to do so. If, in the opinion of the Owner, the need is bona fide, the Owner will authorize the Contractor to work such hours as may be necessary.

## 1.07 REIMBURSEMENT FEES

- A. Reimbursement shall be in accordance with City of Clearwater Section III, Item 6.1, and as described below.
- B. The following rates shall be applied as the Owner's reimbursement of the Engineer's fee to be paid by the Contractor for expenses defined in City of Clearwater Sections III and IV.
  - 1. Senior Field Representative (Construction): \$ 120.00
  - 2. Senior Construction Administrator: \$ 165.00
  - 3. Engineering Consultant (Senior Project Manager): \$ 235.00
  - 4. Project Engineer: \$ 180.00
  - 5. Administrative Assistant: \$ 100.00
  - 6. Owner Supervisor \$ 100.00

## PART 2 PRODUCTS (NOT USED)

## PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01200**  
**MEASUREMENT AND PAYMENT**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. This Section covers methods of measurement and payment for items of work under this Contract.
- B. The total Contract Price shall cover all work required by the Contract Documents. All cost in connection with the proper and successful completion of the work, including furnishing all materials, equipment, and tools and performing all necessary labor and supervision to fully complete the work, shall be included in the unit price and lump-sum Bid prices. All work not specifically set forth as a pay item in the Bid Form or Bidder's Proposal in Section V shall be considered a subsidiary/ancillary obligation of the Contractor and all costs in connection with these subsidiary/ancillary obligations shall be included in the Bid(s) to provide a complete and functional Project.

**1.02 RELATED WORK**

- A. Section 01290, Schedule of Values.
- B. Section 01650, Delivery, Storage, and Handling.
- C. Section 01780, Warranties and Bonds.

**1.03 WARRANTIES**

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

**1.04 DELIVERY, STORAGE, AND HANDLING**

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

**1.05 EXCAVATION, TRENCHING, AND CLEARING**

- A. Except where otherwise specified, the unit price or lump-sum price bid for each item of work which involves excavation, trenching, clearing, grubbing, or disposal of cleared and grubbed materials shall include all costs for such work. No direct payment shall be made for clearing, grubbing, disposal of cleared or

grubbed materials, excavation, trenching, disposal of surplus excavated material, handling water (and groundwater) and purchasing and hauling of required fill material. All excavation and trenching shall be unclassified as to materials which may be encountered; in addition, trenches shall be unclassified as to depth, unless otherwise stated.

#### 1.06 LUMP SUM

- A. For lump-sum items, payments shall be made to the Contractor in accordance with an accepted Progress Schedule of Values on the basis of actual work completed and accepted by the Owner at the final completion of the Project.

#### 1.07 UNIT PRICE

- A. For unit price items, payment shall be made to the Contractor in accordance with an accepted Progress Schedule of Values on the basis of actual amount of materials in place accepted by the City.
- B. After the work is completed and before final payment is made, the City will make final measurements, with all required assistance from the Contractor, to determine the quantities of various items of work accepted as the basis for the final unit price payment.

#### 1.08 PAYMENT FOR INCREASED OR DECREASED QUANTITIES

- A. When alterations in the quantities of unit price work not requiring a Change Order(s), as herein provided for, are ordered and performed, the Contractor shall accept payment in full at the Contract unit price multiplied by the actual quantities of work constructed and accepted by the Owner at the completion of the project.
- B. The actual percentage of each lump sum bid item completed by the Contractor and accepted by the Owner at the final completion of the Project will be paid to the Contractor.

#### 1.09 DELETED ITEMS

- A. Should any items contained in the Bidder's Proposal in Section V be found unnecessary for the proper completion of the work contracted, the City may eliminate such items from the Contract. This action shall in no way invalidate the Contract and no financial allowance or compensating payment for expected profit, overhead, etc., will be made for items so eliminated in making final payment to the Contractor.

## 1.10 FINAL PAYMENT

- A. If requested by the City, the Contractor shall field verify all quantities in dispute by using visual observation, taped measurements, or other methods designated by the Engineer. The field verification shall be made in the presence of the City and agreed to by both the Engineer and the Contractor. The City will prepare a final adjusting Change Order which will adjust the final quantities of the project Bidder's Proposal in Section V to reflect the actual work accepted by the City and for which the Contractor will be compensated.

## 1.11 SCHEDULE OF VALUES

- A. A schedule of values for the lump-sum bid items and some of the unit-price bid items shall be submitted and accepted before the first pay request is approved by the City. The schedule of values shall be based on the prices bid in the Bidder's Proposal in Section V. Prices bid in the Bidder's Proposal in Section V cannot be changed in the schedule of values; they can only be broken down into more detail so that the City can more accurately review and approve the Contractor's pay application for the completed work.

## 1.12 MISCELLANEOUS CONSTRUCTION ITEMS

- A. The Contractor shall take all precautions necessary to protect existing utilities, roads, and miscellaneous items from damage during construction.
- B. The Contractor shall repair, relocate, or replace existing utilities, roadways, and miscellaneous items to pre-construction conditions.
- C. All repairs, relocations, and replacements necessary are considered incidental to the work and will be at the Contractor's cost, with no cost to the City.
- D. The unit-price bid items and lump-sum bid items for all pipe items shall constitute full compensation for furnishing, laying, jointing, and testing of pipe; dewatering; excavation and backfill; and cleanup. All pipelines which are to be paid for per linear foot where identified in the Bidder's Proposal in Section V, will be measured for payment only on a horizontal plane after installation, unless otherwise noted.
- E. Payment for the water services, fire hydrants, and isolation valve bid items shall not be made until the associated Water Service Cards, Fire Hydrant Cards, and Isolation Valve Cards have been properly filled out, signed by the Contractor, and accepted by the Engineer as completed installations. Samples of the Water Service Card, Fire Hydrant Card, and Isolation Valve Card are located at the end

of Section 15110, Manual, Check, and Process Valves. The Contractor shall make all required copies of the cards for use in the work.

- F. The Contractor shall allow the Engineer, City, or their representative as deemed necessary to observe and document the installation of each underground fitting on the project. When this is enacted by the City or Engineer representative, if the installation of any fitting is not confirmed and documented by the City or Engineer, it shall not be paid for by the City.

## PART 2 PAY ITEM DESCRIPTIONS

### 2.01 BID

The descriptions provided in the following Paragraphs are to be used by the Bidder in preparing the Bidder's Proposal in Schedule V. They generally indicate how the major workscope items and their respective costs are to be separated into the line items listed in the Bidder's Proposal in Schedule V. These descriptions are not fully representative nor all-inclusive of the work required to complete the project in accordance with the Contract Documents. It is the Bidder's responsibility to include all required costs within the most appropriate line item(s).

### UNIT PRICE SCHEDULE

The unit price payment shall be made based on the actual amount of work and for the actual amount of materials in place at the final completion of the Project, as confirmed by the final measurements accepted by the City.

Item 1. Remove Contents of Existing Sludge Holding Tank—The Contractor shall furnish all labor, material, equipment, and services necessary to remove the settled grit, sludge, scum, rags, solids, and trash in the tank and wash down tank walls and floor to remove accumulations. The item includes but is not limited to removing, loading, transporting, and properly disposing of the tank contents including liquid, sludge, scum, rags, grit, hair, grease, solids, and semi-solids off site in accordance with applicable federal, state, and local regulations. The Contractor should expect manways may be required to access the tank, confined space conditions apply, and air ventilation and monitoring will be required to complete the work. The Contractor shall be paid based on the volume of material in the tank agreed upon by the Contractor, Engineer, and the Owner's Project Manager before the cleaning or removal of contents. Contractor to be paid based on the Cubic Yard volume agreed upon in the tank, not the volume removed, per the Contractor's Bid Item and Approved Schedule of Values and upon City verification.

### LUMP-SUM BID ITEMS

The bid lump sum shall be full compensation for all labor, equipment, and materials necessary for a full and completely operational installation. Measurement shall be based on the percentage complete for each application for payment.

Item 2. Mobilization, Demobilization, and General Conditions (Not to exceed 5% of the Base Bid)—This item shall include and cover the costs for performance of construction, preparatory, and overhead operations, including but not limited to movement of personnel and equipment to and from the site; sanitary facilities; project administration and management; insurance; bonds; City and Engineer indemnification; temporary utilities; establishing, maintaining, and monitoring a complete and comprehensive site health and safety program during the execution of the Construction Contract that complies with all local, state, and federal safety guidelines and laws; and all other similar activities and facilities necessary for executing this project. Health and safety are the sole responsibility of the Contractor. The Engineer will only be responsible for the safety of their personnel and facilities. This item shall not exceed 5% of the Base Bid amount. The Contractor will be paid 20% of this item upon completion of mobilization and 10% upon demobilization; the remainder will be prorated equally over the construction period.

Item 3. Demolition—The Contractor shall furnish all labor, materials, equipment, and services necessary to demolish, remove, and dispose of non-salvageable materials in accordance with the Contract Drawings. Any items demolished are the property of the Owner unless indicated otherwise. Contractor shall coordinate with the Owner on what items are to be kept and which are to be disposed of. This item includes the removal of any tank aeration piping remaining in the tank and penetrating outside of the tank, including associated supports. This item also includes the removal of the tank walkway, stairs, handrailing, associated supports, dewatering pumps, pads, piping, recirculation pump, pads, piping, concrete pads, hose bibbs, effluent water piping, and all associated appurtenances as indicated in Section 01100, Summary of Work, and the Contract Drawings. This item also includes all bypass pumping, temporary piping, electrical, instrumentation, and all associated items related to bypassing activities during construction. Contractor responsible for coordinating with Owner and Engineer to ensure bypass equipment containment and bypass plans are sufficient before implementing is allowed. Plug valves shall be removed, protected, and salvaged for future connection. Photographs should be taken to document the existing and final conditions of the Work. The items also include but are not limited to: dewatering, loading, hauling, excavation, disposal, filling, backfilling, compaction, grouting, and sodding all area disturbed by the Contractor's operations. Salvage of items shall be as directed in the Contract Documents. Loading and disposal of the construction debris shall be in accordance with applicable local, state, and federal regulations. Payment for this item will be made based on percent complete in accordance with the Contractor's approved Schedule of Values and upon Engineer verification.

Item 4. Existing Odor Control Piping, Stairs, and Sludge Holding Tank Walkway

Replacement—The Contractor shall furnish all labor, materials, equipment, and services for the repair and refurbishment of the odor control piping connection to the Sludge Holding Tank cover (including, but not limited to the painting, coating, and restoration of all FRP piping from the tank cover to the Dewatering Building) in accordance with the Contract Documents. The Contractor shall furnish all labor, materials, equipment, and services for the demolition and replacement of the stairs, supports, handrailing, and walkway over the Sludge Holding Tank with access ladders and harness tie-off points on the tank. The Contractor shall furnish all other labor,

materials, equipment, and services required to perform all requested work and shall coordinate with the manufacturers to verify the understanding of the requested work before submitting their Bid. Payment for this item will be made based on percent complete in accordance with the Contractor's approved Schedule of Values and upon Engineer verification.

**Item 5. Clean and Coat the Interior and Exterior of the Existing Sludge Holding Tank**—The Contractor shall furnish all labor, materials, equipment, and services for the cleaning and coating of the existing Sludge Holding Tank interior (walls and floor) and exterior (walls) to the satisfaction of the City. This item includes pressure washing to remove debris and all hardened deposits on the interior surface of the tank. This may require the tank to be manually scraped to remove muck or scale that is not removed from pressure washing. The tank shall be rinsed and dried to remove any excess material or liquid from the tank and otherwise prepare the tank for structural inspection. This item includes all concrete repair to the tank including cracks, bug holes, spalling, and any other deficiencies to the structural integrity of the tank. The Contractor shall notify the City 48 hours before the completion of the final rinse. The Contractor is responsible for dewatering the materials removed from the tank and adding chemicals, as necessary, for odor control of the tank contents to meet all federal, state, and local regulatory requirements. Water from the dewatering process can be conveyed to the head of the WRF provided it is of a quality no worse than the centrate or filtrate. Contractor shall coordinate with the City on obtaining the acceptable limits. Water required for dilution, wash down and related purposes will be available from the City's water reclaimed system. Following cleaning the interior and exterior of the tank, the existing interior and exterior coatings shall be removed and shall be painted and coated in accordance with the Contract Documents. The Contractor shall furnish all other labor, materials, equipment, and services required to perform all requested work and shall coordinate with the painting and coating manufacturers to verify the understanding of the requested work before submitting their Bid. Payment for this item will be based on percent complete in accordance with the Contractor's approved Schedule of Values and upon Engineer verification.

**Item 6. Sludge Holding Tank and Pump Station Equipment and Rehabilitation**—The Contractor shall furnish all labor, materials, equipment, and services required including, but not limited to, the installation of one mixer with baffles in the Sludge Holding Tank; a new aluminum cover with associated handrailing, stairs, and support; installation of the new Dewatering and Truck Off-Loading/Recirculation Pump Station, piping, valving, supports, elevated pad with grating, guard railing, access stairs, containment area, electrical equipment, anaerobic digester feed meter and belt filter press meter, drain inlets with associated piping, cleanouts, and fittings, hose bibbs with associated effluent flushing water piping, valves, and fittings, control panels, PLC, and any other associated appurtenances not addressed in Bid Items 1-5 which are located west of the Sludge Holding Tank as shown in the Drawings; and in accordance with the Contract Documents. The Contractor shall furnish all other labor, materials, equipment, and services required to perform all requested work and shall coordinate with the manufacturers to verify the understanding of the requested work before submitting their Bid. Payment for this item will be made based on percent complete in accordance with the Contractor's approved Schedule of Values and upon Engineer verification.

Item 7. Surveyor's Record Drawings—This item includes all costs for providing the services of a Professional Land Surveyor to perform pre-construction stakeout; establish vertical control; establish horizontal control, rights-of-way locations, and property boundary location; and provide Record Drawing information verification and certification in accordance with the Contract Documents and to the satisfaction of the Owner. The Contractor shall furnish all labor, materials, equipment, and services for composing and providing Record Drawings for the entire project in accordance with the Contract Documents, including but not limited to updating the electronic copy of the Drawings, identifying items that were revised during the project or addenda, having all Drawings signed and sealed by a Florida-licensed Professional Land Surveyor, and providing signed-and-sealed paper copies of the Record Drawings. The Contractor will be paid 40% upon initial project layout and 20% upon completion of the Record Drawings. The remainder will be prorated equally over the duration of construction.

Item 8. Owner's 10% Contingency—The Contractor shall furnish all labor, materials, equipment, and services to perform unforeseen work not included in the other Bid items that may be requested and approved by the Owner. The scope of work and cost of this additional work shall be agreed on in writing and approved by the Engineer before the work begins. The Contractor will be paid based on the percent completion of approved work.

### PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01290**  
**SCHEDULE OF VALUES**

**PART 1 GENERAL**

**1.01 RELATED WORK**

- A. Section III, General Conditions.
- B. Section 01000, Project Requirements.
- C. Section 01200, Measurement and Payment.
- D. Section 01650, Delivery, Storage, and Handling.
- E. Section 01780, Warranties and Bonds.

**1.02 SUBMITTALS**

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. To the Engineer, a proposed Schedule of Values allocated to the various portions of the Work, in accordance with Section 01000, Project Requirements, and Section 01200, Measurement and Payment.
- B. Upon request of the Engineer, supporting data which will substantiate the values' correctness.
- C. The accepted Schedule of Values shall be used only as the basis for the Contractor's Applications for Payment.
- D. An update and resubmittal of the Schedule of Values when Change Orders affect the listing or when the actual performance of the Work involves necessary changes of substance to values previously listed and approved.
- E. Schedule of Values.
  - 1. Submit typed schedule on EJCDC 1910-8-E forms provided by the Engineer. The Contractor's standard form or electronic media printout will be considered.
  - 2. Submit Schedule of Values in duplicate within 10 days after the date of Owner-Contractor Agreement.
  - 3. Format – Use the schedule of prices in the Bid Proposal. Show the cost breakdown for each lump-sum item. The lump-sum breakdown shall, at a minimum, use the Table of Contents of this manual outline. Identify each line item with the number and title of the major Specification Section.

- Identify site mobilization and demobilization, bonds and insurance,  
Record Drawings, photographs, and operations and maintenance manuals,  
etc.
4. For unit cost allowances, identify quantities taken from the Contract Documents multiplied by the unit cost to achieve the total for the item.
  5. Include within each line item a direct proportional amount of the Contractor's overhead and profit.
  6. Revise the schedule to list approved Change Orders with each Application for Payment.

#### 1.03 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

#### PART 2 PRODUCTS (NOT USED)

#### PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01300**  
**CONTRACT ADMINISTRATION**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. This Section sets forth some of the general project requirements.

**1.02 RELATED WORK**

- A. Section 01320, Progress Schedule.
- B. Section 01325, Construction Photographs.
- C. Section 01330, Submittals and Acceptance.
- D. Section 01650, Delivery, Storage, and Handling.
- E. Section 01780, Warranties and Bonds.

**1.03 SUBMITTALS**

- A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance.

**1.04 WARRANTIES**

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

**1.06 SCHEDULE CONTENT**

- A. The Contractor shall adhere to the requirements specified in Section 01320, Progress Schedule.

**1.07 REVISIONS TO SCHEDULES**

- A. The Contractor shall adhere to the requirements specified in Section 01320, Progress Schedule.

## 1.08 PROGRESS MEETINGS

- A. The Owner and Engineer will organize and conduct progress meeting at least once a month to discuss the progress of the Work. The Contractor and any subcontractors the Contractor deems necessary shall attend these meetings. At the Engineer's discretion, the frequency of the meetings may be increased if the progress of the Work is not satisfactory or if coordination problems should arise.

## 1.09 RECORD DOCUMENTS

- A. The Contractor shall adhere to the requirements specified in Section 01785, Record Documents.

## PART 2 PRODUCTS (NOT USED)

## PART 3 EXECUTION

### 3.01 GENERAL

- A. The Contractor shall employ a competent photographer to take construction record photographs during the Work.

### 3.02 REQUIRED PHOTOGRAPHS

- A. The Contractor shall adhere to the requirements specified in Section 01325, Construction Photographs.

END OF SECTION

**SECTION 01310**  
**CONSTRUCTION COORDINATION**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. The Contractor shall coordinate Work with that of other construction projects as needed.
- B. Before starting Work and from time to time as the Work progresses, the Contractor and each subcontractor shall examine the work and materials installed by others as it applies to its own work and shall notify the Engineer immediately in writing if any conditions exist which will prevent satisfactory results in the installation of the system. Should the Contractor or subcontractor start work without such notification, it shall be construed as an acceptance of all claims or questions as to the suitability of the work of others to receive its Work. The Contractor shall remove and/or replace, at its own expense, all work under this Contract which may have to be removed on account of such defects or omissions.

**1.02 RELATED WORK**

- A. Section 01000, Project Requirements.
- B. Section 01300, Contract Administration.
- C. Section 01320, Progress Schedule.
- D. Section 01330, Submittals and Acceptance.
- E. Section 01770, Project Closeout.

**1.03 SUBMITTALS**

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. The Contractor shall ensure that all drawings, product data, and samples comply with Contract Documents and field dimensions and clearances.
- B. The Contractor shall submit requests for interpretation of Contract Documents in a timely fashion to ensure there are no disruptions with the Work as scheduled. Obtain instructions through the Engineer to resolve all queries.
- C. Process requests for substitutions and Change Orders through the Engineer.
- D. Deliver close-out submittals to the Engineer.

## **1.04 WORK SEQUENCE**

- A. The Contractor shall submit a preliminary Progress Schedule, in accordance with Section 01320, Progress Schedule, to the Engineer. After review, the Contractor shall revise and resubmit the Progress Schedule to comply with requested revisions.

## **1.05 WARRANTIES**

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

## **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

## **1.07 CONSTRUCTION MOBILIZATION**

The Contractor shall do the following:

- A. Cooperate with the Owner in allocating mobilization areas on site for field offices and sheds, access, traffic, and parking facilities. During construction, the Contractor shall coordinate the use of the site and facilities through the Engineer.
- B. Comply with the Engineer's procedures for intra-project communications: submittals, reports and records, schedules, coordination drawings, recommendations, and resolution of ambiguities/conflicts.
- C. Comply with the Engineer's instructions for use of temporary utilities and construction facilities.
- D. Coordinate field engineering and layout work under instructions of the Engineer.
- E. Coordinate scheduling, submittals, and work of the various sections of Contract Documents to ensure the efficient and orderly sequence of installation of construction elements, with provisions for accommodating items to be installed later.
- F. Coordinate the sequence of Work to accommodate the Owner occupancy as specified in the Contract Documents.

- G. In addition to Progress Meetings specified in Section 01300, Contract Administration, hold pre-construction conferences with personnel and Subcontractors to ensure coordination of Work. The Engineer and Owner shall be informed of such meetings and shall be allowed to attend.
- H. Coordinate the Work of various sections having interdependent responsibilities for installing equipment, connecting equipment, and placing such equipment in service.
- I. Coordinate the use of project space and the sequence of installing civil, architectural, mechanical, structural, instrumentation, systems, and electrical work. Follow practicable routings for pipes, ducts, and conduits, with due allowance for available physical space; make runs parallel with lines of building. Use space efficiently to maximize accessibility for other installations, maintenance, and repairs.
- J. Coordinate Work at existing facilities to minimize disruption of the Owner's operations.
- K. Assemble and coordinate close-out submittals specified in Section 01770, Project Closeout.

## 1.08 COORDINATION DRAWINGS

- A. The Contractor shall provide information required by the Engineer for preparing coordination drawings.
- B. The Contractor shall review drawings before submitting them to the Engineer.

## 1.09 CLOSE-OUT PROCEDURES

The Contractor shall do the following:

- A. Notify the Owner when Work is considered ready for Substantial Completion.
- B. Comply with the Owner's instructions to correct items of Work listed in executed Certificates of Substantial Completion.
- C. Notify the Owner when Work has reached Final Completion.
- D. Comply with the Owner's instructions for completing items of Work found incomplete in the Engineer's final inspection.
- E. Comply with Section 01770, Project Closeout.

## PART 2 PRODUCTS (NOT USED)

## PART 3 EXECUTION

### 3.01 GENERAL

- A. All vehicles on the property or easement must be operational.
- B. All personnel on the property are to be informed of line voltage and necessary changes.

### 3.02 UTILITIES

- A. The Contractor shall coordinate the activities of all utility companies with equipment in the construction area with the Contractor's and Subcontractor's Work.

### 3.03 CUTTING AND PATCHING

- A. No cutting and patching of new Work will be accepted. All Work must be new and continuous in its final form.

END OF SECTION

**SECTION 01320**  
**PROGRESS SCHEDULE**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. All work of this Contract shall be scheduled and monitored by the Contractor using the Critical Path Method (CPM) and shall use the Precedence Diagram Method (PDM) of scheduling. The Contractor shall prepare all schedules and all monthly updates described in this Section. The Contractor will prepare revisions of the schedule to reflect changes in the Contractor's plan of performance or changes in the Work and submit these revisions to the Engineer for acceptance. The Engineer's acceptance of the scheduling documents is to ensure that all CPM Scheduling documents prepared by the Contractor are in conformance with the Contract Documents and Specifications described herein. This acceptance will not impose on the Engineer or Owner the responsibility for the schedule or for the sequencing, scheduling, or progress of the Work, nor will the acceptance interfere with or relieve the Contractor of full responsibility for the schedule and the means, methods, procedures, and sequence of construction.
- B. The Contractor shall use the latest version of Primavera Scheduling software, or an approved equal, for all CPM Scheduling applications.
- C. The Engineer or Owner may retain the professional services of a CPM Scheduling Consultant to assist in the review and acceptance of the CPM Scheduling documents prepared by the Contractor. Therefore, any reference to the Engineer or Owner within this Section may also indicate the involvement of the Engineer's or Owner's CPM Scheduling Consultant.
- D. The Contractor shall prepare and maintain a detailed progress schedule throughout the construction of the Project. The schedule shall be the Contractor's working schedule and be used to plan, organize, and execute the Work, record and report actual performance and progress, and show how the Contractor plans to complete the Work. The schedule will be in the form of an activity-oriented network diagram (Critical Path Method).
- E. When the Contractor prepares the CPM Schedule and the schedule is accepted by the Engineer, it shall become part of the Contract Documents and will be used by Contractor and Engineer to monitor the progress of the Project. The CPM Schedule may be revised to show changes in the Contractor's method or manner of performance; delays, or authorized changes in the Work. All changes to the schedule will be made in accordance with Article 1.12 of this Section.

F. The Contractor acknowledges that free float belongs to the Owner.

## 1.02 RELATED WORK

- A. Section 01330, Submittals and Acceptance.
- B. Section 01650, Delivery, Storage, and Handling.
- C. Section 01780, Warranties and Bonds.

## 1.03 SUBMITTALS

- A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance.

## 1.04 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

## 1.05 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

## 1.06 QUALIFICATIONS

- A. To help prepare the detailed CPM Schedule, the Contractor shall engage at his own expense a Consultant who is skilled in the time-and-cost application of network techniques for construction projects. If the Contractor has qualified personnel on staff, the Contractor can perform the required scheduling within his own organization.
- B. The person performing the CPM scheduling shall have a minimum of 3 years of CPM scheduling experience within the past 5 years on projects of similar size and complexity.
- C. Before engaging a Consultant or using in-house staff personnel and within 5 calendar days after Award of Contract, the Contractor shall submit the following to the Engineer:
  1. The name and address of the proposed Consultant or employee who will prepare the CPM schedule.

2. Sufficient information to show that the proposed Consultant or employee has the above qualifications including a list of prior construction projects of similar size and complexity, along with selected network samples, which the proposed Consultant or employee has performed. These network samples must show complete project planning similar to that required under this Contract.
- D. The Engineer shall have the right to approve or disapprove employment of the proposed Consultant or the performance of the requirements herein by the Contractor's employee and will notify the Contractor of the decision within 7 calendar days from receipt of the information. If the proposed Consultant is rejected, the Contractor shall resubmit another name within 7 calendar days for renewed consideration. Such approval or disapproval does not release the Contractor from his obligations under this Contract.
- E. If the Owner or Engineer has reasonable objections to the qualifications of the Contractor's nominated scheduling personnel, the Contractor shall, at no additional cost to the Owner, employ a scheduler whose qualifications comply with the requirements of this Section or employ a qualified subcontractor, subject to review of his qualifications by the Engineer and the Owner.

## 1.07 PRELIMINARY 90-DAY CPM SCHEDULE

- A. The Contractor shall develop a 90-Day CPM Schedule within 10 days after the date indicated in the Notice to Proceed. This schedule shall be a computerized CPM Schedule showing only the early start, early finish of each work activity. The 90-Day Schedule shall contain work activities over the first 90 days, and the estimated durations for each work activity shall be 15 workdays or less. The balance of the job shall be shown in summary log. The 90-Day Schedule shall include but not be limited to site work, hazardous material removal, demolition, key procurement activities (i.e. submissions, approvals, fabrication, and delivery), equipment, mechanical, electrical, and plumbing coordination and any other work that will occur during the first 90 days. This 90-Day Schedule shall become part of the Detailed CPM Schedule.

## 1.08 DEFINITIONS

The following terms used in this Section shall have the following meanings:

- A. *Activity.* A fundamental unit of work in a CPM Schedule establishing the time and resources required for performing or furnishing a part of the Work or a requisite step. Each Activity has defined geographical boundaries, time duration in days, and a detailed estimate of resources required to construct the task. Each activity is assigned a unique description, activity number, activity code, and a dollar value.

- B. *Record Schedule.* The Record Schedule will have actual start dates and actual finish dates for all work Activities and Milestones necessary to complete the Work.
- C. *Baseline Schedule.* The Engineer-accepted Proposed Baseline Schedule. The Baseline Schedule is the Contractor's plan which has been approved by the Engineer for completion of the Work in compliance with the Milestones listed in the Contract Documents and within the Contract Time. The Baseline Schedule may be revised only by the Engineer's approval of a Contractor-produced adjusted Baseline Schedule. The Baseline Schedule for the Work is the sole basis for (a) the monitoring of the Contractor's progress against Milestones and the Contract Time; (b) calculating Total Float or Contract Float; and (c) the evaluation and reconciliation of extensions in Contract Time, if any. The first Baseline Schedule shall be designated by all parties as the Baseline Schedule, Rev. 0. When Baseline Schedules are adjusted by the Contractor and approved by the Engineer, they shall be designated as Baseline Schedule, Rev. 1, 2, 3, etc. (as appropriate) and shall replace the previously approved Baseline Schedule.
- D. *Contract Float.* Workdays between the Contractor's anticipated date for early completion of the Work, or specified part, and the corresponding Contract Time.
- E. *CPM Network.* The structure of the computerized schedule. The CPM Network accounts for the entire Work and defines the construction logic in terms of all of the Activities with their logical dependencies.
- F. *Critical Path.* A series of Activities linked by dependencies that determine the shortest possible time to complete the Work.
- G. *Early Dates.* The early start dates and early finish dates, i.e., the dates each Activity will start and finish if each is started at the earliest end of the range of dates that the CPM indicates the Activities can be performed.
- H. *Excusable Delay.* An unforeseeable delay, beyond the control of the Contractor, experienced due to no fault or negligence by the Contractor, its subcontractors, or suppliers.
- I. *Free Float.* The amount of time that any activity can be delayed without adversely affecting the early start of the following activity.
- J. *Fragnet.* A predefined or individual segment of a network which represents a specified sequence of the Work. Fragnets shall be submitted which include all Activities, required resources, and costs and shall be submitted to the Engineer for approval of all Change Orders before their incorporation into the Baseline

Schedule by the Contractor. A Fragnet shall be submitted before approval of any proposed logic changes. Fragnets are banded Activities representing a revised portion of the Baseline Schedule and shall be logically connected and constrained by previously existing predecessor and successor Activities, as applicable.

- K. *Late Dates.* The late start dates and the late finish dates; i.e., the dates each Activity will start and finish if each is started at the latest end of the range of dates that the CPM Network indicates the Activities can be performed and still achieve the Milestones and Contract Time.
- L. *Milestone.* A point of progress designated for the purpose of establishing start or finish times for a key aspect of the Work.
- M. *Predecessor Activity.* An Activity which precedes another Activity (to which it is logically tied) in the CPM Network.
- N. *Preliminary Schedule.* The Contractor's Baseline Schedule for the first 180 days of the Contract.
- O. *Proposed Baseline Schedule.* The Proposed Baseline Schedule shall represent the Contractor's plan for completion of the Work in compliance with Milestones listed in the Contract Documents and within the Contract Time. It represents the Contractor's first complete planned schedule submitted for review and approval by the Engineer. The Proposed Baseline Schedule shall take into account all foreseeable activities to be accomplished by any separate contractors, utility owners, or the Owner's operations. The Proposed Baseline Schedule shall anticipate all necessary manpower and resources to accomplish activities within the durations set forth in the Proposed Baseline Schedule. The Proposed Baseline Schedule shall address and indicate all submittals required by the Contract and indicate the times allowed for review, resubmittal, and approval of submittals. Upon approval by the Engineer, the first Proposed Baseline Schedule shall become the Baseline Schedule, Rev. 0.
- P. *Resource Loading.* The allocation of work force and equipment necessary for the completion of an Activity as scheduled.
- Q. *Six-Week Schedule.* A detailed progress schedule taken from the Working Schedule, which discloses the plan for the next 6 weeks' Work and the actual schedule for the previous 6 weeks' Work.
- R. *Successor Activity.* An Activity which follows another Activity (to which it is logically tied) in the CPM Network.

- S. *Total Float.* The number of workdays by which a part of the Work in the Baseline Schedule or Revised Baseline Schedule may be delayed from its Early Dates without necessarily extending the Contract Time.
- T. *Working Schedule.* When the Proposed Baseline Schedule (or a subsequent adjustment is made by the Contractor to the Baseline Schedule) is accepted by the Engineer and becomes the Baseline Schedule, Rev. 0, 1, 2, 3, etc., it shall be duplicated and become the Working Schedule. The Contractor shall update the Working Schedule monthly with a Data Date designated by the Engineer. The Working Schedule shall be updated monthly to reflect actual progress only and shall be the basis for determining monthly progress payments and the Contractor's performance in relation to the most recently approved Baseline Schedule. The Final Working Schedule shall be the Record Schedule.

## 1.09 DETAILED CPM SCHEDULE

- A. The Detailed Network Diagram shall provide sufficient detail and clarity of form and technique so that the Contractor can plan, schedule, and control his work properly and the Engineer can readily monitor and follow the progress for all portions of the Work. The Detailed Network Diagram shall comply with the Contract Times of the Agreement and various limits imposed by the Contract Documents, including required sequencing of portions of the Work described in Section 01100, Summary of Work. The degree of detail shall be to the satisfaction of the Engineer, but the following factors shall have a bearing on the required depth of activity detail:
  1. The structural breakdown of the Project.
  2. Project Phasing and/or Milestones.
  3. The type of work to be performed and the labor trades involved.
  4. All purchase, manufacture, and delivery activities for all major materials and equipment.
  5. Maintenance of Facilities in Operation.
  6. Submittal and approval of shop drawings and material samples.
  7. Plans for all subcontract work.
  8. Crew flows and sizes.
  9. Assignment of responsibility for performing all activities.
  10. Access and availability to work areas.
  11. Identification of interfaces and dependencies with preceding, concurrent, and follow-on subcontractors and contractors.
  12. Testing and start-up of systems.
  13. Planning for phased takeover by the Owner.
- B. Activities shown shall be in workdays and shall have a maximum duration of 5 days, except in the case of non-construction activities such as procurement of

materials and delivery of equipment. All durations shall be the result of definitive manpower and resource planning by the Contractor.

- C. The Detailed Network Diagram shall be prepared using a computer plotter.

#### 1.10 COMPUTERIZATION OF THE DETAILED CPM SCHEDULE

- A. The mathematical analysis of the Detailed Network Diagram shall be made by computer, and a tabulation for each activity shall include the following:

1. Unique event numbers.
2. Activity descriptions.
3. Durations in workdays for each activity.
4. Earliest start date (by calendar date).
5. Earliest finish date (by calendar date).
6. Latest start day (by calendar date).
7. Latest finish day (by calendar date).
8. Slack or total float in workdays.
9. Percentage of activity completed.

- B. The following computer outputs shall be prepared as part of the initial schedule submission and each update thereafter:

1. Activity file sort.
2. Eight-week “Look Ahead” detailed bar chart.
3. Summary bar chart.
4. Additional computer sorts as required by the Owner.
5. CDs of all computer files.
6. Items 1 through 4 above, submit seven (7) copies of each.

#### 1.11 COMPLETION REQUIREMENT

- A. The 90-Day Schedule shall be completed within 10 calendar days after the date indicated in the Notice to Proceed.
- B. The Detailed CPM Schedule shall be prepared within 30 calendar days after the date indicated in the Notice to Proceed.
- C. If the Contractor fails to provide the required CPM scheduling documents to the Engineer within the time prescribed and/or revisions of the scheduling documents within the required time, the Contractor shall be in default of the Contract requirements and the Engineer may withhold approval of progress payments until such time as the Contractor submits the required information.

- D. Notwithstanding the implementation of the Progress Schedule, it shall be the sole responsibility of the Contractor to complete the Work within the time of completion required by the Contract.

## 1.12 UPDATINGS

- A. The 90-Day CPM Schedule shall be updated monthly until the Engineer accepts the Detailed CPM Schedule.
- B. The first update of the Detailed CPM Schedule shall take place 60 calendar days after the Notice to Proceed with subsequent updates performed monthly at the jobsite for the duration of the contract.
- C. The Contractor shall update the Detailed CPM Schedule monthly, using a cutoff/data date agreeable to the Contractor and the Engineer. This cutoff/data date shall be consistent from month to month. The update information shall include but not be limited to the following:
1. Actual start dates.
  2. Actual completion dates.
  3. Activity percent completion.
  4. Remaining duration of activities in progress.
- D. The Contractor shall update all the scheduling documents and submit these documents to the Engineer within 5 workdays of the cutoff/data date.
- E. The Contractor shall submit seven copies of the CPM schedule and one electronic copy of the CPM schedule on a CD.
- F. As part of the normal CPM update, the Contractor shall prepare a written narrative report highlighting the progress during the past update period. The written narrative report shall include but not be limited to the following information:
1. Summary of work accomplished during the past update period.
  2. Milestone Comparison Chart.
  3. Analysis of Critical Path(s).
  4. Analysis of Secondary Critical Path(s). Secondary Critical Path is defined as float within 10 workdays of Critical Path.
  5. Analysis of time lost/gained during the update period.
  6. Identification of problem areas.
  7. Identification of change orders and/or any delay that is impacting/delaying the project schedule.
  8. Solutions to current problems.

- G. The Contractor is required to attend and participate in a CPM update review meeting with the Engineer. Attendance is mandatory. This meeting will take place 7 workdays after the cutoff/data date, or during progress meetings as decided by the Owner and the Engineer. The purpose of this meeting is to review past progress, current status, problem areas, and future progress. The Contractor's narrative report will be reviewed at this meeting.
- H. All schedule update information outlined above will be reviewed and accepted by the Engineer.

#### 1.13 RECOVERY SCHEDULE

- A. If the Contractor fails to achieve the planned progress, as indicated in the approved/updated detailed CPM Schedule, and the Contractor's lack of progress delays the Critical path and/or an intermediate milestone by more than 10 workdays (monthly or cumulatively), the Contractor shall submit to the Engineer for review and acceptance a proposed Recovery Schedule indicating how the Contractor will recover the time lost.
- B. If the Contractor fails to submit a Recovery Schedule and/or fails to cooperate with the Engineer in the Recovery Schedule process, the Owner can immediately order the Contractor to accelerate completion of the late activities which have been delayed by whatever means necessary without any additional costs to the Owner. The Owner can withhold future progress payments until the Contractor's progress is in compliance with the Contract Schedule or until the Owner has approved by Change Order proposed adjustments to the contract milestones, extension of contract time, or modification of the Contract Schedule.

#### 1.14 CHANGE ORDERS, DELAYS AND EXTENSIONS OF TIME

- A. When proposed Change Orders, approved Change Orders, or any delays are experienced and the Contractor believes the Change Order/Delay is causing delay to an intermediate contract milestone or to the project completion, the Contractor shall submit to the Engineer a Time Impact Analysis, explaining the influence of each Change Order/Delay on the current updated Contract CPM Schedule. The Contractor shall prepare a "Fragnet" (network analysis) of each Change Order/Delay on the current updated Contract CPM Schedule. The analysis will demonstrate the time impact based on the date the change is given to the Contractor, the status of construction at that point in time, and the event time computation of all affected activities. The event times used in the analysis shall be those included in the latest updated copy of the detailed CPM Schedule closest to the time of delay or as accepted by the Engineer.

- B. For the Contractor to be entitled to an extension of Contract time to an intermediate contract milestone and/or to the project completion, the Time Impact Analysis must show that the Change Order/Delay impacts the intermediate contractual milestone date and/or the updated CPM Schedule's Critical Path, thereby directly impacting the project completion date. Change Orders/Delays that do not impact intermediate contractual milestones and/or the critical path and impact activities with float will not be considered as a delay to the project and no extension of time will be granted.
- C. The Contractor must submit a written analysis within 7 calendar days after a delay occurs or authorized change in work is given to the Contractor. If the Contractor does not submit a written analysis for specific Change Order(s) or Delay(s) within the specified period, then it is mutually agreed that the particular Change Order or Delay has no time impact on the Project CPM Schedule and no time extension is required.
- D. The Engineer will accept or reject each Time Impact Analysis within 14 calendar days after submission, unless subsequent meetings and negotiations are necessary. Upon the Engineer's acceptance, the Contractor will incorporate fragnets illustrating the influence of the Change Orders and Delays into the Detailed CPM Schedule during the first update after agreement is reached.

## PART 2 PRODUCTS (NOT USED)

## PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01325**  
**CONSTRUCTION PHOTOGRAPHS**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. The Contractor shall have digital pictures, photographs, and DVDs made of the Work from views and at such times as directed by the Engineer. These photographs shall represent a visual history of the Project, from Contract Award through Contract Completion.
- B. The Contractor shall take a preconstruction video of the entire site, including the areas of adjacent areas of the site within 100 feet of the limit of Work. Special effort shall be made to show the existing paved roads, shoulders, signs, and other existing features.
- C. The Contractor shall also use electronic “snap-shot” photography as necessary to record and facilitate resolution of on-site issues through the transmission of electronic photographs by e-mail from the site to the Engineer’s and Owner’s offices.

**1.02 RELATED WORK**

- A. Section 01000, Project Requirements.
- B. Section 01650, Delivery, Storage, and Handling.
- C. Section 01780, Warranties and Bonds.
- D. Section 01785, Record Documents.

**1.03 WARRANTIES**

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

**1.04 DELIVERY, STORAGE, AND HANDLING**

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

## PART 2 PRODUCTS

### 2.01 PRODUCTS

- A. Photographs shall be digital and in color. Provide one copy of each digital picture on each of three CDs.
- B. Provide photographs taken of each of the major items during construction.
- C. View and Quantities Required: A minimum of 30 photographs per month clearly showing project status and key elements of construction.
- D. Deliver electronic images to the Engineer with every pay request.
- E. Capture and provide digital, true-color, aerial photographs and videos of the complete project site before beginning construction, during construction, and at final completion. The aerials shall be captured digitally using a drone with high-quality camera.
- F. Provide and update aerial photographs monthly, providing two copies on disk. Each month provide aerial photographs taken at the same elevation and orientation. Provide up to four views to show the complete site progress.

## PART 3 EXECUTION

### 3.01 VIEWS REQUIRED

- A. Photographs shall be from locations to illustrate the condition of construction and the state of progress adequately.
- B. The Contractor shall provide before and after photographs of each portion of the site. The below-ground facilities shall include all equipment, walls, floor, piping, supports, and entrance. At major location photographs shall include before, during, and after photographs and all photographs shall be placed in ascending date order when submitted to show the Work as it progresses.

### 3.02 DESCRIPTIVE INFORMATION

- A. Each digital photograph shall be date and time stamped.
- B. The Contractor shall provide the Engineer with a written description of each photograph. The description shall be submitted with the CDs and shall contain the

information described below. The Field Engineer or inspector shall approve the description.

***COMPLETE PROJECT NAME***

Contract No.

|             |                                    |
|-------------|------------------------------------|
| CONTRACTOR: | (Name of Contractor)               |
| DATE:       | (When photo was taken)             |
| PHOTO NO.:  | (Consecutive Numbers)              |
| PHOTO BY:   | (Firm Name of Photographer)        |
| LOCATION:   | (Description of Location and View) |

### 3.03 VIDEOTAPE REQUIREMENTS

A. Major Locations:

1. The Contractor shall provide color digital video of each major facility and structures and facilities adjacent to the construction before construction starts, during construction, and when construction has been completed. Approximately every 2 weeks, 15 minutes of digital video shall be submitted to the Engineer showing Work completed, Work in progress, Work started, and problems that occurred since the last taping. The Contractor shall maintain the master video CD ROM of each portion of the facility on the Work site. The master video shall be a running chronicle of construction progress. The Contractor shall combine the bi-weekly video onto the master video. The bi-weekly video shall be submitted to the Engineer within 10 working days after recording and the bi-weekly videos may include multiple locations.
2. All videos shall be recorded with character generator operating with date, time, and location on screen. During video recording, the Contractor shall narrate the video, explaining what is being shown, the problem that has occurred, and what is being done. All videos shall be delivered to the Engineer before Final Completion is submitted.

### 3.04 DIGITAL PHOTOGRAPH DOCUMENTATION

- A. Catalog and manage Electronic “snap-shots” and images of photographs in a secure digital photograph management system capable of being linked to the project schedule and document management database. Add captions, descriptions, and key words. Transfer a copy of all “snap-shots” and photographs with their related notes, keywords, captions, and activity IDs to the Engineer weekly.
- B. All photographs shall be clear, sharp, and free of distortion after enlargement.

END OF SECTION

**SECTION 01330**  
**SUBMITTALS AND ACCEPTANCE**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. The Contractor shall submit documentation that describes the Work to be performed under the Contract as required in this Section. This documentation will be for the Engineer and Owner's review and use. The documentation furnished by the Contractor must enable the Engineer and Owner to verify the Contractor's performance and compliance with Contract requirements. The documentation shall cover all services and deliverables required and secured by the Contract Documents.

**1.02 RELATED WORK**

- A. The Contractor shall prepare documentation and submittals required by other sections of the Contract. The format of documents and submittals required by other sections shall conform to the requirements of this Section.
1. Section III, General Conditions.
  2. Section 01785, Record Documents.
  3. Section 01820, Training.
  4. Section 01830, Operations and Maintenance Manuals.
  5. All Sections and Divisions that require submittal of documents.

**1.03 SUBMITTALS**

- A. General—The Contractor shall submit the following:
1. Project documentation: For the Engineer and Owner's internal use and shall include all information that will be essential for the facility's operations, maintenance, training, and repair of equipment and facilities supplied by the Contractor. The Contractor shall submit all documentation necessary to ascertain compliance with technical/contractual provisions.
  2. Shop drawings: Drawings, schedules, diagrams, warrant, and other data prepared specifically for this Contract by the Contractor or through the Contractor by way of subcontractor, manufacturer, supplier, distributor, or other lower-tier contractor to illustrate a portion of the Work.

3. Product data: Preprinted materials such as illustrations, standard schedules, performance charts, instructions, brochures, diagrams, manufacturer's descriptive literature, catalog data, and other data to illustrate a portion of the Work, but not prepared exclusively for this Contract.
4. Samples: Physical examples of products, materials, equipment, assemblies, or workmanship that are physically identical to portions of the Work, illustrating portions of work, or establishing standards for evaluating appearance of finished work or both.
5. Administrative submittals: Data presented for reviews and acceptance to ensure that administrative requirements of the project are adequately met but not to ensure directly that work is in accordance with the design concept and in compliance with Contract Documents.
6. Mockups: Before installing work requiring mockups, the Contractor shall build mockups for each form of construction and finish required using materials indicated for the completed Work, as follows:
  - a. Build mockups in the location and of the size directed by the Engineer.
  - b. Notify the Engineer 7 days in advance of dates and times when mockups will be constructed.
  - c. Demonstrate the proposed range of aesthetic effects and workmanship.
  - d. Obtain the Engineer's acceptance of mockups before starting work, fabrication, or construction.
  - e. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  - f. Demolish and remove mockups when directed by the Engineer.

#### B. Coordination

1. Submittals and schedules shall be checked and coordinated with the Work of all trades involved before they are submitted and shall bear the Contractor's stamp of approval as evidence of such checking and coordination. Drawings or schedules submitted without this stamp of approval shall be returned to the Contractor for resubmission.

#### C. Start of Work

1. Within 30 calendar days after the notice to proceed for the project, the Contractor shall submit to the Engineer a Contract Data Requirements List that defines all data to be submitted under this Contract. Included in this

list shall be the names of all proposed manufacturers furnishing specified items to the extent known. Review of this list by the Engineer shall in no way relieve the Contractor from providing materials, equipment, systems, and structures fully in accordance with the Specifications.

#### D. General Requirements

1. The Contractor shall prepare, assemble, and submit all documents as described herein. The Contractor shall submit certification that the documents prepared conform to the Contract requirements and will result in a complete and operable project. The Engineer and Owner shall review the Contractor's documents for conformance to the Contract requirements and may comment on the documents.
2. The Contractor shall approve and certify all project documents. The Contractor's failure to certify the documents or failure to provide documents that demonstrate conformance to the Contract requirements are grounds for rejection. The Contractor shall be responsible for and bear all costs for proceeding with any part of the Work that fails to meet the Contract requirements.
3. Submittal of documents for the Engineer's review shall in no way relieve the Contractor of full responsibility for providing a complete, safe, reliable, operating, and coordinated Work (system/equipment/facilities) that is in compliance with these Contract documents.

#### E. Requests for Substitution

1. All requests for substitution shall clearly and specifically indicate any and all differences or omissions between the products specified as basis of design and the product proposed for substitution. Data shall include but not be limited to differences as follows for both the specified and substituted products:
  - a. Principle of operation.
  - b. Materials of construction or finishes.
  - c. Thickness or gauge of materials.
  - d. Weight of item.
  - e. Deleted features or items.
  - f. Added features or items.
  - g. Changes in other work caused by the substitution.
  - h. If the substitution contains differences or omissions not specifically called to the attention of the Engineer, the Engineer reserves the right to require equal or similar features to be added to the substituted product at the Contractor's expense.

F. Submittal Requirements and Procedures

1. Drawing Formats and Requirements

- a. Drawings shall comply with City CAD standards as specified in Section 6.11.3.
- b. Drawings—All Drawings and Shop Drawings shall be prepared on 24-x-36-inch paper and shall have a blank area of 3 x 4 inches in the lower right-hand corner above the title block. Each Drawing shall indicate the following information in the title block:
  - (1) Title and Drawing Number.
  - (2) Date of Drawing or Revision.
  - (3) Name of Building or Facility.
  - (4) Name of Contractor or subcontractor.
  - (5) Drawing contents and locations.
  - (6) Specification Section and Subsection numbers.
- c. Required Copies—All drawings submitted shall have a minimum of eight copies distributed in the following way:
  - (1) 2—Owner.
  - (2) 4—Jones Edmunds.
  - (3) 2—Returned.

2. Product Data

- a. Requirements—Product data shall include all catalog cuts, performance surveys, test reports, equipment lists, material lists, diagrams, pictures, and descriptive material. All product data shall be submitted on either 8.5-x-11-inch or folded 11-x-17-inch size paper of 20-lb (9.072 kg) weight. The submittal information shall show the standard and optional product features, as well as all performance data and specifications. The manufacturer's recommendation for special tools shall be supplied.
3. Samples—The Contractor shall furnish samples required by the Contract Documents, for review by the Engineer. Samples shall be delivered to the Engineer as specified or directed.
  - a. All samples shall be of sufficient size and quantity to illustrate clearly the functional characteristics of the product, with integrally related parts and attachment devices. The samples shall show the full range of color, texture, and pattern.

- b. The Contractor shall submit a minimum of one sample of items submitted. All samples shall be marked with required submittal information, as specified above.

4. Color, Texture, and Pattern Charts

- a. The Contractor shall submit color, texture, or pattern charts of all required finishes.
- b. A minimum of one chart of each item shall be submitted.

5. Submittal Information Requirements

- a. When used in the Contract Documents, the term "Submittal Information" shall be considered to mean the following information at a minimum:
  - (1) Contract Name.
  - (2) Contract Number.
  - (3) Location within Facility.
  - (4) Date Submitted.
- b. Drawings—The Contractor shall mark submittal information on all Drawings in the left half of the 4-x-3-inch block as described above.
- c. Product Data and Manufacturer's Literature—The Contractor shall mark all product data and manufacturer's literature with submittal information and note which item is being furnished. The Contractor shall mark the option and supplies to be furnished with the item. At least one original manufacturer product data sheet must be submitted; the balance can be copied. Do not submit the manufacturer's general catalog: submit only items being installed or delivered. When manuals are being submitted, the Contractor shall mark submittal information on both the cover and title page. If manuals being submitted contain more than just one item, each item must be marked and only Contract name and number is to be marked on the cover and title page.

6. Training, Operation and Maintenance Manuals

- a. The Contractor shall submit to the Engineer for review and acceptance of manufacturer's installation, operations, lubrication, maintenance, and training manuals for all equipment installed or delivered under this Contract. All manuals shall have submittal

information marked on the front cover, title page, and three places inside the manual. If the manual being submitted is for different components, mark the front cover and title page only. Each component section must be marked with the Specification Section and Subsection numbers. Operations and Maintenance Manuals shall conform to requirements defined in Sections 01830, Operations and Maintenance Manuals, and 01820, Training.

## G. Required Submittals

1. Architectural and Structural Submittals
  - a. This Section specifies general procedural requirements for contractual submittals for the following architectural and structural schedules, product data, samples, and manufacturer's certificates.
    - (1) Product Data—The Contractor shall provide product data for all architectural and structural items, options, and other data and provide supplemental manufacturer's standard data for information unique to the Work and installation. The submittals shall reflect all items delivered or installed under this Contract.
    - (2) Samples—The Contractor shall provide all samples required under this Specification including color charts and product samples.
    - (3) Material, equipment, and installation and demolition Specifications.
2. Mechanical and Electrical System Submittals
  - a. This Section specifies general procedural requirements for mechanical schedules, performance data, control diagrams, and other submittal data.
  - b. The Contractor shall submit the following:
    - (1) Performance Data.
    - (2) Power and Riser Diagrams—Single line riser, power diagrams, and all conduit runs shall be provided for all equipment and facilities.
    - (3) Wiring Diagrams—Elementary controls diagrams and separate wiring diagrams for mechanical and electrical

unit/subsystem. Drawing for starting and shutdown of equipment including controls shall be provided, including a comprehensive description of operation.

- (4) Finished Data—Complete surface preparation and finished data for all mechanical and electrical unit/subsystems shall be provided, including a complete list of cleaning instructions.
- (5) Factory Testing—Detailed description of factory testing procedures, reporting procedures and criteria for test passing or failing shall be provided for all mechanical and electrical units/subsystems. Testing shall comply with the General Requirements and Technical Requirements Sections.
- (6) Site (Field) Testing and Acceptance—Detailed description of site testing and acceptance tests including descriptions of procedures, testing equipment, reporting procedures, and criteria for passing or failing tests shall be provided for all mechanical and electrical units/subsystems. Testing shall comply with General Requirements and Technical Requirements.
- (7) Factory Test Report—After fabrication and testing, the Contractor shall submit the results of tests. No shipment of any mechanical and electrical unit/subsystem shall be allowed without the written certification from the Contractor that the equipment conforms to the Contract requirements.
- (8) Site Test and Acceptance Report—Site test and acceptance reports shall be submitted to the Owner and Engineer.
- (9) Operations and Maintenance Manuals—The Contractor shall furnish manuals for all mechanical and electrical equipment specified under this Contract. Each manual shall include the following at a minimum:
  - (a) Description of equipment.
  - (b) Record shop drawing.
  - (c) Operation and maintenance instructions.
  - (d) Part lists.
  - (e) Equipment ratings.

- (f) Valve list.
  - (g) Lubrication instructions.
- c. Compliance with this Section does not relieve the Contractor from compliance with the requirements of Section 01830, Operations and Maintenance Manuals.

## H. Submittal Review

1. The Engineer's review of the Contractor's documents shall not relieve the Contractor of the responsibility for meeting all of the requirements of the Contract nor of the responsibility for correcting the documents furnished. The Contractor shall have no claim for additional cost or extension in time because of delays due to revisions of the documents that may be necessary for ensuring compliance with the Contract.
2. The Engineer will review a submittal or re-submittal once, after which the cost of review shall be borne by the Contractor. The cost of Engineering shall be equal to the Engineer's full cost.
3. No partial submittals will be reviewed. A submittal or re-submittal not complete will be returned to the Contractor for completing and re-submittal.
4. Documents submitted by the Contractor for approval by the Engineer will be returned bearing a project-specific stamp bearing the dated signature of the reviewer and one of four boxes checked:
  - a. NO EXCEPTIONS NOTED—This indicates that the submittal appears to be in compliance with the requirements of the performance specifications and that the Work may proceed.
  - b. MAKE CORRECTIONS NOTED—This indicates that the reviewer has added a minor correction to the submission and that the Work (modified in accordance with the correction comment) may proceed. The Contractor shall accept the responsibility of the modified document and resulting Work with no additional compensation.
  - c. AMEND AND RESUBMIT—This indicates that the submittal will require Contractor modifications based on the reviewer's comments that accompanied the returned submittal. The Contractor will be cautioned that work may not proceed under this review status.
  - d. REJECTED—This indicates that the submittal is not in conformance with the requirements of the performance Specifications and cannot be modified to gain compliance. A new submittal will be required in the instance of a "reject" status and the Contractor will be cautioned that work may not proceed under this condition.

## 1.04 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

## 1.05 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

## PART 2 PRODUCTS (NOT USED)

## PART 3 EXECUTION

### 3.01 SUBMITTAL PROCEDURES

- A. Before submitting documents for the Engineer's review, the Contractor shall review the documentation for conformance to the Contract requirements. Submittals shall be complete and comprise a logical division of the Contract Work.
- B. All documentation submitted by the Contractor to the Engineer shall be accompanied by a letter of transmittal and shall be submitted in a sequence that allows the Engineer to have all of the information necessary for checking and accepting a particular document at the time of submittal.
- C. Each document shall be identified by a document number, Contract number, Contract name, location, Specification Section, Subsection numbers, and submittal date. Where a manual/drawing is revised to reflect a change in design or a change for any other reason, each such revision shall be shown by a revision number, date, and subject in a revision block. Indication of official approval by the Contractor's Project Manager shall also be included. To permit rapid location of the revision, additional notation shall be made in the manual opposite the line or area where the change was made and identified by the corresponding revision number.

### 3.02 DOCUMENTATION CONTROL AND SUBMITTAL SEQUENCING

- A. The Contract Data Requirements List shall be updated and resubmitted to the Engineer monthly, throughout the duration of the Contract. This list shall identify the Contractor's submittal number, proposed and actual submittal date, Contract Specification Section Number, Paragraph, Item of the Work, and type of document.

- B. The Contractor shall work with the Engineer to provide a regulated flow of submittals that allows the Engineer to review the submittals in the defined time frame without undue delays. Monthly the Contractor shall provide the Engineer a schedule of the approximate quantities and delivery dates for all submittals due for the next 120 days.

### 3.03 FINAL RECORD DRAWINGS

- A. The Contractor shall submit the Surveyor's Final Record Drawing Package, marked with the Contractor's field corrections, to the Engineer for review 60 days before Final Completion. The Contractor shall be provided with CADD files, AutoCAD Version 2018 or more recent. Surveyor's Final Record Drawings shall be printed on 24-x-36-inch sheets and on CDs, AutoCAD Version 2018, and Adobe PDF files. The Contractor may request to use a different version, but it must be approved by the Engineer.

### 3.04 REQUIREMENTS FOR SUBMITTAL

- A. Additional documents, drawings, interface data, and other pertinent project submittal data are listed in specific sections of this Contract.

### 3.05 RECORD PRINTS

- A. The Contractor shall submit one set of all record prints before final completion. The record print or project records shall include submittals, catalog cuts, drawings, calculations, test reports, manufacturer's data, maintenance manuals, installation instructions, and operating manuals. All "record prints" shall be delivered to the Engineer in three-ring binders with dividers and shall be placed in order by Specification Section.

END OF SECTION

**SECTION 01350**  
**ENVIRONMENTAL PROTECTION PROCEDURES**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. The Work covered by this Section consists of furnishing all labor, materials, and equipment and performing all work required for the prevention of environmental pollution in conformance with applicable laws and regulations during and as the result of construction operations under this Contract. In this Section *environmental pollution* is defined as the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare, unfavorably alter ecological balances of importance to human life, affect other species of importance to man, or degrade the utility of the environment for aesthetic and/or recreational purposes.
- B. The control of environmental pollution requires considering air, water, and land and involves managing noise and solid waste as well as other pollutants.
- C. The Contractor shall schedule and conduct all work in a manner that will minimize the erosion of soils in the area of the Work. The Contractor shall provide erosion-control measures such as diversion channels, sedimentation or filtration systems, berms, staked hay bales, seeding, mulching or other special surface treatments that are required to prevent silting and muddying of streams, rivers, impoundments, lakes, etc. All erosion-control measures shall be in place in an area before any construction activity in that area. Specific requirements for erosion and sedimentation controls are specified in Part 207 of Section IV, City of Clearwater Standard Technical Specifications.
- D. This Section is intended to ensure that construction is achieved with a minimum of disturbance to the existing ecological balance between a water resource and its surroundings. These are general guidelines. It is the Contractor's responsibility to determine the specific construction techniques to meet these guidelines.
- E. All phases of sedimentation and erosion control shall comply with and be subject to the laws of the State of Florida and the Project Environmental Resource Permit.

**1.02 RELATED WORK**

- A. Section IV, Technical Specifications
- B. Section 01100, Summary of Work.
- C. Section 01650, Delivery, Storage, and Handling.

- D. Section 01780, Warranties and Bonds.
- E. Section 02230, Site Preparation.

#### 1.03 SUBMITTALS

- A. The Contractor shall prepare a sedimentation and erosion-control drawing meeting the requirements of the law and furnish two copies of the approved Drawing to the Engineer.

#### 1.04 WORK SEQUENCE

- A. Before beginning the Work, the Contractor shall meet with the Engineer to establish agreed-upon compliance with these provisions and administration of the environmental pollution control program.
- B. The Contractor shall remove temporary environmental control features when approved by the Engineer and incorporate permanent control features into the project at the earliest practicable time.

#### 1.05 REFERENCE STANDARDS

- A. Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. Where this Section differs from these documents, the requirements of this Section shall apply.
- B. The Contractor shall comply with all applicable Federal, State, and local laws and regulations concerning environmental pollution control and abatement.

#### 1.06 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

#### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

### PART 2 PRODUCTS (NOT USED)

## PART 3 EXECUTION

### 3.01 EROSION CONTROL

- A. The Contractor shall provide positive means of erosion control such as shallow ditches around construction to carry off surface water. Erosion-control measures, such as siltation basins, hay check dams, mulching, jute netting, and other equivalent techniques shall be used as appropriate. Surface water shall be prevented from flowing into excavated areas. Ditches shall be used around the construction area to carry away water resulting from dewatering excavated areas. At the completion of the Work, ditches shall be backfilled and the ground surface restored to its original condition.

### 3.02 PROTECTION OF STREAMS AND SURFACE WATERS

- A. Care shall be taken to prevent or reduce to a minimum any damage to any stream or surface water from pollution by debris, sediment, or other material or from the manipulation of equipment and/or materials in or near such streams. Water that has been used for washing or processing or that contains oils or sediments that will reduce the quality of the water in the stream shall not be directly returned to the stream. Such waters shall be diverted through a settling basin or filter before being directed into streams or surface waters.
- B. The Contractor shall not discharge water from dewatering operations directly into any live or intermittent stream, channel, wetlands, surface water, or any storm sewer. Water from dewatering operations shall be treated by filtration, settling basins, or other approved method to reduce the amount of sediment contained in the water to allowable levels.
- C. All preventative measures shall be taken to avoid spillage of petroleum products and other pollutants. In the event of any spillage, prompt remedial action shall be taken in accordance with a contingency action plan approved by the Florida Department of Environmental Protection (FDEP) and the US Environmental Protection Agency. The Contractor shall submit two copies of approved contingency plans to the Engineer. All spills are required to be reported to the Owner, Engineer, and FDEP.
- D. Water being flushed from structures or pipelines after disinfection with Cl<sub>2</sub> shall be treated with a dechlorination solution approved by the Engineer before discharge.

### 3.03 PROTECTION OF LAND RESOURCES

- A. After completion of construction, the Contractor shall restore land resources within the project boundaries and outside the limits of permanent work to a condition that will appear to be natural and not detract from the appearance of the project. All construction activities shall be confined to areas shown on the Drawings.
- B. Outside of areas requiring earthwork for the construction of the new facilities, the Contractor shall not deface, injure, or destroy trees or shrubs nor remove or cut them without prior approval. No ropes, cables, or guys shall be fastened to or attached to any existing nearby trees for anchorage unless specifically authorized by the Engineer. Where such special emergency use is permitted, the Contractor shall first wrap the trunk with a sufficient thickness of burlap or rags over which softwood cleats shall be tied before any rope, cable, or wire is placed. The Contractor shall in any event be responsible for any damage resulting from such use.
- C. The Contractor shall protect trees that may possibly be defaced, bruised, injured, or otherwise damaged by the construction equipment, dumping, or other operations by placing boards, planks, or poles around them. Monuments and markers shall be protected similarly.
- D. Any trees or other landscape features scarred or damaged by the Contractor's equipment or operations shall be restored as nearly as possible to their original condition. The Owner will decide the method of restoration to be used and whether damaged trees shall be treated and healed or removed and disposed of.
  - 1. All scars made on trees by equipment, construction operations, or by the removal of limbs larger than 1 inch in diameter shall be coated as soon as possible with an approved tree wound dressing. All trimming or pruning shall be performed in an approved manner by experienced workmen with saws or pruning shears. Tree trimming with axes will not be permitted.
  - 2. Climbing ropes shall be used where necessary for safety. Trees that are to remain, either within or outside established clearing limits, that are subsequently damaged by the Contractor and, in the opinion of the Owner, are beyond saving shall be immediately removed and replaced.
- E. The Contractor's storage and other construction buildings required temporarily in the performance of the work shall be located in cleared portions of the job site or areas to be cleared as shown on the Drawings and approved by the Engineer and shall not be within wetlands or floodplains. Preserving the landscape shall be required in the selection of all sites and in the construction of buildings. Drawings showing storage facilities shall be submitted for the Engineer's approval.

- F. If the Contractor proposes to construct temporary roads or embankments and excavations for plant and/or work areas, the Contractor shall submit the following for approval at least 10 days before the scheduled start of such temporary work:
1. A layout of all temporary roads, excavations, embankments, and drainage to be constructed within the work area.
  2. Details of temporary road construction.
  3. Drawings and cross-sections of proposed embankments and their foundations, including a description of proposed materials.
  4. Landscaping drawings showing the proposed restoration of the area. The proposed removal of any trees and shrubs outside the limits of the existing clearing area must be indicated. Locations of guard posts or barriers required to control vehicular traffic and protect trees and shrubs to be maintained undamaged must also be indicated. The drawings shall provide for the obliteration of construction scars as such and shall provide for a natural appearing final condition of the area. Modification of the Contractor's approved drawings shall be made only with the written approval of the Engineer. No unauthorized road construction, excavation, or embankment construction including disposal areas will be permitted.
- G. The Contractor shall remove all signs of temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess waste materials, or any other vestiges of construction as directed by the Engineer. It is anticipated that excavation, filling, and plowing of roadways will be required to restore the area to near natural conditions which will permit the growth of vegetation within the roadway areas. The disturbed areas shall be prepared and seeded as approved by the Engineer or Owner.
- H. All debris and excess material will be disposed of outside wetland or floodplain areas in an environmentally sound manner.

### 3.04 PROTECTION OF AIR QUALITY

- A. Burning—Burning shall not be permitted at the project site for the disposal of refuse and debris.
- B. Dust Control—The Contractor shall maintain all excavations, embankment, stockpiles, access roads, plant sites, waste areas, borrow areas, and all other work areas within or outside the project boundaries free from dust which could cause the standards for air pollution to be exceeded and which would cause a hazard or nuisance to others.
- C. An approved method of stabilization consisting of sprinkling or other similar methods will be permitted to control dust. The use of petroleum products is

prohibited. The use of chlorides may be permitted with approval from the Engineer.

- D. To be approved, sprinkling must be repeated at such intervals as to keep all parts of the disturbed area at least damp at all times, and the Contractor shall have sufficient competent equipment on the job to accomplish this. Dust control shall be performed as the Work proceeds and whenever a dust nuisance or hazard occurs, as determined by the Owner.

### 3.05 NOISE CONTROL

- A. The Contractor shall make every effort to minimize noises caused by the construction operations. Equipment shall be equipped with silencers or mufflers designed to operate with the least possible noise in compliance with Federal and State regulations.

### 3.06 MAINTENANCE OF POLLUTION-CONTROL FACILITIES DURING CONSTRUCTION

- A. During the life of this Contract, the Contractor shall maintain all facilities constructed for pollution control as long as the operations creating the particular pollutant are being carried out or until the material concerned has become stabilized to the extent that pollution is no longer being created.

END OF SECTION

**SECTION 01355**  
**SPECIAL PROVISIONS**

**PART 1 GENERAL**

**1.01 RELATED WORK**

- A. Section 01330, Submittals and Acceptance.
- B. Section 01350, Environmental Protection Procedures.
- C. Section 01600, Materials and Equipment.
- D. Section 01650, Delivery, Storage, and Handling.
- E. Section 01780, Warranties and Bonds.
- F. Section 01830, Operations and Maintenance Manuals.
- G. Section 09900, Painting and Coating.
- H. Section 11000, General Equipment Requirements.
- I. Section 15075, Process Equipment, Piping, and Valve Identification.
- J. Section 15110, Manual, Check, and Process Valves.

**1.02 SUBMITTALS**

- A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance.

**1.03 WARRANTIES**

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.
- B. Unless specified otherwise in the Contract Documents, all equipment supplied under these Specifications shall be warranted by the Contractor and the equipment manufacturers for 1 year. The warranty period shall begin on the date of Owner acceptance.
- C. The equipment shall be warranted to be free from defects in workmanship, design, and materials. If any part of the equipment should fail during the warranty period, it shall be replaced in the machine(s) and the unit(s) restored to service at no expense to the Owner.
- D. The manufacturer's warranty period shall run concurrently with the Contractor's warranty or guarantee period. No exception to this provision shall be allowed. The Contractor shall be responsible for obtaining equipment warranties in accordance with Section 01780, Warranties and Bonds, from each of the respective suppliers

or manufacturers for all the equipment specified under Divisions 11, 13, 15, and 16.

- E. If the manufacturer is unwilling to provide a 1-year warranty beginning at the time of Owner acceptance, the Contractor shall obtain from the manufacturer a 2-year warranty starting at the time of equipment delivery to the job site. This 2-year warranty shall not relieve the Contractor of the 1-year warranty starting at the time of Owner acceptance of the equipment.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

#### 1.05 INSTALLATION OF EQUIPMENT

- A. The Contractor shall take special care to ensure proper alignment of all equipment with particular reference to the pumps, mixers, and electric drives. The units shall be carefully aligned on their foundations by qualified millwrights after the units' sole plates have been shimmed to true alignment at the anchor bolts. The anchor bolts shall be set in place and the nuts tightened against the shims. After the Engineer has approved the foundation alignments, the bedplates or wing feet of the equipment shall be securely bolted in place. The Contractor shall further check the alignment of the equipment after it is secured to the foundations and, after all alignments are conformed, shall finally grout the sole plates in place. The Contractor shall be responsible for the exact alignment of equipment with associated piping and under no circumstances will "pipe springing" be allowed.
- B. The Contractor shall furnish all wedges, shims, filling pieces, keys, packing, grout, or other materials necessary to properly align, level, and secure apparatus in place. All parts intended to be plumb or level must be proven to be exactly so. The Contractor shall perform all grinding necessary to bring parts to proper bearing after erection.

#### 1.06 SLEEVES AND OPENINGS

- A. The Contractor shall provide all openings, channels, chases, etc., in new construction and furnish and install anchor bolts and other items to be embedded in concrete, as required to complete the Work under this Contract. The Contractor shall perform all cutting, coring, and rough and finish patching required in existing construction for the work of all trades.

- B. Subcontractors shall furnish all sleeves, inserts, hangers, anchor bolts, etc., required for the execution of their work. Before the work of the Contractor begins, the subcontractors shall be responsible for furnishing the Contractor with the above items and with templates, drawings, or written information covering chases, openings, etc., which they require and to follow up the work of the Contractor as it progresses, making sure that their drawings and written instructions are carried out. If the subcontractors fail to do this, they shall be responsible for the cost of any corrective measures that may be required to provide necessary openings, etc. If the Contractor fails to carry out the directions given him, covering details and locations of openings, etc., he shall be responsible for any cutting and refinishing required to make the necessary corrections. In no case shall beams, lintels, or other structural members be cut without the approval of the Engineer.

#### 1.07 GREASE, OIL, AND FUEL

- A. The Contractor shall furnish all grease, oil, and fuel required for testing equipment with the respective equipment. The Owner shall be furnished with a year's supply of required lubricants including grease and oil of the type recommended by the manufacturer with each item of equipment supplied under Divisions 11, 13, 15 and 16.

#### 1.08 TOOLS

- A. The Contractor shall furnish any special tools (including grease guns or other lubricating devices) which may be necessary for the adjustment, operation, and maintenance of any equipment with the respective equipment.
- B. Tools shall be furnished in heavy steel tool-boxes complete with lock and duplicate keys.

#### 1.09 POWER SUPPLY

- A. Unless otherwise specified, all motors 1/2 Hp and larger shall be designed for a power supply of 460 volts, three-phase, 60 Hz, and all motors 1/3 Hp and smaller shall be designed for a power supply of 120 Volts, single phase, 60 Hz.

#### 1.10 POWER FACTOR CORRECTION CAPACITORS

- A. All single- and multi-speed three-phase induction motors 5 Hp and larger shall be furnished with factory-provided power factor correction capacitors.
- B. Capacitors shall be sized by the manufacturers so that over voltage due to self excitation will be prevented and transient torques limited to normal values. The

full-load power factor shall be corrected to not less than 0.95 where such correction will not violate the provisions of NEC Article 460.

- C. Capacitor enclosures shall be compatible with those specified for their respective motors, i.e. dust-tight for indoor installation in non-hazardous areas and weatherproof for outdoor installations.
- D. Capacitors shall be dry or oil insulated with integral fuse protection and discharge resistor. The insulating medium shall be non-flammable and meet US Environmental Protection Agency Standards.

#### 1.11 ARCHITECTURAL COATINGS

- A. The Contractor shall maintain coordination among all sections (windows, window walls, louvers, doors, and frames, etc.) requiring PVF, PVC, or anodic coatings. All coatings shall match to the satisfaction of the Engineer with regard to color and texture. Items rejected by the Engineer shall promptly be removed from the job site.

#### 1.12 PIPE MARKING

- A. Pipe marking is included in Section 09900, Painting and Coating, and Section 15075, Process Equipment, Piping, and Valve Identification, but it shall be the Contractor's responsibility, as required by the Engineer, to help identify pipe contents, direction of flow, and all else required for proper marking of pipe.

#### 1.13 VALVE IDENTIFICATION

- A. The Contractor shall prepare a valve schedule for all valves required for the Work showing a number, the location, type, function, and normal operating position for each valve. The schedule shall be submitted to the Engineer for approval not less than 120 days before start-up. The Contractor shall coordinate valve identification with Section 15075, Process Equipment, Piping, and Valve Identification, and Section 15110, Manual, Check, and Process Valves.
- B. The Contractor shall install valve tags on all valves required for the Work.

#### 1.14 NOISE LIMITATIONS

- A. All equipment to be furnished under this Contract, unless specified otherwise in the Technical Specifications, shall be designed to ensure that the sound pressure level does not exceed 85 decibels over a frequency range of 37.8 to 9,600 cycles per second at a distance of 3 feet from any portion of the equipment, under any load condition, when tested using standard equipment and methods. Noise levels

shall include the noise from the motor. Mufflers or external baffles shall not be acceptable for reducing noise. Data on noise levels shall be included with the shop drawing submittal.

#### 1.15 SPARE PARTS

- A. Where spare parts are specified in the Specification Sections, the Contractor shall furnish all spare parts recommended by the manufacturer or system supplier for 1 year of service. In addition, the Contractor shall furnish all spare parts itemized in each Section.
- B. The Contractor shall collect and store all spare parts in an area to be designated by the Engineer and shall furnish the Engineer with an inventory listing all spare parts, the equipment they are associated with, the name and address of the supplier, and the delivered cost of each item. Copies of actual invoices for each item shall be furnished with the inventory to substantiate the delivery cost.
- C. Spare parts shall be packed in cartons properly labeled with indelible markings with complete descriptive information, including manufacturer, part number, part name, and equipment for which the part is to be used and shall be properly treated for 1 year of storage.

#### 1.16 HURRICANE PREPAREDNESS PLAN

- A. Within 30 calendar days of the date of Notice to Proceed, the Contractor shall submit a Hurricane Preparedness Plan to the Engineer and the Owner for approval. The Plan shall describe in detail the necessary measures that the Contractor will perform, at no additional costs to the Owner, in case of a hurricane warning. The Contractor shall revise the Plan as required by the Engineer and Owner.

#### 1.17 WEATHER PROTECTION

- A. In the event of inclement weather, the Contractor shall protect the Work and materials from damage or injury from the weather. If, in the opinion of the Engineer, any portion of the Work or materials has been damaged by reason of failure on the part of the Contractor to protect the Work, such Work and materials shall be removed and replaced with new materials and Work to the satisfaction of the Engineer.

#### 1.18 PROVISIONS FOR CONTROL OF EROSION

- A. The Contractor shall take sufficient precautions during construction to minimize the run-off of polluting substances such as silt, clay, fuels, oils, bitumens, calcium

chloride, or other polluting materials harmful to humans, fish, or other life, into the supplies and surface waters of the State. Control measures must be adequate to ensure that turbidity in the receiving water will not be increased more than 10 nephelometric turbidity units (NTU), or as otherwise required by the State or other controlling body, in water used for public water supply or fish unless limits have been established for the particular water. In surface water used for other purposes, the turbidity must not exceed 25 NTU unless otherwise permitted. Special precautions shall be taken in the use of construction equipment to prevent operations that promote erosion.

#### 1.19 PROVISIONS FOR THE CONTROL OF DUST AND LITTER

- A. The Contractor shall take sufficient precautions during construction to minimize the amount of dust created. Wetting down the Site may be required or as directed by the Engineer to prevent dust as a result of vehicular traffic. Control of blowing litter caused by any regrading by the Contractor shall be the responsibility of the Contractor.

#### 1.20 ON-SITE STORAGE

- A. The Contractor should note that there may be special storage requirements and possible charges for noncompliance of on-site storage requirements for materials and equipment as specified in Section 01600, Materials and Equipment.

#### 1.21 ELECTRICAL POWER AND TESTING EQUIPMENT

- A. The Contractor shall furnish electric power and all equipment and tools required for testing equipment. The cost of this electric power, equipment, and tools shall be included in the prices quoted in the Bid Form.

#### 1.22 PROTECTION AGAINST ELECTROLYSIS

- A. Where dissimilar metals are used in conjunction with each other, the Contractor shall provide suitable insulation between adjoining surfaces to eliminate direct contact and any resulting electrolysis. The insulating material shall be bituminous impregnated felt, heavy bituminous coatings, nonmetallic separators or washers, or other approved materials.

#### 1.23 DAMAGE DUE TO HIGH WATER

- A. The Contractor will be responsible for all damage done to his work by heavy rains or floods and he shall take all reasonable precautions to provide against damages by building such temporary dikes, channels, or shoring to carry off stormwater as the nature of the work may require.

## 1.24 EMERGENCY PHONE NUMBERS AND ACCIDENT REPORTS

- A. Emergency phone numbers (fire, medical, police) shall be posted at the Contractor's phone and the phone's location be made known to all.
- B. Accidents shall be reported immediately to the Engineer by messenger or phone.
- C. The Contractor shall document all accidents and shall submit to the Engineer a fully detailed written report about the accident after each accident.

## 1.25 ITEMS SPECIFIED ON DRAWINGS

- A. Items of material, equipment, machinery, and the like may be specified on the Drawings and not in the Specifications. The Contractor shall provide such items in accordance with the Project Specifications on the Contract Drawings.

## 1.26 DISINFECTION

- A. The Contractor shall clean, disinfect, and bacteriologically test and clear, in accordance with Chapters 62-550, 62-555, and 62-560 of the Florida Administrative Code (FAC), all water supply facilities affected by this project which shall come into contact with raw water, water being treated, or treated water before placing the facility in operation. This shall apply to new facilities installed as well as to existing facilities that are to be modified.
- B. The Contractor shall employ a disinfection method approved by the Engineer and Owner and shall fully satisfy the Owner that adequate disinfection has been achieved before placing a facility on-line.
- C. The cost of all disinfection work shall be included in the prices quoted in the Proposal. The Owner shall pay for all bacteriological clearance tests.

## 1.27 SALVAGE

- A. Any existing equipment or material, including but not limited to valves, pipes, fittings, couplings, etc., which is removed or replaced as a result of construction under this project may be designated as salvage by the Engineer or Owner and, if so, shall be excavated, if necessary, and shall be cleaned and stored on or adjacent to the Site in a protected place specified by the Engineer or loaded onto trucks provided by the Owner. Any equipment or material not worthy of salvaging, as directed by the Owner, shall be disposed of by the Contractor at a suitable location at the Contractor's expense.

## 1.28 WORKMANSHIP, MATERIAL, AND EQUIPMENT

- A. When a particular product or products are specified or called for, it is intended and shall be understood that the proposal tendered by the Contractor include those products in his bid. Should the Contractor desire to substitute a product or products equal to those specified, the Contractor shall furnish information as described in the Standard General Conditions. The alternate product or products submitted by the Contractor shall meet the requirements of the Specifications and shall, in all respects, be equal to the product or products specified by name in the Specifications.
- B. All apparatus, mechanisms, equipment, machinery, and manufactured articles for incorporation into the Work shall be the new and unused standard products of recognized reputable manufacturers.

## 1.29 SERVICES OF MANUFACTURERS' FIELD SERVICE TECHNICIAN

- A. Bid prices of equipment furnished under Divisions 11, 13, 15, and 16 shall include the cost of a competent field service technician of the manufacturers of all equipment to supervise the installation, adjustment, and testing of the equipment and to instruct the Owner's operating personnel on operation and maintenance. The approved manufacturer's operation and maintenance data as specified in Section 01830, Operations and Maintenance Manuals, shall be delivered to the Engineer before instructing the Owner's personnel. This supervision may be divided into two or more periods as required by the installation program or as directed by the Engineer.
- B. After the equipment has been installed and the equipment is presumably ready for operation, but before it is operated by others, the manufacturers' field service technician shall inspect, operate, test, and adjust the equipment. The inspection shall include at least the following points where applicable:
  1. Soundness (without cracked or otherwise damaged parts).
  2. Completeness in all details, as specified and required.
  3. Correctness of setting, alignment, and relative arrangement of various parts.
  4. Adequacy and correctness of packing, sealing, and lubricants.
  5. Calibration and adjustment of all related instrumentation and controls.
  6. Energize equipment.
  7. Deficiency correction.
  8. Demonstration of compliance with application performance specification.

- C. The operation, testing, and adjustment shall be as required to prove that the equipment has been left in proper condition for satisfactory operation under the conditions specified.
- D. Upon completion of this operation, testing, and adjustment, the manufacturers' field service technician shall submit to the Engineer, in triplicate, a complete, signed report of the results of the inspection, operation, adjustments, and tests. The report shall include detailed descriptions of the points inspected, tests and adjustments made, quantitative results obtained if such are specified, and suggestions for precautions to be taken to ensure proper maintenance.
- E. Each equipment manufacturer shall provide instruction to the Owner's operating personnel. Training shall not be performed until the requirements of Paragraphs B, C, and D above have been fully satisfied and any specified performance testing completed. Training shall be provided for the number of days specified in each Equipment Section of these Specifications. Training shall be provided on an 8-hour-per-day basis. Partial days (less than 8 full working hours) shall not be credited toward the specified durations. Training shall not be concurrent with on-going testing, debugging, or installation activities but shall be a separate activity devoted exclusively to the instruction of the Owner's personnel in the operation and maintenance of the manufacturers' equipment. Training shall be performed by qualified representatives of each equipment manufacturer specifically skilled in providing instruction to operation personnel. Training shall provide an overview of operations and maintenance requirements and shall include but not be limited to the following:
  - 1. Description of unit and component parts.
  - 2. Operating capabilities and performance criteria.
  - 3. Operating procedures.
  - 4. Maintenance procedures
  - 5. Servicing and lubrication schedules.
  - 6. Troubleshooting.
  - 7. Electrical instrumentation and control requirements and interface as a minimum. The operating and maintenance data to be provided in accordance with Section 01830, Operations and Maintenance Manuals, shall be used as a basis for training.
- F. A certificate from the manufacturer stating that the installation of the equipment is satisfactory; that the unit has been satisfactorily tested and is ready for operation; and that the operating personnel have been suitably instructed in the operation, lubrication, and care of the unit shall be submitted before start-up and acceptance by the Owner. The certificate shall indicate date and time the instruction was given and names of the operating personnel in attendance. This certification shall

be submitted on the certification sheet included at the end of Section 11000, General Equipment Requirements.

- G. See the detailed Specifications for additional requirements for furnishing the services of the manufacturers' field service technician.
- H. For equipment furnished under Divisions other than 11, 13, 15, and 16, the Contractor, unless otherwise specified, shall furnish the services of accredited field service technicians of the manufacturer only when some evident malfunction or over-heating makes such services necessary in the opinion of the Engineer

### 1.30 OPERATING AND MAINTENANCE DATA

- A. Operating and maintenance data covering all equipment furnished shall be delivered directly to the Engineer, for approval, within 60 days before the facility's start-up. No payment shall be made for equipment installed or stored on-site until the Engineer has approved the adequacy and completeness of the operating and maintenance data. Data shall be prepared and submitted in full conformance with Section 01830, Operations and Maintenance Manuals. Final approved copies of operating and maintenance data shall have been delivered to the Engineer on the Owner's behalf 2 weeks before scheduling the instruction period with the Owner.

### 1.31 RESPONSIBILITY OF CONTRACTOR

- A. The Contractor shall be responsible for the entire Work determined by the Drawings, Specifications, and Contract from the date of the starting of the Work until it is accepted as evidence of approval of the Completion Certificate by the Owner. The Contractor shall be responsible for removals, renewals, and replacements due to action of the elements and all other causes except as otherwise provided in the Specifications. The Contractor shall keep the Contract under his own control and it shall be his responsibility to see that the Work is properly supervised and carried on faithfully and efficiently. The Contractor shall supervise the work personally or shall have a competent English-speaking superintendent or representative, who shall be on the site of the project at all working hours and who shall be empowered with full authority by the Contractor to direct the performance of the Work and make arrangement for all necessary materials, equipment, and labor without delay.
- B. Renewals or repairs required because of defective materials or workmanship or due to the action of the elements or other natural causes, including fire and flood, before the acceptance as determined by the Completion Certificate, shall be done in accordance with the Contract and Specifications at the expense of the Contractor.

## 1.32 CONSTRUCTION CONDITIONS AND SUBSURFACE INVESTIGATION

- A. The Contractor shall strictly adhere to the specific requirements of the governmental unit(s) or agency(ies) having jurisdiction over the Work. Wherever there is a difference in the requirements of a jurisdictional body and these Specifications, the more stringent shall apply.
- B. The Contractor shall be responsible for having determined to his satisfaction, before submitting his bid, the nature and location of the Work, the conformation of the ground, the character and quality of the substrata, the types and quantity of materials to be encountered, the nature of the groundwater conditions, the character of equipment and facilities needed before and during the execution of the Work, the general and local conditions, and all other matters which can in any way affect the Work under this Contract. The prices established for the work to be done will reflect all costs pertaining to the Work. Any claims for extras based on substrata, groundwater table, and other such conditions will not be allowed.

## 1.33 SUSPENSION OF WORK DUE TO WEATHER

- A. During inclement weather, all work which might be damaged or rendered inferior by such weather conditions shall be suspended. The orders and decisions of the Engineer as to suspensions shall be final and binding. The ability to issue such an order shall not be interpreted as a requirement to do so. During suspension of the work from any cause, the Work shall be suitably covered and protected so as to preserve it from injury by the weather or otherwise, and if the Engineer shall so direct, the rubbish and surplus materials shall be removed.

## 1.34 PERMITS

- A. Upon notice of award, the Contractor shall immediately apply for all applicable permits not previously obtained by the Owner to do the Work from the appropriate governmental agency or agencies. No work shall begin until all applicable permits have been obtained and copies delivered to the Engineer. The Contractor shall bear all costs for obtaining all permits.

## 1.35 PUMPING

- A. The Contractor with his own equipment shall do all pumping necessary to prevent flotation of any part of the structures during construction operations.
- B. For the duration of the Contract and with his own equipment, the Contractor shall pump out water and wastewater which may seep or leak into the excavations or structures. Galleries and other operating areas shall be kept dry at all times. The

Engineer will determine the extent of pumping required in the tanks, channels, and other non-operating areas.

#### 1.36 OWNER OCCUPANCY AND OPERATION OF COMPLETED FACILITIES

- A. It is assumed that portions of the Work will be completed before the entire work is completed. Upon completion of construction in each individual facility, including testing, if the Owner, at its sole discretion, desires to accept the individual facility, the Contractor will be issued a dated certificate of completion and acceptance for each individual facility. The Owner will assume ownership and begin operation of the individual facility on that date and the 1-year guaranty period shall begin on that date. The Owner has the option of not accepting any individual completed facility, but accepting the entire work as a whole when it is completed and tested.

#### 1.37 CLAIMS FOR PROPERTY DAMAGE

- A. Upon notification by the Owner or Engineer, the Contractor shall investigate each claim for property damage and shall file, within 10 days of such notification, a statement with the Owner or Engineer setting forth all facts and details relative to the claim.

#### 1.38 DAILY REPORTS

- A. The Contractor shall submit daily reports of construction activities, including non-work-days. The report shall include the following:
  1. Manpower, number of workers by craft.
  2. Equipment on the project.
  3. Major deliveries.
  4. Activities work with reference to the CPM schedule activity numbers.
  5. New problems.
  6. Other pertinent information.
- B. A similar report shall be submitted for/by each subcontractor.
- C. The reports shall be submitted to the Engineer's Field Office within 2 days of the respective report date. Each report shall be signed by the Contractor's Superintendent or Project Manager.

#### 1.39 CONNECTIONS TO EXISTING SYSTEMS

- A. The Contractor shall perform all work necessary to locate, excavate, and prepare for connections to the terminus of the existing systems all as shown on the

Drawings or where directed by the Engineer. The cost of this work and for the actual connection of the existing mains shall be included in the bid for the Project and shall not result in any additional cost to the Owner.

## 1.40 COORDINATION OF WORK

- A. Because of the nature of this Project, the Contractor should expect other construction to occur in the vicinity of this Project during the Contract. In such instances the Contractor will be required to cooperate fully to eliminate or minimize the creation of conflicts. Adjustments from time to time may be required in the Contractor's work location and/or schedule provided a reasonable notice is given by the Owner or Engineer.
- B. The Contractor shall afford other contractors and the Owner reasonable opportunity for the introduction and storage of their materials and equipment and the execution of their work and shall properly connect and coordinate the Work with such other work. The Contractor shall coordinate his Work with the Owner and other contractors to store his apparatus, materials, supplies, and equipment in such orderly fashion at the site of the Work so that it will not unduly interfere with the progress of the Work or the work of any other contractors.
- C. If the execution or result of any part of the Work depends on any work of the Owner or of any separate contractor, the Contractor shall, before proceeding with the Work, inspect and promptly report to the Owner in writing any apparent discrepancies or defects in such work of the Owner or of any separate contractor that render it unsuitable for the proper execution or result of any part of the Work.
- D. Failure of the Contractor to inspect and report any deficiencies shall constitute an acceptance of the Owner's or separate contractor's work as fit and proper to receive the Work, except as to defects which may develop in the Owner's or separate contractor's work after completion of the Work and which the Contractor could not have discovered by his inspection before the Work was completed.
- E. If the Contractor damages the work or property of the Owner or of any separate contractor on the Project or other work on the Site, or delays or interferes with the Owner's work on ongoing operations or facilities or adjacent facilities or the separate contractor's work, the Contractor shall be liable for damage caused, and, in the case of another contractor, the Contractor shall attempt to settle the claim with the other contractor before the other contractor institutes litigation or other proceedings against the Contractor.
- F. If a separate contractor sues the Owner on account of any damage, delay, or interference caused or alleged to have been caused by the Contractor, the Owner shall notify the Contractor, who shall defend the Owner in such proceedings at the

Contractor's expense. If any judgment or award is entered against the Owner, the Contractor shall satisfy the same and shall reimburse the Owner for all damages, expenses, attorneys' fees, and other costs which the Owner incurs as a result of the judgment or award

- G. If a separate contractor causes damage to the Work or to the property of the Contractor or causes delay or interference with the Contractor's performance of the Work, the Contractor shall present directly to the separate contractor any claims it may have as a result of such damage, delay, or interference (with an information copy to the Owner) and shall attempt to settle its claim against the separate contractor before instituting litigation or other proceedings against the separate contractor.
- H. In no event shall the Contractor seek to recover from the Owner or the Engineer, and the Contractor hereby represents to the Owner and the Engineer that he will not seek to recover from them, or either of them, any costs, expenses, (including, but not limited to, attorneys' fees) or losses of profit incurred by the Contractor as a result of any damage to the Work or property of the Contractor or any delay or interference caused or allegedly caused by any separate contractor.
- I. The Engineer shall determine and adjust any difference or conflict which may arise between the Contractor and other contractors who may be performing work on behalf of the Owner or between the Contractor and workmen of the Owner in regard to their work. If the work of the Contractor is delayed because of any acts of omissions of any other contractor of the Owner, the Contractor shall on that account have no claim against the Owner other than for an extension of time.

#### 1.41 FINAL GUARANTEE

- A. The Contractor shall guarantee all work for 1 year from the date of Substantial Completion of the Work by the Owner.
- B. If, within the guarantee period, repairs or changes are required in connection with guaranteed work, which, in the opinion of the Engineer, are rendered necessary as the result of the use of materials, equipment, or workmanship which are inferior, defective, or not in accordance with the terms of the Contract, the Contractor shall do the following promptly upon receipt of notice from the Owner and without expense to the Owner:
  1. Place in satisfactory condition in every way all such guaranteed work and correct all defects in the guaranteed work.
  2. Make good all damage to the building or site, or equipment or piping, or their contents, which, in the opinion of the Engineer, is the result of the

- use of materials, equipment, or workmanship which are inferior, defective, or not in accordance with the terms of the contract.
3. Make good any work or material or the equipment and contents of the building, structure, or site disturbed in fulfilling any such guarantee.
- C. If the Contractor, after notice, fails to proceed to comply with the terms of this guarantee within 10 days, the Owner may have the defects corrected and the Contractor and his surety shall be liable for all expenses incurred provided. However, that in case of an emergency where, in the opinion of the Owner, delay would cause loss or damage, repairs may be started without notice being given to the Contractor and the Contractor shall pay the cost of such repairs.
- D. All special guarantees or warranties applicable to specific parts of the Work as may be stipulated in the Contract Specifications or other papers forming a part of this Contract shall be subject to the terms of this Paragraph during the first year of life of each such guarantee. The Contractor shall assemble all special guarantees and manufacturers' warranties, along with a summary list of the special guarantees and warranties, and deliver these to the Engineer before the Work is accepted.

#### 1.42 AUTOMATICALLY CONTROLLED EQUIPMENT

- A. Whenever batching or mixing plant equipment is required to be operated automatically under the Contract and a breakdown or malfunction of the automatic controls occurs, the equipment may be operated manually or by other methods for 48 hours after the breakdown or malfunction, provided this method of operation will produce results otherwise meeting the Specifications.

#### 1.43 EQUIPMENT DATA FORMS

- A. The Contractor shall obtain, prepare, and submit a complete, detailed listing of equipment and motor data for all electrical items furnished under this Contract. This listing shall be submitted with the preliminary draft of Operations and Maintenance Data Manuals on Equipment Data sheets and the Equipment Manufacturer's Certificate of Installation, Testing, and Instruction and the Manufacturer's Certificate of Compliance forms, which are included at the end of Section 11000, General Equipment Requirements.

#### 1.44 RIGHTS IN AND USE OF MATERIALS FOUND ON THE WORK

- A. With the approval of the Engineer, the Contractor may use on the project such stone, gravel, sand, or other material determined suitable by the Engineer as may be found in the excavation and will be paid both for the excavation of such materials at the corresponding Contract unit price and for the pay item for which

the excavated material is used. The Contractor shall replace at his own expense, with other acceptable material, all of that portion of the excavation materials so removed and used which were needed for use in the embankments, backfills, approaches, or otherwise. No charge for the materials used will be made against the Contractor.

#### 1.45 OWNER-FURNISHED MATERIAL

- A. The Contractor shall furnish all materials required to complete the Work. No materials will be furnished by the Owner.

#### 1.46 MAINTENANCE AND LUBRICATION SCHEDULES

- A. The Contractor's attention is directed to Section 01830, Operations and Maintenance Manuals, for requirements relative to the submission of operating and maintenance data for the mechanical equipment. For all mechanical and electrical equipment furnished, the Contractor shall provide a list including the equipment name, address, and telephone number of the manufacturer's representative and service company so that service and/or spare parts can be readily obtained.

#### 1.47 INSTALLATION LISTS

- A. All manufacturers or equipment suppliers who propose to furnish equipment or products under Divisions 11, 13, 15, and 16 shall submit an installation list to the Engineer along with the required Shop Drawings.
- B. The installation list shall include all installation where identical equipment has been installed and has been in operation for at least 1 year.

#### PART 2 PRODUCTS (NOT USED)

#### PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01400**  
**QUALITY REQUIREMENTS**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. General
  - 1. This Section defines minimum requirements for the Quality Assurance (QA) Program to be provided by the Contractor. The deliverable documents are defined, along with the method of execution of the QA Program.
  - 2. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve the Contractor of responsibility for compliance with the Contract Document requirements.
  - 3. Specified tests, inspections, and related actions do not limit the Contractor's Quality Control (QC) procedures that facilitate compliance with the Contract Documents.
- B. Definitions
  - 1. QA services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and ensure that proposed construction complies with Contract requirements.
  - 2. QC services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that completed construction comply with requirements.
- C. Payment: Separate payment will not be made for providing and maintaining an effective QA and Q C Program, and all costs associated with such a program shall be included in the applicable unit prices, lump-sum prices, or allowances contained in the Contract Price Breakdown.

**1.02 RELATED WORK**

- A. Section 01000, Project Requirements.
- B. Section 01300, Contract Administration.
- C. Section 01330, Submittals and Acceptance.
- D. Section 02305, Earthwork for Utilities.

## 1.03 SUBMITTALS

- A. Submittals shall be made as specified in Section 01330, Submittals and Acceptance. The QC organization shall be responsible for certifying that all submittals comply with the Contract requirements.

## 1.04 WORK SEQUENCE

- A. Where reference is made to a particular standard, the revision in effect at the time of Bid opening shall apply except where a specific date is established.
- B. For products or workmanship specified by association, trades, or other consensus standards, the Contractor shall comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable code.
- C. If specified reference standards conflict with Contract Documents, the Contractor shall request clarification from the Engineer before proceeding.

## 1.05 QUALITY ASSURANCE

- A. The Contractor shall install all materials and equipment in a neat and first-class workman-like manner.
- B. The Contractor shall replace all existing paving, stabilized earth, curbs, driveways, sidewalks, fences, signs, and other improvements with the same type of material that was removed during construction or as directed by the Engineer without increase in the Contract Price or Contract Time.
- C. The Engineer reserves the right to direct the removal and replacement of any items which, in the Engineer's opinion, do not present an orderly and reasonably neat or workman-like appearance, provided such an orderly installation can be made using customary trade methods. The removal and replacement shall be done when directed in writing by the Engineer at the Contractor's own expense and without additional expense to the Owner.

## 1.06 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

## 1.07 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

## 1.08 TOLERANCES

- A. Monitor tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. If manufacturers' tolerances conflict with Contract Documents, request clarification from the Engineer before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

## 1.09 FIELD SAMPLES

- A. The Contractor shall furnish field samples at the site as required by individual Specifications Sections for review.
- B. Acceptable samples represent a quality level for the Work.
- C. Where field sample is specified in individual Sections to be removed, the Contractor shall clear the area after the field sample has been accepted by the Engineer.

## PART 2 PRODUCTS (NOT USED)

## PART 3 EXECUTION

### 3.01 GENERAL

- A. The Contractor is responsible for QC and shall establish and maintain an effective QC system in compliance with the Contract Documents. The QC system shall consist of plans, procedures, and organization necessary to produce an end product which complies with the Contract requirements. The system shall cover all Work and shall be keyed to the proposed design and construction sequence. The project QC Officer will be held responsible for the quality of work on the job and is subject to removal by the Engineer for non-compliance with quality requirements specified in the Contract. The project QC Officer in this context shall mean the individual with the responsibility for the overall management of the project quality.

### 3.02 QUALITY CONTROL PLAN

- A. General: Not later than 30 calendar days after receipt of Notice to Proceed, the Contractor shall furnish for review by the Engineer the QC Plan proposed to implement the requirements of the Contract. The Plan shall identify personnel, procedures, control, instructions, test, records, and forms to be used. The Engineer will consider an interim plan for the first 30 calendar days of operation.
- B. Content of the QC Plan: The QC Plan shall include, at a minimum, the following to cover all construction operations, both on site and off site, including work by subcontractors, fabricators, suppliers, and purchasing agents:
  1. A description of the QC organization, including a chart showing lines of authority for all aspects of the Work specified. The staff shall include a QC Officer who shall report to the Project Manager or executive.
  2. The name, qualifications (in résumé format), duties, responsibilities, and authorities of each person assigned a QC function.
  3. A copy of the letter to the QC Officer signed by an authorized official of the firm which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the QC Officer, including authority to stop work which is not in compliance with the Contract.
  4. Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, off-site fabricators, suppliers, and purchasing agents.
  5. Procedures for tracking construction deficiencies from identification through acceptable corrective action. These procedures will verify that identified deficiencies have been corrected.
  6. Reporting procedures, including proposed reporting formats.
- C. Acceptance of Plan: Acceptance of the Contractor's plan is required before the start of Work. Acceptance is conditional and will be predicated on satisfactory performance during the Work. The Engineer reserves the right to require the Contractor to make changes in its QC Plan and operations, including removing personnel as necessary to obtain the quality specified.
- D. Notification of Changes: After acceptance of the QC Plan, the Contractor shall notify the Engineer in writing of any proposed change. Proposed changes are subject to acceptance by the Engineer.

### 3.03 TESTS

#### A. Testing Services

1. All tests to determine compliance with the Contract Documents shall be performed by an independent commercial testing firm acceptable to the Owner. The testing firm's laboratory shall be staffed with experienced technicians, properly equipped, and fully qualified to perform the tests in accordance with the specified standards.
  2. Testing services provided by the Owner are for the sole benefit of the Owner; however, test results shall be available to the Contractor. Testing necessary to satisfy the Contractor's internal QC Procedures shall be the sole responsibility of the Contractor.
  3. When necessary, the Contractor shall interrupt its Work for Owner sampling and testing. The Contractor shall have no Claim for increase in Contract Price or Contract Time due to such interruption. The Contractor shall cooperate in these testing activities as needed.
  4. Testing, including sampling, will be performed by the testing firm's laboratory personnel in the general manner indicated in the Specifications.
- B. Transmittal of Test Reports: Written reports of tests and engineering data furnished by the Contractor for the Engineer's review shall be submitted as specified for Shop Drawings.

#### C. Manufacturer's Field Services

1. The manufacturer's field services will be specified in the respective Equipment Sections.
2. An experienced, competent, and authorized representative of the manufacturer of each item of equipment for which field services are indicated shall visit the Site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. In each case the manufacturer's representative shall be present when the equipment is placed in operation. The manufacturer's representative shall revisit the Site as often as necessary until any and all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of the Engineer.
3. Each manufacturer's representative shall furnish to the Owner, through the Engineer, a written report certifying that the equipment has been properly installed and lubricated, is in accurate alignment, is free from any undue stress imposed by connecting piping or anchor bolts, has been operated under full load conditions, and has operated satisfactorily.

### **3.04 COMPLETION INSPECTION**

- A. Final Completion Punch List: Near the completion of all Work the QC Officer shall inspect the Work and develop a "punch list" of items which do not conform to the approved Drawings and Specifications. Such a list of deficiencies shall be included in the QC documentation and shall include the estimated date by which the deficiencies will be corrected. The QC Officer or staff shall make a second inspection to ascertain that all deficiencies have been corrected. Once this is accomplished, the Contractor shall notify the Engineer and Owner that the Facility is ready for the Engineer's final inspection.
- B. Final Inspection and Acceptance: The Contractor's QC Officer and the Engineer will attend this inspection. Additional Engineer and Owner personnel may also be in attendance. The final acceptance inspection will be formally scheduled by the Engineer when all punch list deficiencies have been corrected. Notice will be given to the Engineer at least 14 days before the final inspection and must include the Contractor's assurance that all punch list items will be complete and acceptable by the date scheduled for the final inspection. Failure of the Contractor to have all Contract Work acceptably complete for this inspection will be cause for noncertification of final payment by the Engineer.

### **3.05 NOTIFICATION OF NONCOMPLIANCE**

- A. The Engineer will notify the Contractor of any detected noncompliance with the foregoing requirements. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Engineer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

### **3.06 REPAIR AND PROTECTION**

- A. On completion of testing, inspection, sampling, and similar services, the Contractor shall repair damaged construction and restore substrates and finishes.
- B. The Contractor shall protect all construction exposed by or for QC service activities.
- C. The repair and protection are the Contractor's responsibilities, regardless of the assignment of responsibility for QC services.

**END OF SECTION**

**SECTION 01450**  
**TESTING AND TESTING LABORATORY SERVICES**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. The Owner will pay for the costs of all passing laboratory tests required to determine soil density and concrete compressive strength. The cost of all testing shall be paid for from the Bid Item allowance as stated in the Bid Form. Costs will be determined from direct invoices from the testing laboratory to the Contractor. Failed tests will be back-charged to the Contractor at the time of final payment. All required soil, concrete, and bacteriological water testing shall be coordinated with and scheduled by the Contractor.
  - 1. The Contractor shall cooperate with the laboratory to facilitate the execution of required services.
  - 2. The Owner shall approve the selection of the testing laboratory.
  - 3. Employment of a testing laboratory shall in no way relieve the Contractor of the obligation to perform work in accordance with the requirements of the Contract Documents.

**1.02 RELATED WORK**

- A. Conditions of the Contract: Inspections and testing required by laws, ordinances, rules, regulations, orders, or approvals of public authorities.
- B. Respective Sections: Certification of products.
- C. Each Section listed: Laboratory tests required and standards for testing.
- D. Testing Laboratory inspection, sampling, and testing are required for but are not limited to the following:
  - 1. Section 01330, Submittals and Acceptance.
  - 2. Section 01650, Delivery, Storage, and Handling.
  - 3. Section 01780, Warranties and Bonds.
  - 4. Section 02230, Site Preparation.
  - 5. Section 02305, Earthwork for Utilities.
  - 6. Section 03200, Concrete Reinforcement.
  - 7. Section 03300, Cast-In-Place Concrete.
  - 8. Section 11000, General Equipment Requirements.
  - 9. Section 15055, Piping Systems—General.

## 1.03 SUBMITTALS

- A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance.
- B. Submit to the Engineer for review a list and schedule of all tests to be conducted.
- C. Describe test procedures along with duration of tests.
- D. After each inspection and test, the Laboratory shall promptly submit two copies of the laboratory report to the Engineer, one copy to the Contractor, and one copy to the Owner.
- E. Include the following:
  - 1. Date issued.
  - 2. Project title and number.
  - 3. Name of field-testing technician or inspector.
  - 4. Date and time of sampling or inspection.
  - 5. Identification of product and Specifications Section.
  - 6. Location in the Project.
  - 7. Type of inspection or test.
  - 8. Date of test.
  - 9. Results of test.
  - 10. Conformance with Contract Documents.
- F. When requested by the Engineer, provide interpretation of test results.

## 1.04 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American Society for Testing and Materials (ASTM)
  - 1. ASTM D3740—Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
  - 2. ASTM E329—Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.

## 1.05 QUALITY ASSURANCE

- A. The Laboratory is not authorized to do any of the following:
  - 1. Release, revoke, alter, or enlarge on requirements of Contract Documents.
  - 2. Approve or accept any portion of the work.
  - 3. Perform any duties of the Engineer of Record or the Engineer.
- B. The Contractor shall be responsible for the following:
  - 1. Cooperating with laboratory personnel, providing access to work and to manufacturer's operations.
  - 2. Securing and delivering to the laboratory adequate quantities of representative samples of materials proposed to be used and which require testing.
  - 3. Providing to the laboratory the preliminary design mix proposed to be used for concrete and other materials mixes which require control by the testing laboratory.
  - 4. Furnishing incidental labor and facilities:
    - a. To provide access to work to be tested.
    - b. To obtain and handle samples at the project site or at the source of the product to be tested.
    - c. To facilitate inspections and tests.
    - d. To store and cure test samples.
  - 5. Notifying the Engineer and laboratory sufficiently in advance of operations to allow for the laboratory to assign personnel and schedule tests.
  - 6. Employing and paying for the services of the same or a separate, equally qualified independent testing laboratory to perform additional inspections, sampling, and testing required for the Equipment Supplier or Contractor's (as applicable) convenience.
- C. Materials and equipment used in the performance of Work under this Contract are subject to inspection and testing at the point of manufacture or fabrication. Standard requirements for quality and workmanship are indicated in the Contract Documents. The Engineer may require the equipment supplier or Contractor (as applicable) to provide statements or certificates from the manufacturers and fabricators that the materials and equipment provided by them are manufactured

or fabricated in full accordance with the standard specifications for quality and workmanship indicated in the Contract Documents. All costs of this testing and providing statements and certificates shall be a subsidiary obligation of the Contractor, and no extra charge to the Owner shall be allowed on account of such testing and certification.

- D. If the test and any subsequent retest results indicate that the materials or equipment fail to meet the requirements of the Contract Documents, the equipment supplier or Contractor (as applicable) shall pay for the laboratory costs directly to the testing firm and these will not be reimbursable to the equipment supplier or Contractor (as applicable).

#### 1.06 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

#### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

#### 1.08 QUALIFICATIONS

- A. Comply with requirements of ASTM D3740 and ASTM E329.
- B. Laboratory: Licensed to operate in Florida.
- C. Laboratory Staff: Maintain a full-time Professional Engineer registered in Florida on staff to review the services performed under this project.
- D. Testing Equipment: Calibrated at reasonable intervals with devices of accuracy traceable to either National Bureau of Standards (NBS) or accepted values of natural physical constants.
- E. Provide qualified personnel at the site. Cooperate with the Engineer and Contractor in performing services.
- F. Perform specified inspection, sampling, and testing of products in accordance with specified standards.
- G. Ascertain compliance of materials and mixes with requirements of Contract Documents.

H. Promptly notify the Engineer and Contractor of observed irregularities or non-conformance of Work or Products.

I. Perform additional inspections and tests required by Engineer.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01500**  
**TEMPORARY FACILITIES AND CONTROLS**

**PART 1 GENERAL**

**1.01 RELATED WORK**

- A. Section 01650, Delivery, Storage, and Handling.
- B. Section 01780, Warranties and Bonds.

**1.02 WARRANTIES**

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

**1.03 DELIVERY, STORAGE, AND HANDLING**

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

**1.04 RESPONSIBILITY**

- A. This Section specifies the minimum requirements for temporary facilities, utilities, and controls required to provide an adequate and safe work site at every stage during construction of the Project. The Contractor is solely responsible for the requirements set forth in this Section.

**1.05 ON-SITE TEMPORARY**

- A. Except as otherwise indicated, the Contractor may, at his option, furnish stand-alone utility plants to provide needed services in lieu of connected services from available public utilities, provided such stand-alone plant facilities comply with all governing regulations. Before availability of temporary utility services, the Contractor will provide trucked-in/trucked-out containerized or unitized services for start-up of construction operations at the site.
- B. As part of the construction of this project, the Contractor shall provide an all-terrain vehicle (ATV) for the Owner to use when observing construction activities onsite. The ATV shall be Gator, or Owner-approved equal.

## 1.06 COSTS

- A. Except as otherwise indicated, the costs of providing and using temporary utility services are included in the contract sum.

## 1.07 TEMPORARY FACILITIES

- A. The types of utility services required for temporary use at the project site include the following (other specific services may be required for specific construction methods of operations):
  1. Electrical Power Service.
  2. Water Service (potable for certain uses).
  3. Sanitary.
  4. Storm Sewer or Open Drainage/Run-off Control.
  5. Gas (fuel) Service.
  6. Telephone Service.

## 1.08 TEMPORARY ELECTRICITY

- A. The Contractor shall make the necessary applications and arrangements and pay all fees and charges for electrical energy for power and light necessary for proper completion of the Work and during its entire progress up to time of final acceptance by the Owner. The Contractor shall provide and pay for all temporary switches, connections, and meters.

## 1.09 TEMPORARY WATER

- A. The Contractor shall make all necessary application and arrangements and pay all fees and charges for water necessary for the proper completion of the Project up to the time of final acceptance. The Contractor shall provide and pay for any temporary piping and connections.

## 1.10 TEMPORARY SANITARY FACILITIES

- A. The Contractor shall provide adequate sanitary facilities for the use of those employed on the Work. Such facilities shall be made available when the first employees arrive on the site of the Work, shall be properly secluded from public observation, and shall be constructed and maintained during the progress of the Work in suitable numbers and at such points and in such manner as may be required or approved.

## 1.11 CLEANLINESS OF FACILITIES

- A. The Contractor shall maintain the sanitary facilities in a satisfactory and sanitary condition at all times and shall enforce their use. He shall rigorously prohibit the committing of nuisances on the site of the Work, on the lands of the Owner, or on adjacent property.

## 1.12 TERMINATION AND REMOVAL

- A. At the time the need for a temporary utility service has ended or has been replaced by use of permanent services, or not later than the time of final completion, the Contractor shall promptly remove the installation unless requested by the Engineer to retain it for a longer period. Any work which may have been delayed or affected by the installation and use of the temporary utility, including repairs to construction and grades and restoration and cleaning of exposed surfaces, shall be completed at this time. The Contractor shall replace any work damaged beyond acceptable restoration.

## 1.13 NOISE CONTROL

- A. The Contractor shall provide adequate protection against objectionable noise levels caused by the operation of construction equipment.

## 1.14 DUST CONTROL

- A. The Contractor shall provide for adequate protection against raising objectionable dust clouds caused by moving construction equipment, high winds, or any other cause.

## 1.15 WATER CONTROL

- A. The Contractor shall provide for satisfactory disposal of surplus water and shall submit a plan to the Engineer for review before initiating and implementing the plan. Prior approval shall be obtained from the proper authorities for the use of public or private lands or facilities for such disposal.

## 1.16 POLLUTION CONTROL

- A. The Contractor shall provide for adequate protection against polluting any public or private lands, lakes, ponds, rivers, streams, creeks, and other such areas by the disposal of surplus material in the form of solids, liquids, gases, or from any other cause.

## 1.17 ADVERSE IMPACT

- A. The Contractor shall evaluate and assess the impact of any adverse effects on the natural environment which may result from construction operations and shall operate to minimize pollution of air, ground, or surface waters vegetation, and afford the neighboring community the maximum protection during and up to completion of the construction project.

## 1.18 STREAMS, LAKES, AND OTHER BODIES OF WATER

- A. The Contractor shall take sufficient precautions to prevent pollution of streams, lakes, and reservoirs with fuels, oils, bitumens, calcium chloride, or other harmful materials. He shall conduct and schedule his operations so as to avoid or otherwise prevent pollution of siltation of streams, lakes, and reservoirs and to avoid interference with the movements of migratory fish.

## 1.19 CHEMICALS

- A. All chemicals used during project construction or furnished for project operation, whether herbicide, pesticide, disinfectant, polymer, reactant, or of other classification, must show approval of either US EPA or USDA. Use of all such chemicals and disposal of residues shall be in strict conformance with instructions.

## 1.20 EROSION CONTROL

- A. The Contractor shall not expose by construction operations a larger area of erosive land at any one time than the minimum necessary for efficient construction operations, and the duration of exposure of the uncompleted construction to the elements shall be as short as practicable. Erosion-control features shall be constructed concurrently with other work and at the earliest practicable time.

## 1.21 STORAGE FACILITIES

- A. All products, materials, and equipment shall be stored in accordance with the manufacturer's instructions, with seals and labels intact and legible. Products subject to damage by the elements shall be stored in weathertight enclosures. Temperature and humidity shall be maintained within the ranges required by the manufacturer's instructions. Fabricated products shall be stored above the ground on blocking or skids. Products which are subject to deterioration shall be covered with impervious coatings with adequate ventilation to avoid condensation. Loose granular materials shall be stored in a well-drained area on solid surfaces to

prevent mixing with foreign matter. Any products which will come in contact with water shall be stored off the ground to prevent contamination.

#### 1.22 INSPECTION

- A. Storage shall be arranged in such a manner to provide easy access for inspection. Periodic inspections shall be made of all stored products to ensure that they are maintained under specified conditions and free from damage or deterioration.

#### 1.23 TEMPORARY PROTECTION

- A. After installation, the Contractor shall provide substantial coverings as necessary to installed products to protect them from damage from traffic and subsequent construction operations. Coverings shall be removed when no longer needed.

#### 1.24 ADJACENT TO WORK

- A. The Contractor shall protect from damage all property along the line of the Work or in the vicinity of or in any way affected by the Work, the removal or destruction of which is not called for by the Drawings. Wherever such property is damaged due to the activities of the Contractor, it shall be immediately restored to its original condition by the Contractor at no cost to the Owner.

#### 1.25 REMEDY BY OWNER

- A. In case of failure on the part of the Contractor to restore such property or make good such damage or injury, the Owner may, after 48 hours' notice to the Contractor, proceed to repair, rebuild, or otherwise restore such property as may be deemed necessary and the cost of such repairs, rebuilding, or restoration will be deducted from any monies due or which may become due to the Contractor under this Contract.

#### 1.26 PROTECTION FROM DAMAGE

- A. The Contractor shall be responsible for protecting property in the areas in the vicinity of the Project and for protecting his equipment, supplies, materials, and work against any damage resulting from the elements, such as flooding, rainstorm, wind damage, or other such damage, and shall be responsible for damage resulting from the same. The Contractor shall provide adequate drainage facilities, tie-downs, or other protection throughout the contract period for the protection of his, the Owner's, and other properties from such damage.

**1.27 TRAFFIC REGULATION**

- A. Signs, marking barricades, and procedures shall conform to the requirements of the Florida Department of Transportation Manual on Traffic Controls and Safe Practices for Street and Highway Construction, Maintenance, and Utility Operations.

**1.28 SIGNAGE**

- A. The Contractor shall provide and maintain adequate barricades around open excavations.

**1.29 REMOVAL OF SIGNAGE**

- A. On completion of the Work, the Contractor shall remove all debris, excess materials, barricades, and temporary work, leaving walkways and roads clear of obstructions.

**PART 2 PRODUCTS (NOT USED)**

**PART 3 EXECUTION (NOT USED)**

**END OF SECTION**

**SECTION 01600**  
**MATERIALS AND EQUIPMENT**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

This Section includes the minimum requirements for the furnished materials and equipment for this project. The more stringent requirements in the Technical Specification Sections shall take precedence over these requirements for any conflicts.

- A. Materials and equipment furnished by the Contractor shall be new and shall not have been in service at any other installation unless otherwise approved. They shall conform to applicable specifications approved in writing by the Engineer.
- B. Manufactured and fabricated products shall be designed, fabricated, and assembled in accordance with the best engineering and shop practices. Like parts of duplicate units shall be manufactured to standard sizes and gauges so that they are interchangeable.
- C. Quantities of items that are identical shall be by the same manufacturer, regardless of the Design Package breakdown.
- D. Equipment sizes, capacities, and dimensions shown or specified shall be adhered to unless variations are specifically approved in writing.
- E. Materials and equipment shall not be used for any purpose other than that for which they are designed or specified.
- F. Where materials or equipment are specifically shown or specified to be reused in the Work, special care shall be used in removing, handling, storing, and reinstalling to ensure their proper function in the completed Work.
- G. Material and equipment incorporated into the Work:
  - 1. Shall conform to applicable specifications and standards.
  - 2. Shall comply with size, make, type, and quality specified or as specifically approved in writing by the Engineer.

3. Manufactured and fabricated products:
  - a. Rotating machinery shall be designed and fabricated to provide satisfactory operation without excessive wear and without excessive maintenance during its operating life. Rotating parts shall be statically and dynamically balanced and shall operate without excessive vibration.

## 1.02 RELATED WORK

- A. Section III, General Conditions.
- B. Section 01000, Project Requirements.
- C. Section 01650, Delivery, Storage, and Handling.
- D. Section 01740, Final Cleaning.
- E. Section 01780, Warranties and Bonds.
- F. Section 01830, Operations and Maintenance Manuals.

## 1.03 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

## 1.04 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

## 1.05 ACCEPTANCE OF MATERIAL AND EQUIPMENT

- A. Only new materials and equipment shall be incorporated in the Work. All materials and equipment furnished by the Contractor shall be subject to the inspection and acceptance of the Engineer. No material shall be delivered to the site that does not meet the Contract Specifications.
- B. The Contractor shall submit data and samples sufficiently early to permit consideration and acceptance before materials are necessary for incorporating in the work. Any delay of acceptance resulting from the Contractor's failure to submit samples or data promptly shall not be used as a basis of claim against the Owner.
- C. The materials and equipment used in the Work shall correspond to the approved samples or other data.

- D. If requested, the Contractor shall be required to submit to the Engineer ample evidence that each and every part of the materials, machinery, and equipment to be furnished is of a reliable make and of a type that has been in successful operation within the continental United States. No equipment will be considered unless the manufacturer has designed and manufactured equipment of a comparable type and size for at least 3 years. The Engineer or Owner will not allow any experimental or untried type of material or machinery to be installed.
- E. The equipment specified shall be carefully designed and installed to ensure that it adequately performs all required functions within the specified degree of precision. Each unit shall operate with each of the other parts of the equipment to provide a completely integrated system that shall operate to the satisfaction of the Engineer and Owner.
- F. All equipment, machinery, parts, and assemblies of equipment, machinery, or parts entering into the Work shall be tested as specified. Unless waived in writing by the Engineer, all field and operating tests shall be made in the presence of the Engineer or the Engineer's authorized representative. When such a waiver is issued, the Contractor or manufacturer shall furnish sworn statements in duplicate of the tests conducted and the results of the tests to the Engineer.
- G. The Contractor shall submit copies of welding procedures for all welding. Welders and welding operators shall be selected in accordance with the qualification requirements of the AWS Code. Welders and welding operators for stainless steel shall pass qualification tests using stainless steel filler metal and procedures developed for stainless steel. Procedures, welder, and operator qualifications shall be certified by an independent testing laboratory retained and paid by the Contractor.
- H. The Contractor shall not start fabrication of the Work until the Contractor receives written acceptance of the proof of welding procedures from the Engineer for each type of weld.
- I. The Contractor shall submit copies of mill certificate for each type of rolled steel and as required in the Specifications. The Contractor shall not start fabrication of the work until the Contractor receives written acceptance of all mill certificates from the Engineer.

## 1.06 MANUFACTURER'S INSTRUCTIONS FOR INSTALLATION

- A. The equipment installation details shall suit the existing and furnished equipment and are subject to acceptance by the Engineer.

- B. Any changes or revisions made necessary by the type and dimensions of the equipment furnished shall be made at the expense of the Contractor who shall furnish detailed drawings showing such changes or revision for the acceptance of the Engineer.
- C. The installation of all work shall comply with the manufacturer's printed instructions. The Contractor shall obtain and distribute copies of such instructions to parties involved in the installation, including six copies to the Engineer for distribution. One complete set of instructions shall be maintained at the job site during installation and until the Project is complete.
- D. All products and equipment shall be handled, installed, connected, cleaned, conditioned, and adjusted in accordance with the manufacturer's instructions and specified requirements. Should job conditions or specified requirements conflict with the manufacturer's instructions, such conflicts shall be called to the Engineer's attention for resolution and revised instructions.
- E. The Contractor shall perform work according to the manufacturer's instructions and not omit any preparatory step or installation procedure unless the instructions are specifically modified or the step or procedure exempted by the Contract Documents.

## 1.07 INSTALLATION OF EQUIPMENT

- A. The cost of the Work shall include the cost of competent manufacturers' representatives of all equipment to supervise the installation, adjustment, and testing of the equipment and to instruct the Owner's operating personnel on operation and maintenance.
- B. A certificate from the manufacturer stating that the installation of the equipment is satisfactory, that the unit has been satisfactorily tested, is ready for operation, and that the operating personnel have been suitably instructed in the operation, lubrication, and care of the unit shall be submitted before Substantial Completion. The Manufacturer's Certificate of Compliance and Equipment Manufacturer's Certificate of Installation Testing and Instruction are included in Section 11000, General Equipment Requirements.
- C. The Contractor shall furnish the service of competent manufacturers' representatives for Contractor- or Owner-furnished equipment when evident malfunction or over-heating makes such services necessary or as determined by the Engineer. All such equipment shall be installed by skilled mechanics and in accordance with the instructions of the manufacturer.

- D. Special care shall be taken to ensure proper alignment of all equipment with particular reference to mechanical equipment such as pumps and electric drives. These units shall be carefully aligned on their foundations by qualified millwrights after their sole or base plates have been shimmed to true alignment at the anchor bolts. The anchor bolts shall be set in place and the nuts tightened against the shims. After the manufacturer has approved the foundation alignments, the bedplates or wing feet of the equipment shall be securely bolted in place. The alignment of equipment shall be further checked after securing to the foundations. After all alignments are confirmed, the sole or base plates shall be finally grouted in place. The Contractor shall be responsible for the exact alignment of equipment with associated piping, and under no circumstances, will "pipe springing" be allowed. Special installation requirements in the Technical Specifications shall take precedence over the requirements of this Section.
- E. The Contractor shall furnish all wedges, shims, filling pieces, keys, packing, grout, or other materials necessary to properly align, level, and secure an apparatus in place. All parts intended to be plumb or level must be proven exactly so. Any grinding necessary to bring parts to proper alignment after erection shall be done at the expense of the Contractor.
- F. The Contractor shall furnish the necessary materials and construct suitable concrete foundations or pads for all equipment installed by the Contractor, even though such foundations or pads may not be indicated on the Drawings. The tops of foundations shall be at such elevations as will permit grouting.
- G. In setting pumps, motors, and other items of equipment customarily grouted, the Contractor shall make an allowance of at least 1 inch (2.54 cm) for grout under the equipment bases. Shims used to level and adjust the bases shall be steel. Shims may be left embedded in the grout, in which case they shall be installed neatly and so as to be as inconspicuous as possible in the completed work. Unless otherwise permitted, all grout shall be a suitable non-shrinking grout.
1. Grout shall be mixed and placed in accordance with the recommendations of the manufacturer. Where practicable, the grout shall be placed through the grout holes in the base and worked outward and under the edges of the base and across the rough top of the concrete foundation to a peripheral form so constructed as to provide a suitable chamfer around the top edge of the finished foundation.
  2. Where such procedure is impracticable, the method of placing grout shall be as permitted. After the grout has hardened sufficiently, all forms, hoppers, and excess grout shall be removed, and all exposed grout surfaces shall be patched in an approved manner and, if necessary, as required by the Engineer, given burlap-rubbed finish, and painted with at least two coats of an acceptable paint.

## 1.08 SPECIAL TOOLS

- A. Manufacturers of equipment and machinery shall furnish two sets of any special tools (including grease guns or other lubricating devices) required for normal adjustment, operations and maintenance, and disassembly, together with instructions for their use. The Contractor shall preserve and deliver to the Owner these tools and instructions in good order before completing the Contract. Tools shall be high-grade, smooth, forged, alloy tool steel. Grease guns shall be lever-type.
- B. Special tools are considered to be those tools which because of their limited use are not normally available, but which are necessary for the particular equipment.
- C. Special tools shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such special tools until completion of the work, at which time they shall be delivered to the Owner.

## 1.09 LUBRICATION SYSTEM

- A. The minimum design criteria for lubricating moving parts of the equipment shall include 1 week of continuous operation during which no lubricants shall be added to the system.
- B. The system shall be designed to receive lubricants whether in operation or shut down and shall not leak or waste lubricants under either condition. The manufacturer's recommendations of grade and quality and a supply of the lubricants so recommended in quantities sufficient to conduct start-up and testing operations shall be furnished with the equipment.

## 1.10 TESTS AND TEST REPORTS

- A. When used in the Contract Documents, "Factory/Fabricating Shop Performance, Evaluation, Certification, and/or Acceptance Tests and Test Reports" shall be considered to mean the corresponding manufacturer's, fabricator's, and/or other builder's official test and tests reports. Included in these test reports shall be appropriate substantiating documentation/data ascertaining the correct and complete manufacture, fabrication, and "shop performance" (to the greatest extent normally practicable) of the particular material, equipment, system, and/or facilities proposed for eventual delivery. These are subdivided into three significant tests and test report types: 1) Certification Tests and Test Reports, 2) Factory Tests and Test Reports, and 3) Shop Performance/Evaluation Tests and Test Reports. Minimal requirements are described below.

B. Certification Tests and Test Reports

1. Standard specifications, code references, etc. for minimum quality and workmanship levels are indicated in the Contract Documents and Construction Documents. Statements, certificates, and other substantiating reporting data, called "Certification Test Reports" in this Section, of tests conducted on previously manufactured materials or equipment identical to that proposed for use shall be compiled by the Contractor.
2. At a minimum all Certification Test Reports shall contain an official analysis of sufficient material composition or show evidence of meeting or exceeding the specified material standard(s) referenced, e.g., ASTM, ASME, or other designations. All reports shall also indicate from whom the material was/will be purchased.
3. The Contractor shall pay all costs of certification tests and test reports.

C. Factory Tests and Test Reports

1. Additional tests and reports performed on material or equipment by the manufacturer or fabricator to ascertain quality or workmanship are referred to here as "Factory Tests and Test Reports."
2. Before the delivery of any Factory Test Report, the Contractor shall first submit for review and approval a detailed description of the proposed testing, including reporting procedure and criteria. Such descriptions shall also be delivered to the Engineer for review as part of the first submission of the technical submittal.
3. Materials and equipment used in the performance of the Work under this Contract are subject to inspection and testing at the point of manufacture or fabrication. If Work to be accomplished away from the construction site is to be inspected on behalf of the Owner during its fabrication or manufacture, the Contractor shall give prior notice to the Engineer of the place and time where such fabrication or manufacture is to be done. Such notice shall be in writing and delivered to the Engineer not less than 30 days before the Work is to be done so that the necessary arrangements for the particular factory inspection tests can be made.
4. Upon completion of the factory inspection tests and immediately following manufacture or fabrication, the Contractor shall compile a complete Factory Test Report following the approved format above. All such reports shall be delivered to the Engineer for review as part of the technical submittal corresponding to such tested material or equipment.

D. Shop Performance/Evaluation Tests and Test Reports

1. Material and equipment used in the performance of the Work of this Contract are also subject to evaluation and testing after the complete full-

- scale assembly into major equipment and/or systems. Shop Performance/Evaluation Tests, i.e., tests of simulated startup, steady-state, variable loading, and other normal operating conditions, for such assembled equipment/systems shall be accomplished in strict accordance with the standard testing practices specified or otherwise accepted by the Engineer.
2. Before the delivery of any Shop Performance/Evaluation Test Report, the Contractor shall submit for review a detailed description of the proposed performance/evaluation tests, including anticipated reporting procedures, data reduction, and criteria used. Where appropriate, such descriptions shall also be delivered to the Engineer for review as part of a first or subsequent submission of the technical submittal.
  3. Should such performance/evaluation tests be accomplished away from the construction site, the Contractor shall give prior notice to the Engineer of the places and times where such tests will be accomplished. Such prior notice shall be in writing and delivered not less than 30 days before such events so that necessary arrangements for the particular tests can be made.
  4. The requirements above pertaining to Factory Tests and Test Reports shall be incorporated for shop Performance/Evaluation Tests and Test Reports. Unless factory tests are coincident with shop performance tests and vice versa for the same material or equipment, a minimum of 15 days shall be scheduled between such multiple equipment tests where extended travel is required.

#### E. Cost of Performance Shop Tests

1. The Contractor shall conduct shop performance full-scale tests at its expense on all equipment as specified. Each piece of equipment shall be tested completely assembled and the shop tests performed by the equipment manufacturer until successful tests are achieved.
2. If the performance tests are conducted outside the continental United States, the Contractor shall pay all transportation expenses incurred by the Owner's representatives in witnessing the tests at no additional cost to the Owner.

### 1.11 FIELD TESTING

- A. Field testing shall be conducted when called for in the Technical Specification Sections and on all completed systems in general. The Contractor shall provide services of a factory-authorized service representative to perform, approve, and certify the field testing specified in this Section. Field testing shall generally consist of performing the pre-startup and startup tests as specified in the Division 11 Specifications and the final mechanical performance test specified in Section 11000, General Equipment Requirements. The Contract Documents may

require the Contractor to perform factory testing on equipment items before the Engineer approves their use for this project. The Contractor shall refer to the Division 11 Specifications regarding equipment shop testing requirements.

- B. After completing the installation, the Contractor shall test the system in the presence of the Engineer and under actual operating conditions. Tests shall be performed according to the manufacturer's recommendations.
- C. The Contractor shall include with its bid the services of the equipment manufacturer's field service technician for a period necessary to complete the Work to the satisfaction of the Engineer and the Owner.
- D. This service shall be for the purposes of checkout, initial start-up, certification, and instruction of facilities personnel.
- E. A written report covering the technician's findings and installation approval shall be submitted to the Engineer covering all inspections and outlining in detail any deficiencies noted.

## 1.12 ACCEPTANCE OF INSTALLATION

- A. The Engineer may accept an equipment system installation as ready for Substantial Completion when:
  - 1. The Engineer has accepted all factory tests and all other component testing.
  - 2. The Engineer has accepted all performance shop tests.
  - 3. All components of the system are installed and tested, including without limitation hydrostatic tests, leak tests, continuity tests, insulation resistance tests, phase rotation tests, bump tests, stroke testing, calibration, adjustment for proper operation, and all other component tests as appropriate.
  - 4. Field start-up activities have been completed and approved by the Engineer.
  - 5. The appropriate certificates have been submitted.
  - 6. All equipment has met the performance requirements.
  - 7. The Engineer has accepted integrated system tests and adjustments performed by the Contractor to demonstrate that the system as a whole functions reliably and meets the performance requirements, in manual and automatic modes, without failure, fault, or defect of any component or of the system as a whole.
  - 8. The Engineer has accepted integrated facilities tests performed by the Contractor to demonstrate that the entire Construction functions together reliably as an integrated facility and meets the performance requirements,

- in manual and automatic modes, without failure, fault, or defect of any component.
9. The Engineer has accepted facilities performance tests which demonstrate that the design criteria and performance criteria are met.
  10. The Engineer has accepted the O&M Manuals.
  11. All required Owner personnel have been trained.
  12. All other Contract requirements for Substantial Completion have been satisfied.

#### 1.13 GREASE, OIL, AND FUEL

- A. All grease, oil, and fuel required for start-up and testing of equipment shall be furnished with the respective equipment.
- B. The Contractor shall be responsible for changing the oil in all drives and intermediate drives of each mechanical equipment from after initial break-in of the equipment, which shall be no greater than 30 days.

#### 1.14 ELECTRICAL EQUIPMENT ENCLOSURES

- A. All items of electrical equipment that are furnished with process, heating, ventilating, or other equipment shall conform to the requirements specified under the appropriate electrical Sections of the Specifications. Enclosures for electrical equipment, such as switches and starters, shall conform to the requirements specified under the appropriate electrical Sections of the Specifications.

#### 1.15 EQUIPMENT DRIVE GUARDS

- A. Screens, guards, or cages shall be provided for all exposed rotating or moving parts in accordance with accepted practices of applicable governmental agencies. Unless specified otherwise in the Technical Specification Sections, guards shall be constructed of galvanized sheet steel or galvanized woven wires or expanded metal set in a frame of galvanized steel members. Guards shall be secured in position by steel braces or straps, which will permit easy removal for servicing the equipment.

#### 1.16 PROTECTION AGAINST ELECTROLYSIS

- A. Where dissimilar metals are used in conjunction with each other, suitable insulation shall be provided between adjoining surfaces so as to eliminate direct contact and any resultant electrolysis. The insulation shall be bituminous-impregnated felt, heavy -bituminous coatings, nonmetallic separators or washers, or other acceptable materials.

## 1.17 CONCRETE INSERTS

- A. Concrete inserts for hangers shall be designed to support safely, in the concrete that is used, the maximum load that can be imposed by the hangers used in the inserts. Inserts for hangers shall be of a type which will permit adjustment of the hangers both horizontally (in one plane) and vertically and locking of the hanger head or nut. All inserts shall be galvanized.

## 1.18 SLEEVES

- A. Unless otherwise indicated on the Drawings or specified, openings for the passage of pipes through floors and walls shall be formed of sleeves of standard-weight, galvanized-steel pipe. Each sleeve shall be of ample diameter to pass the pipe and its insulation, if any, and to permit such expansion as may occur. Sleeves shall be of sufficient length to be flush at the walls and the bottom of the slabs and to project 2 inches above the finished floor surface. Threaded nipples shall not be used as sleeves.
- B. Sleeves in exterior walls below ground or in walls to have liquids on one or both sides shall have a 2-inch annular fin of 1/4-inch plate welded with a continuous weld completely around the sleeve at about mid-length. Sleeves shall be galvanized after the fins are attached.
- C. All sleeves shall be set accurately before the concrete is placed or shall be built-in accurately as the masonry is being built.

## 1.19 SERVICES OF MANUFACTURER'S REPRESENTATIVE

- A. The Contractor shall arrange for a qualified service representative from each company manufacturing or supplying certain equipment as listed in this Section (or in the respective Technical Specification Sections) to perform the duties described in this Section.
- B. After the listed equipment has been installed and the equipment is presumably ready for operation but before it is operated by others, the representative shall inspect, operate, test, and adjust the equipment. The inspection shall include but not be limited to the following points as applicable:
  1. Soundness (without cracked, abraded, or otherwise damaged parts).
  2. Completeness in all details, as specified.
  3. Correctness of setting, alignment, and relative arrangement of various parts.
  4. Adequacy and correctness of packing, sealing, and lubricants.

- C. The operation, testing, and adjustment shall be as required to prove that the equipment is left in proper condition for satisfactory operation under the conditions specified.
- D. On completion of his or her work, the manufacturer's or supplier's representative shall submit in triplicate to the Engineer a complete, signed report of the result of the inspection, operation, adjustments, and tests. The report shall include detailed descriptions of the points inspected, tests and adjustment made, quantitative results obtained if such are specified, and suggestions for precautions to be taken to ensure proper maintenance. The report also shall include a certificate 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.
- E. After the Engineer has reviewed the reports from the manufacturer's representatives, the Contractor shall make arrangements to have the manufacturer's representatives present when the field acceptance tests are made.
- F. The Contractor, at a minimum, shall arrange for the service of qualified service representatives from the companies manufacturing or supplying the following equipment and as required in the Technical Specifications:
  - 1. Pumping Equipment
  - 2. Mixing Equipment.
  - 3. Sludge Holding Tank Covers.
  - 4. Level Controllers.
  - 5. Flow Meters.
  - 6. Instrumentation and Control Systems.
  - 7. Programmable Controllers.
  - 8. Electric Motors.

## PART 2 PRODUCTS (NOT USED)

## PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01650**  
**DELIVERY, STORAGE, AND HANDLING**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. This Section specifies the general requirements for the delivery, handling, storage, and protection of all items required in the construction of the Work. Specific requirements, if any, are specified with the related item.

**1.02 RELATED WORK**

- A. Section 01780, Warranties and Bonds.

**1.03 WARRANTIES**

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

**1.04 DELIVERY, STORAGE, AND HANDLING**

- A. The Contractor shall adhere to the requirements specified in this Section for storing and protecting the items.
- B. The Contractor shall do the following:
  - 1. Materials and equipment shall be loaded and unloaded by methods affording adequate protection against damage. Every precaution shall be taken to prevent injury to the material or equipment during transportation and handling. Suitable power equipment shall be used and the material or equipment shall be under control at all times. Under no condition shall the material or equipment be dropped, bumped, or dragged. When a crane is used, a suitable hook or lift sling shall be used. The crane shall be so placed that all lifting is done in a vertical plane. Materials or equipment skid loaded, palletized, or handled on skidways shall not be skidded or rolled against material or equipment already unloaded.
  - 2. Material and equipment shall be delivered to the job site by means that will adequately support it and not subject it to undue stresses. Material and equipment damaged or injured in the process of transportation unloading or handling shall be rejected and immediately removed from the site.

3. The Contractor shall coordinate the delivery of all materials, including those furnished by the Owner. The Contractor shall be responsible for the proper transport, handling, and storing of all materials, and materials shall be protected to ensure their expected performance. Delivery schedules shall be coordinated by the Contractor, in advance, so that the Work will be done in a timely manner. Under no circumstances shall the Owner's personnel or equipment be used to receive the Contractor's materials at the site. If the Contractor is not available to accept a delivery, it will be turned away.
4. The Contractor shall coordinate deliveries of products with construction schedules to avoid conflict with work and conditions at the site. The Contractor shall also do the following:
  - a. Deliver products in undamaged condition, in the manufacturer's original containers or packaging, with identifying labels intact and legible.
  - b. Immediately on delivery, inspect shipments to ensure compliance with requirements of the Contract Documents and approved submittals and to ensure that the products are properly protected and undamaged.
5. The Contractor shall provide equipment and personnel to handle products by methods to prevent soiling or damage to products or packaging.
6. All materials and equipment shall be stored on site in complete compliance with the manufacturer's recommendations.
7. Store products subject to damage by the elements in weather-tight enclosures.
8. Maintain temperature and humidity within the ranges required by the manufacturer's instructions.
9. Store fabricated products above the ground, on blocking or skids to prevent soiling or staining. Cover products that are subject to deterioration with impervious sheet coverings, and provide adequate ventilation to avoid condensation.
10. All materials and equipment to be incorporated in the Work shall be handled and stored by the Contractor before, during, and after shipment in a manner that will prevent warping, twisting, bending, breaking, chipping, rusting, and any injury, theft, or damage of any kind to the material or equipment.

11. All materials which, in the opinion of the Engineer, have become so damaged as to be unfit for the use intended or specified shall be promptly removed from the site of the Work, and the Contractor shall receive no compensation for the damaged material or its removal.
12. The Contractor shall arrange storage in a manner to provide easy access for inspection and make periodic inspections of stored products to ensure that products are maintained under specified conditions, free from damage or deterioration.
13. The Contractor shall provide substantial coverings as necessary to protect installed products from traffic damage and subsequent construction operations and shall remove these coverings when they are no longer needed.
14. Should the Contractor fail to take proper action on storage and handling of equipment supplied under this Contract, within 7 days after written notice to do so has been given, the Owner retains the right to correct all deficiencies noted in the previously transmitted written notice and deduct the cost associated with these corrections from the Contractor's Contract. These costs may include expenditures for labor, equipment use, administrative, clerical, engineering, and any other costs associated with making the necessary corrections.
15. Schedule delivery to reduce long-term onsite storage before installation and/or operation. Under no circumstances shall equipment be delivered to the site more than 1 month before installation without written authorization from the Engineer.
16. Coordinate delivery with installation to ensure minimum holding time for items that are hazardous, flammable, easily damaged, or sensitive to deterioration.
17. Deliver products to the site in the manufacturer's original sealed containers or other packing systems, complete with instructions for handling, storing, unpacking, protecting, and installing.
18. Unload and place all items delivered to the site in a manner which will not hamper normal construction operation nor that of subcontractors and other contractors and will not interfere with the flow of necessary traffic.
19. Provide necessary equipment and personnel to unload all items delivered to the site.

20. The Contractor shall store and protect products in accordance with the manufacturer's instructions, with seals and labels intact and legible. Follow storage instructions, review them with the Engineer, and keep a written record of this. Arrange storage to permit access for inspection.
21. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
22. Store cement and lime under a roof and off the ground and keep it completely dry at all times. All structural, miscellaneous, and reinforcing steel shall be stored off the ground or otherwise to prevent accumulations of dirt or grease and in a position to prevent accumulations of standing water and to minimize rusting. Beams shall be stored with the webs vertical. Precast concrete shall be handled and stored in a manner to prevent accumulations of dirt, standing water, staining, chipping, or cracking. Handle and store brick, block, and similar masonry products in a manner to keep breaking, cracking, and spilling to a minimum.
23. Store all mechanical and electrical equipment and instruments subject to corrosive damage by the atmosphere if stored outdoors (even though covered by canvas) in a weathertight building to prevent damage. The building may be a temporary structure on the site or elsewhere, but it must be satisfactory to the Engineer. The building shall be provided with adequate ventilation to prevent condensation. The Contractor shall ensure that temperature and humidity are maintained within the range required by the manufacturer.
  - a. All equipment shall be stored fully lubricated with oil, grease, and other lubricants unless otherwise instructed by the manufacturer.
  - b. Moving parts shall be rotated a minimum of once weekly to ensure proper lubrication and to avoid metal-to-metal "welding." Upon installation of the equipment, the Contractor shall start the equipment, at least at half load, once weekly for an adequate period to ensure that the equipment does not deteriorate from lack of use.
  - c. Lubricants shall be changed when installation is complete and as frequently as required thereafter during the period between installation and acceptance. The Contractor shall put new lubricants into the equipment at the time of acceptance.
  - d. Before accepting equipment that has been stored for some time, the Contractor shall have the manufacturer inspect the equipment and certify that its condition has not been detrimentally affected by the long storage period. Such certifications by the manufacturer

shall be deemed to mean that the equipment is judged by the manufacturer to be in a condition equal to that of equipment that has been shipped, installed, tested, and accepted in a minimum time period. As such, the manufacturer will guarantee the equipment equally in both instances. If such a certification is not given, the equipment shall be judged to be defective. It shall be removed and replaced at the Contractor's expense.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01720**  
**FIELD ENGINEERING**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

The Contractor shall do the following:

- A. Provide and pay for the following field engineering services required for the Project:
  1. Survey work required in the execution of the Project.
  2. Civil, structural, or other professional engineering services specified or required to execute the Contractor's construction methods.
  
- B. Retain the services of a registered land surveyor licensed in Florida to do the following:
  1. Identify existing control points and property line corner stakes as required.
  2. Verify all existing structure locations and all proposed structure corner locations, Sludge Holding Tank locations, and equipment locations within the Project site.
  3. Maintain an accurate location of all buried piping 4 inches in diameter and larger.

**1.02 RELATED WORK**

- A. Section 01100, Summary of Work.
- B. Section 01330, Submittals and Acceptance.
- C. Section 01650, Delivery, Storage, and Handling.
- D. Section 01780, Warranties and Bonds.
- E. Section 01785, Record Documents.

**1.03 SUBMITTALS**

- A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance.
  
- B. The Contractor shall submit to the Engineer the name and address of the registered land surveyor or professional engineer.

- C. On request of the Engineer, the Contractor shall submit documentation to verify the accuracy of field engineering work.
- D. At the end of the Project and before final payment, submit the certified drawings listed below with the Surveyor's title block (signed and sealed by the registered land surveyor) of the items listed below. These drawings shall be included with and made a part of the project record documents.
  - 1. Certified site survey at 1-inch = 10-foot scale on sheets 24 inches by 36 inches, indicating the building corners, sidewalks, paved areas, and location of all above-ground structures for the project site.
  - 2. Certified drawing showing the location, lines, and grades of all lines buried and exterior to buildings and other buried facilities (e.g., valves, tanks, vaults) installed as a result of the work. This shall be at the same scale as the Engineer's yard piping drawing and submitted on reproducible tracing paper.
  - 3. Certified drawings showing elevations of all existing and new structures, and equipment and existing adjacent structures and equipment in the treatment plant.

#### 1.04 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. All work will be performed in accordance with the Minimum Technical Standards set forth by the Board of Professional Surveyors and Mappers.

#### 1.05 QUALITY ASSURANCE

- A. Existing basic horizontal and vertical control points for the project are those designated on Drawings.
- B. Locate and protect control points before starting site work and preserve all permanent reference points during construction:
  - 1. Make no changes or relocations without prior written notice to the Engineer.
  - 2. Report to the Engineer when any reference point is lost or destroyed or requires relocation because of necessary changes in grades or locations.

3. Require the surveyor to correctly replace project control points which may be lost or destroyed.
4. Establish replacements based on original survey control.

## 1.06 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

## 1.07 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

## 1.08 QUALIFICATIONS

- A. Registered land surveyor of the discipline required for the specific service on the project, currently licensed in Florida.

## 1.09 SYSTEM DESCRIPTION

- A. The Contractor shall establish a minimum of two permanent benchmarks on the site, referenced to data established by survey control points:
  1. Record locations, with horizontal and vertical data, on Record Documents.
- B. Establish lines and levels, locate and layout, by instrumentation and similar appropriate means:
  1. Site improvements:
    - a. Stakes for grading, fill, and topsoil placement.
    - b. Concrete slabs.
    - c. Utility slopes and invert elevations.
  2. Building foundation, column locations, and floor levels.
  3. Controlling lines and levels required for mechanical and electrical trades.
- C. Periodically verify layouts by the same methods.
- D. Maintain a complete and accurate log of all control and survey work as the work progresses.

- E. As a condition for approval of monthly progress payment requests, update the project record drawings monthly based on the work performed during the month ending at the pay request. The Contractor shall coordinate this monthly with the Owner's representative on the site as part of the pay request.
- F. Maintain an accurate record of piping changes, revisions, and modifications.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01730**  
**CUTTING, CORING, AND PATCHING**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. The Contractor shall provide all cutting, coring, fitting, and patching, including attendant excavation and backfill, required to complete the Work or to accomplish the following:
  - 1. Uncover portions of the Work to provide for installation of ill-timed work.
  - 2. Remove and replace defective work.
  - 3. Remove and replace work not conforming to requirements of Subcontract Documents.
  - 4. Remove samples of installed work as specified for testing.
  - 5. Provide routine penetrations of non-structural surfaces for installing piping and electrical conduit.

**1.02 RELATED WORK**

- A. Section 01100, Summary of Work.
- B. Section 01330, Submittals and Acceptance.
- C. Section 01650, Delivery, Storage, and Handling.
- D. Section 01780, Warranties and Bonds.
- E. Division 2, Site Construction.
- F. Division 3, Concrete.

**1.03 SUBMITTALS**

- A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance.
- B. The Contractor shall submit a written request well in advance of executing any cutting or alteration which affects the following:
  - 1. Work of the Owner or any other Contractor.
  - 2. Structural value or integrity of any element of the Project.
  - 3. The integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.
  - 4. The efficiency, operational life, maintenance, or safety of operational elements.
  - 5. Visual qualities of elements exposed to view.

- C. The written request shall include the following:
1. Identification of the Project.
  2. Description of affected Work.
  3. The necessity for cutting, altering, or excavating.
  4. The effect on the work of the Owner or any other Contractor or on the structural or weatherproof integrity of the Project.
  5. Description of proposed Work:
    - a. Scope of cutting, patching, alteration, or excavation.
    - b. Trades which will execute the Work.
    - c. Products proposed to be used.
    - d. Extent of refinishing to be done.
  6. Alternatives to cutting and patching.
  7. Cost proposal, when applicable.
  8. Written permission of any other Contractor whose work will be affected.
- D. The Contractor shall submit written notice to the Engineer designating the date and the time the Work will be uncovered.

#### 1.04 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

## PART 2 PRODUCTS

### 2.01 MATERIALS

- A. Concrete and grout for rough patching shall be as specified in Division 3, Concrete.
- B. Materials for finish patching shall be equal to those of adjacent construction.

## PART 3 EXECUTION

### 3.01 INSPECTION

- A. The Contractor shall inspect existing conditions of project, including elements subject to damage or to movement during cutting and patching.
- B. After uncovering Work, the Contractor shall inspect conditions affecting installation of products or performance of the Work.
- C. The Contractor shall report unsatisfactory or questionable conditions to the Engineer in writing and shall not proceed with work until the Engineer has provided further instructions.
- D. All cutting and coring shall be performed in such a manner as to limit the extent of patching.
- E. All holes cut through concrete and masonry walls, slabs, or arches shall be core-drilled unless otherwise approved. No structural members shall be cut without approval of the Engineer or Engineer's representative, and all such cutting shall be done in a manner directed by the Engineer. No holes may be drilled in beams or other structural members without obtaining prior approval. All work shall be performed by mechanics skilled in this type of work.
- F. Rough patching shall be such as to bring the cut or cored areas flush with existing construction unless otherwise shown. Finish patching shall match existing surfaces as approved.

### 3.02 PREPARATION

- A. Provide adequate temporary support as necessary to ensure the structural value or integrity of the affected portion of the Work.
- B. Provide devices and methods to protect other portions of the Project from damage.

- C. Provide protection from elements for that portion of the Project which may be exposed by cutting and patching work and maintain excavations free from water.
- D. Perform coring with an approved non-impact rotary tools with diamond core drills. The size of the holes shall be suitable for pipe, conduit, sleeves, and equipment or mechanical seals to be installed.
- E. Ensure that all equipment conforms to OSHA standards and specifications pertaining to plugs, noise and fume pollution, wiring, and maintenance.
- F. Provide protection for existing equipment, utilities, and critical areas against water or other damage cause by drilling operation.
- G. Following drilling, vacuum or otherwise remove from the area all slurry or tailings resulting from coring operations.

### 3.03 PERFORMANCE

- A. Cut and demolish by methods which will prevent damage to other work and will provide proper surfaces to receive installation of repairs.
- B. Excavate and backfill by methods which will prevent settlement or damage to other work.
- C. Employ the original installer or fabricator to perform cutting and patching for the following:
  - 1. Weather-exposed or moisture-resistant elements.
  - 2. Sight-exposed finished surfaces.
- D. Fit and adjust products to provide a finished installation to comply with specified products, functions, tolerances, and finishes.
- E. Cut with a concrete wall saw and diamond saw blades of proper size.
- F. Control slurry generated by sawing operation on both sides of wall.
- G. When cutting a reinforced concrete wall, cut so as not to damage the bond between the concrete and reinforcing steel left in structure. Make the cut so that steel neither protrudes nor is recessed from the face of the cut.

- H. Install adequate bracing of the area to be cut before cutting starts. Check the area during sawing operation for partial cracking and provide additional bracing as required to prevent a partial release of the cut area during sawing operations.
- I. Provide equipment of adequate size to remove cut panel.
- J. Restore work which has been cut or removed; install new products to provide completed work in accordance with requirements of Subcontract Documents.
- K. Fit work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- L. Refinish entire surfaces as necessary to provide an even finish to match adjacent finishes:
  - 1. For continuous surfaces, refinish to the nearest intersection.
  - 2. For an assembly, refinish the entire unit.
- M. Provide for Proper Pavement Restoration: The Contractor shall restore existing paving, including underdrains if any are encountered and broken into, and shall replace or rebuild the paving using the same type of construction as was in the original. The Contractor shall be responsible for restoring all such work, including subgrade and base courses where present. The Contractor shall obtain and bear the expense of such local or other governmental permits as may be necessary.

END OF SECTION

**SECTION 01735**  
**CONTROL OF WORK**

**PART 1 GENERAL**

**1.01 RELATED WORK**

- A. Section 01500, Temporary Facilities and Controls.

**1.02 PRIVATE LAND**

- A. Do not enter or occupy private land outside of easements, except by permission of the landowner.

**1.03 PIPE LOCATIONS**

- A. Locate pipelines substantially as indicated on the Contract Drawings. The Engineer reserves the right to make such modifications in locations as may be found desirable to avoid interference with existing structures or for other reasons. Where fittings are noted on the Contract Drawings, such notation is for the Contractor's convenience and does not relieve him of laying and jointing different or additional items where required.

**1.04 OPEN EXCAVATIONS**

- A. Adequately safeguard all open excavations by providing temporary barricades, caution signs, lights, and other means to prevent accidents to persons and damage to property. Provide suitable and safe bridges and other crossings for accommodating travel by pedestrians and workers. Remove bridges provided for access during construction when no longer required. The length or size of excavation will be controlled by the particular surrounding conditions, but shall always be confined to the limits prescribed by the Engineer. If the excavation becomes a hazard or if it excessively restricts traffic at any point, the Engineer may require special construction procedures, such as limiting the length of the open trench, prohibiting stacking excavated material in the street, and requiring that the trench be closed overnight.
- B. Take precautions to prevent injury to the public due to open trenches. Provide adequate light at all trenches, excavated material, equipment, or other obstacles that could be dangerous to the public at night.

## 1.05 TEST PITS

- A. Excavate test pits, at the direction of the Engineer, to locate underground pipelines or structures in advance of the construction. Backfill test pits immediately after their purpose has been satisfied and restore and maintain the surface in a manner satisfactory to the Engineer.

## 1.06 MAINTENANCE OF TRAFFIC

- A. Unless permission to close a street is received in writing from the proper authority, place all excavated material so that vehicular and pedestrian traffic may be maintained at all times. If the construction operations cause traffic hazards, repair the road surface, provide temporary ways, erect wheel guards or fences, or take other measures for safety satisfactory to the Engineer.
- B. Maintenance of traffic shall be in accordance with the latest edition of the Florida Department of Transportation (FDOT) Standards. Detours around construction will be subject to the approval of the Owner and the Engineer. Where detours are permitted, provide all necessary barricades and signs as required to divert the flow of traffic. Expedite construction operations while traffic is detoured. The Owner will strictly control periods when traffic is being detoured.
- C. Take precautions to prevent injury to the public due to open trenches. Night watchmen may be required where special hazards exist or police protection provided for traffic while work is in progress. The Contractor shall be fully responsible for damage or injuries whether or not police protection has been provided.

## 1.07 CARE AND PROTECTION OF PROPERTY

- A. The Contractor shall be responsible for preserving all property and use every precaution necessary to prevent damage to property. If any direct or indirect damage is done to any property by or on account of any act, omission, neglect, or misconduct in the execution of the work on the part of the Contractor, the Contractor shall restore such property to a condition similar or equal to that existing before the damage was done or make good the damage in other manner acceptable to the Engineer.

## 1.08 PROTECTION AND RELOCATION OF EXISTING STRUCTURES AND UTILITIES

- A. The Contractor shall assume full responsibility for protecting all buildings, structures, and utilities, public or private, including poles, signs, services to buildings, utilities in the street, gas pipes, water pipes, hydrants, sewers, drains, and electric and telephone cables, whether or not they are shown on the Contract

Drawings. Carefully support and protect all such structures and utilities from injury of any kind. Immediately repair any damage resulting from the construction operations.

- B. The Contractor shall bear full responsibility for obtaining all locations of underground structures, utilities, and facility yard piping (including existing water services, drain lines, and sewers). The Contractor shall maintain services to buildings and pay costs or charges resulting from damage to such services.
- C. Notify all utility companies in writing at least 72 hours (excluding Saturdays, Sundays, and legal holidays) before excavating in any public way. Also notify Sunshine State One Call of Florida, telephone 1-800-638-4097 at least 72 hours before starting work.
- D. If, in the opinion of the Engineer, permanent relocation of a utility owned by the Owner is required, the Engineer may direct the Contractor, in writing, to perform the work. Work so ordered will be paid for at the Contract unit prices, if applicable, or as extra work under the General Conditions. If relocation of a privately-owned utility is required, the Engineer will notify the Utility to perform the work as expeditiously as possible. The Contractor shall cooperate with the Engineer and Utility. No claim for delay will be allowed due to such relocation.
- E. Protection and temporary removal and replacement of existing utilities and structures as described in this Section shall be part of the work under the Contract and all costs associated shall be included in the Contract Price.
- F. Coordinate the removal and replacement of traffic loops and signals, if required for the performance of the work, at no additional cost to the Owner.

## 1.09 WATER FOR CONSTRUCTION PURPOSES

- A. Water for construction purposes shall be used in accordance with Section 01500, Temporary Facilities and Controls.

## 1.10 MAINTENANCE OF FLOW

- A. Provide for the flow of sewers, drains, and water courses interrupted during the progress of the work, and immediately cart away and remove all offensive matter. Discuss the entire procedure of maintaining existing flow with the Engineer well in advance of the interruption of any flow.

## 1.11 COOPERATION WITHIN THIS CONTRACT

- A. All firms or persons authorized to perform any work under this Contract shall cooperate with the General Contractor and subcontractors or trades and assist in incorporating the work of other trades where necessary or required.
- B. Cutting and patching and drilling and fitting shall be carried out where required by the trade or subcontractor having jurisdiction, unless otherwise indicated in this Section or directed by the Engineer.

## 1.12 CLEANUP AND DISPOSAL OF EXCESS MATERIAL

- A. During the work keep the site of operations as clean and neat as possible. Dispose of all residue resulting from the construction work and at the conclusion of the work remove and haul away any surplus excavation, broken pavement, lumber, equipment, temporary structures, and any other refuse remaining from the construction operations and leave the entire site of the work in a neat and orderly condition.
- B. To prevent environmental pollution arising from the construction activities related to the performance of this Contract, comply with all applicable Federal, State, and local laws and regulations concerning waste material disposal, as well as the specific requirements stated in this Section and in other related sections.
- C. Disposing of excess excavated material in wetlands, stream corridors, and plains is strictly prohibited even if the permission of the property owner is obtained. Any violation of this restriction by the Contractor or any person employed by the Contractor will be brought to the immediate attention of the responsible regulatory agencies, with a request that appropriate action be taken against the offending parties. The Contractor will be required to remove the fill and restore the area impacted at no increase in the Contract Price.

## 1.13 CHARACTER OF THE CONTRACTOR'S SUPERINTENDENT AND WORKERS

- A. The Contractor's superintendent and project manager shall conduct themselves in a professional manner. If, in the opinion of the Owner and the Engineer, the superintendent and project manager do not conduct themselves in a professional and courteous manner, the Engineer can recommend to the Owner that the superintendent and/or the project manager be relieved of their responsibilities and removed from the project. Upon written notice from the Owner, the Contractor shall immediately remove the superintendent and/or the project manager of their responsibilities and removed from the project. The work of this project must be conducted under the supervision of a full-time superintendent.

- B. Any person employed by the Contractor or by any subcontractor who in the opinion of the Engineer does not conduct him/herself in a professional and courteous manner or is intemperate or disorderly, shall, at written request of the Engineer, be removed immediately by the Contractor or subcontractor employing such person, and that person shall not be allowed to work on any other portion of work in this Contract without written approval of the Engineer. Should the Contractor fail to remove such person(s) or fail to furnish suitable and sufficient personnel for the proper prosecution of the work, the Engineer may recommend to the Owner that the work be suspended until compliance with such orders has been met. Contract time will not be stopped during this time.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01740  
FINAL CLEANING

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. The Contractor shall execute cleaning during progress of the Work and at the completion of the Work as required by the General Conditions.

**1.02 RELATED WORK**

- A. Section 01350, Environmental Protection Procedures.
- B. Section 01650, Delivery, Storage, and Handling.
- C. Section 01780, Warranties and Bonds.

**1.03 WARRANTIES**

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

**1.04 DELIVERY, STORAGE, AND HANDLING**

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

**1.05 ENVIRONMENTAL CONCERNS**

- A. Cleaning and disposal operations shall comply with codes, ordinances, regulations, and anti-pollution laws and in accordance with Section 01350, Environmental Protection Procedures.

**PART 2 PRODUCTS**

**2.01 CLEANING MATERIALS**

The Contractor shall do the following:

- A. Use only those cleaning materials which will not create hazards to health or property and which will not damage surfaces.

- B. Use only those cleaning materials and methods recommended by the manufacturer of the surface material to be cleaned.
- C. Use cleaning materials only on surfaces recommended by the cleaning material manufacturer.

## PART 3 EXECUTION

### 3.01 PERIODIC CLEANING

The Contractor shall do the following:

- A. Execute periodic cleaning to keep the work, the site, and adjacent properties free from accumulations of waste materials, rubbish, and windblown debris.
- B. Provide onsite containers for the collection of waste materials, debris, and rubbish.
- C. Remove waste materials, debris, and rubbish from the site periodically and dispose of at legal areas away from the site.

### 3.02 DUST CONTROL

The Contractor shall do the following:

- A. Clean interior spaces before the start of finish painting and continue cleaning on an as-needed basis until painting is finished.
- B. Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly coated surfaces.

### 3.03 FINAL CLEANING

The Contractor shall do the following:

- A. Employ skilled workers for final cleaning.
- B. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from interior and exterior surfaces exposed to view.
- C. Broom clean exterior paved surfaces; rake clean other surfaces of the grounds.

- D. Before final completion or Owner occupancy, inspect interior and exterior surfaces exposed to view and all work areas to verify that the entire Work is clean.

END OF SECTION

**SECTION 01745**  
**MISCELLANEOUS WORK AND CLEANUP**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. The Contractor shall furnish all labor, materials, equipment, and incidentals required and perform the miscellaneous work not specified in other sections but obviously necessary for the proper completion of the work as shown on the Contract Drawings.
- B. When applicable, perform the work in accordance with other related sections. When no applicable specification exists, perform the work in accordance with the best modern practice and/or as directed by the Engineer.
- C. The work of this Section includes but is not limited to the following:
  - 1. Crossing and relocating existing utilities.
  - 2. Restoring bituminous concrete driveways and sidewalks.
  - 3. Cleaning up.
  - 4. Performing incidental work.
  - 5. Protecting and/or removing and reinstalling/replacing signs, lampposts, and fencing.
  - 6. Construction signage.
  - 7. Obtaining and complying with construction permits.
- D. Submit to the Engineer a breakdown of the lump sum for miscellaneous work and cleanup, including the above items at a minimum. This breakdown shall be subject to the approval of the Engineer and when so approved shall be the basis for determining progress payments and for negotiating change orders, if required.

**1.02 REFERENCE STANDARDS**

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. FDOT Design Standards for Design, Construction, Maintenance, and Utility Operations on the State Highway System

- 1. Index Series 600, "Traffic Control Through Work Zones."

## PART 2 PRODUCTS

### 2.01 MATERIALS

- A. Materials required for this Section shall be the same quality of materials that are to be restored. Where possible, re-use existing materials that are removed.

## PART 3 EXECUTION

### 3.01 CROSSING AND RELOCATING EXISTING UTILITIES

- A. Perform any extra work required in crossing culverts, watercourses including brooks and drainage ditches; storm drains; gas mains; water mains; electric, telephone, gas, and water services; and other utilities. This work shall include bracing, hand excavation, backfill (except crushed stone), and any other work required for crossing the utility or obstruction not included for payment in other items in the Bid Form. Notification of Utility Companies shall be as specified in Section 01355, Special Provisions.
- B. In locations where existing utilities cannot be crossed without interfering with the construction of the work as shown on the Drawings, remove and relocate the utility as directed by the Engineer or cooperate with the Utility Companies concerned if they relocate their own utility.
- C. At pipe crossings and where designated by the Engineer, furnish and place crushed stone bedding so that the existing utility or pipe is firmly supported for its entire exposed length. The bedding shall extend to the mid-diameter of the pipe crossed. Payment for crushed stone at pipe crossings will be made according to the unit price bid in the Bid Form.

### 3.02 RESTORING BITUMINOUS CONCRETE DRIVEWAYS AND SIDEWALKS

- A. Existing public and private driveways disturbed by the construction shall be replaced. Paved drives shall be repaved to the limits and thicknesses existing before construction. Gravel drives shall be replaced and regraded in kind.
- B. Existing public and private sidewalks disturbed by the construction shall be replaced with sidewalks of equal quality and dimension.

### **3.03 CLEANING UP**

- A. Remove all construction material, excess excavation, buildings, equipment, and other debris remaining on the job as a result of construction operations and restore the site of the work to a neat and orderly condition.

### **3.04 INCIDENTAL WORK**

- A. Perform all incidental work not otherwise specified but obviously necessary to the proper completion of the work as shown on the Drawings and as specified in this Section.

### **3.05 PROTECTION AND/OR REMOVAL AND REINSTALLATION/REPLACEMENT OF SIGNS, LAMPPOSTS, AND FENCING**

- A. Existing signs, lampposts, and fencing that may be damaged or removed when installing the new pipelines shall be reinstalled in a vertical position in the same location from which they were removed. Replace damaged items with items of equal or better quality than the damaged items. Provide a concrete anchor as necessary to ensure a rigid alignment. Exercise care in reinstalling all items to prevent damage to the newly installed pipelines.

### **3.06 CONSTRUCTION SIGNAGE**

- A. Furnish, install, maintain, and remove warning devices and traffic and construction signs in accordance with FDOT Index Series 600 and as directed by the Engineer.

### **3.07 PERMITS**

- A. The Contractor is responsible for obtaining and complying with all permits or their implementation, including the Minor Impact Wetlands Permit and the NPDES Construction Dewatering Permit.

**END OF SECTION**

**SECTION 01755**  
**EQUIPMENT TESTING AND STARTUP**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. The Contractor shall provide a competent field services technician of the manufacturers of all equipment furnished under Divisions 11, 13, 15, and 16 to supervise installation, adjustment, initial operation and testing, performance testing, final acceptance testing, and startup of the equipment.
- B. The Contractor shall perform specified equipment field performance tests, final acceptance tests, and startup services.

**1.02 RELATED WORK**

- A. Section 01330, Submittals and Acceptance.
- B. Section 01650, Delivery, Storage, and Handling.
- C. Section 01810, Watertightness Test for Hydraulic Structures.
- D. Section 01830, Operations and Maintenance Manuals.
- E. Section 11000, General Equipment Requirements, for Manufacturer's Certificate of Compliance form.
- F. Divisions 11, 13, 15, and 16 for performance and acceptance testing and startup requirements.

**1.03 SUBMITTALS**

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Submit name, address, and résumé of proposed field services technicians at least 30 days in advance of the need for such services.
- B. Submit for review detailed testing procedures for shop tests, field performance tests, and final acceptance tests as specified in the various equipment sections. Test procedures shall be submitted at least 30 days in advance of the proposed test dates and shall include at least the following information:
  - 1. Name of equipment to be tested, including reference to Specification Section number and title.
  - 2. Testing schedule of proposed dates and times for testing.

3. Summary of power, lighting, chemical, water, sludge, gas, etc., needs and identification of who will provide them.
  4. An outline of specific assignments of the responsibilities of the Contractor and manufacturers' factory representatives or field service personnel.
  5. Detailed description of step-by-step testing requirements, with reference to appropriate standardized testing procedures and laboratory analyses by established technical organizations (e.g., ASTM, WPCF Standard Methods, etc.).
  6. Samples of forms to be used to collect and record test data and to present tabulated test results.
- C. Submit copies of test reports upon completion of specified shop, performance, and acceptance tests. Test reports shall incorporate the information provided in the test procedures submittals, modified to reflect the actual conducting of the tests and the following additional information:
1. Copies of all test data sheets and results of lab analyses.
  2. Summary comparison of specified test and performance requirements vs. actual test results.
  3. Should actual test results fail to meet specified test and performance requirements, a description of actions to be taken before re-testing equipment.
- D. Submit copies of the manufacturer's field service technician's report summarizing the results of the initial inspection, operation, adjustment, and pre-tests. The report shall include detailed descriptions and tabulations of the points inspected, tests and adjustments made, quantitative results obtained, suggestions for precautions to be taken to ensure proper maintenance, and the equipment supplier's Certificate of Installation in the format specified in this Section.

#### 1.04 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American Society for Testing and Materials (ASTM)
- B. American Water Works Association (AWWA)
  1. AWWA C653—Disinfection for Water Treatment Plants.
- C. Water Pollution Control Federation (WPCF)

- D. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

## 1.05 QUALITY ASSURANCE

- A. Field service technicians shall be competent and experienced in the proper installation, adjustment, operation, testing, and startup of the equipment and systems being installed.
- B. Manufacturers' sales and marketing personnel will not be accepted as field service technicians.

## 1.06 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

## 1.07 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

## PART 2 PRODUCTS (NOT USED)

## PART 3 EXECUTION

### 3.01 PRELIMINARY REQUIREMENTS

- A. After the equipment has been installed and the equipment is presumably ready for operation but before it is operated by others, the manufacturer's field service technician shall inspect, operate, test, and adjust the equipment. The inspection shall include at least the following points where applicable:
  1. Soundness (without cracks or otherwise damaged parts).
  2. Completeness in all details, as specified and required.
  3. Correctness of setting, alignment, and relative arrangement of various parts.
  4. Adequacy and correctness of packing, sealing, and lubricants.
- B. The operation, testing, and adjustment shall be as required to prove that the equipment has been left in proper condition for satisfactory operation under the conditions specified.

- C. Upon completion of this work, the manufacturer's field service technician shall submit a signed report of the results of his/her inspection, operation, adjustments, and tests.

### 3.02 WITNESS REQUIREMENTS

- A. Shop tests or factory tests may be witnessed by the Owner and/or the Owner's representatives, as required by the various equipment specifications.
- B. Field performance and acceptance tests shall be performed in the presence of the Owner, the Owner's designated personnel, and/or the Owner's representatives.

### 3.03 STARTUP AND ACCEPTANCE OF THE TREATMENT PLANT AND RELATED SYSTEMS

#### A. General Requirements

1. Successfully execute the step-by-step procedure of startup and performance demonstration specified in this Section.
2. The startup and performance demonstration shall be successfully executed before Substantial Completion and acceptance by the Owner of the treatment plant and its related systems.
3. All performance tests and inspections shall be scheduled at least 5 working days in advance or as otherwise specified with the Owner and the Engineer. All performance tests and inspections shall be conducted during Monday through Friday, unless otherwise specified.

#### B. Preparation for Startup

1. Tanks and basins shall be flushed with reclaimed water and hydraulically checked for leaks, cracks, and defects in accordance with Section 01810, Watertightness Test for Hydraulic Structures.
2. All mechanical and electrical equipment shall be checked to ensure that it is in good working order and properly connected. Preliminary run-ins of the various pumps, compressors, and other remaining equipment shall be made. All systems shall be cleaned and purged as required. All sumps, tanks, basins, chambers, pump wells, and pipelines which are hydraulically checked shall be drained and returned to their original condition once the water testing is complete.
3. All instruments and controls shall be calibrated through their full range. All other adjustments required for proper operation of all instrumentation and control equipment shall be made.

4. The Contractor shall perform all other tasks needed for preparing and conditioning the treatment facilities for proper operation.
5. No testing shall be conducted or equipment operated until the Engineer has verified that all specified safety equipment has been installed and is in good working order.
6. No testing shall be conducted or equipment operated until the Engineer has verified that all lubricants, tools, maintenance equipment, spare parts, and approved equipment operation and maintenance manuals have been furnished as specified.

C. Facilities Startup

1. The startup period shall not begin until all new treatment facilities and equipment have been tested as specified and are ready for operation. The Owner shall receive spare parts, safety equipment, tools and maintenance equipment, lubricants, approved operation and maintenance data, and the specified operation and maintenance instruction before the startup with wastewater. All valves shall be tagged before this startup.
2. Demonstrate 7 consecutive 24-hour days of successful operation of the facility as a prerequisite of Substantial Completion and Acceptance.
3. If the facility fails to demonstrate satisfactory performance on the first or any subsequent attempt, the Contractor shall make all necessary alterations, adjustments, repairs, and replacements. When the facility is again ready for operation, it shall be brought on line and a new test shall be started. This procedure shall be repeated as often as necessary until the facility has operated continuously to the satisfaction of the Owner and Engineer for the specified duration.
4. The Owner will furnish all operating personnel (other than vendor's or subcontractor's service personnel) needed to operate equipment during the final test period; however, these personnel will perform their duties under the Contractor's direct supervision. Until performance tests are completed and units and systems are accepted by the Owner as substantially complete, the Contractor shall be fully responsible for the operation and maintenance of all new facilities.
5. The Owner will provide all necessary electricity. However, the Contractor shall provide all necessary personnel of the various construction trades, i.e., electricians, plumbers, etc., and field service personnel of the major equipment suppliers on an 8-hour-per-day basis at the facilities and on a

24-hour-per-day basis locally during the startup period. Major equipment suppliers shall include but not be limited to the following:

- a. Telemetry, Instrumentation, and Control Equipment.
  - b. Sludge Holding Tank Mixers.
  - c. Sludge Holding Tank Covers.
  - d. All Pumping Equipment.
6. At no time during startup shall the Contractor allow the facility to be operated in a manner that subjects equipment to conditions that are more severe than the maximum allowable operating conditions for which the equipment was designed.

END OF SECTION

**SECTION 01770  
PROJECT CLOSEOUT**

**PART 1 GENERAL**

**1.01 RELATED WORK**

- A. Section III, General Conditions.
- B. Section 01000, Project Requirements.
- C. Section 01650, Delivery, Storage, and Handling.
- D. Section 01740, Final Cleaning.
- E. Section 01780, Warranties and Bonds.
- F. Section 01785, Record Documents.
- G. Section 01830, Operations and Maintenance Manuals.

**1.02 WARRANTIES**

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

**1.03 DELIVERY, STORAGE, AND HANDLING**

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

**1.04 SUBSTANTIAL COMPLETION**

- A. When the Contractor considers that the Work or designated portion of the Work is Substantially Complete, the Contractor shall submit written notice to the Engineer with a list of items to be completed or corrected.
- B. If the Engineer's inspection finds that the Work is not substantially complete, the Engineer will promptly notify the Contractor in writing, listing observed deficiencies.
- C. The Contractor shall remedy deficiencies and send a second written notice of Substantial Completion.
- D. When the Engineer finds the Work is Substantially Complete the Engineer will prepare a Certificate of Substantial Completion.

## 1.05 FINAL COMPLETION

- A. When the Contractor considers that the Work or designated period of the Work is complete, the Contractor shall submit written certification to the Engineer indicating the following:
  - 1. The Contract Documents have been reviewed.
  - 2. The Work has been inspected for compliance with the Contract Documents.
  - 3. The Work has been completed in accordance with the Contract Documents and deficiencies listed with Certificates of Substantial Completion have been corrected.
  - 4. The Work is complete and ready for final inspection.
  - 5. All required shop drawings, catalog cuts, maintenance manuals, instruction manuals, test reports, samples, operational manuals, and all other submittals have been submitted and reviewed by the Engineer.
  - 6. All deliverables have been delivered or placed as accepted by the Engineer.
- B. If the Engineer's inspection reveals that the Work is incomplete, the Engineer will promptly notify the Contractor in writing listing observed deficiencies.
- C. The Contractor shall remedy deficiencies and send a second certification of Final Completion.
- D. When the Engineer finds that the Work is complete, the Engineer will consider closeout submittals.

## 1.06 REINSPECTION FEES

- A. If the status of Completion of Work requires more than one re-inspection by the Engineer due to failure of the Work to comply with the Contractor's claims on initial inspection, the Owner will deduct from the final payment to the Contractor the amount of the Engineer's compensation for additional re-inspection services.

## 1.07 CLOSEOUT SUBMITTALS

- A. Evidence of Compliance with Requirements of Governing Authorities:
  - 1. Certificate of Occupancy.
  - 2. All required Certificates of Inspection.
- B. Operation and Maintenance Manuals: Under provisions of Section 01830, Operations and Maintenance Manuals.

- C. Record Documents: Under provisions of Section 01785, Record Documents.
- D. Evidence of Payment and Release of Liens: In accordance with Conditions of the Contract.
- E. Consent of Surety to Final Payment.

#### 1.08 STATEMENT OF ADJUSTMENT OF ACCOUNTS

- A. Submit final statement reflecting adjustments to total Contract Price, indicating the following:
  1. Original total Contract Price.
  2. Previous change orders.
  3. Changes under allowances.
  4. Changes under unit prices.
  5. Deductions for uncorrected Work.
  6. Penalties and bonuses.
  7. Deductions for liquidated damages.
  8. Deductions for re-inspection fees.
  9. Other adjustments to total Contract Price.
  10. Total Contract Price as adjusted.
  11. Previous payments.
  12. Sum remaining due.
- B. The Engineer will issue a final Change Order reflecting approved adjustments to the total Contract Price not previously made by change orders.

#### 1.09 APPLICATION FOR FINAL PAYMENT

- A. Submit application for final payment in accordance with provisions of Conditions of the Contract.

#### PART 2 PRODUCTS (NOT USED)

#### PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01780**  
**WARRANTIES AND BONDS**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

The Contractor shall do the following:

- A. Compile specified warranties and bonds.
- B. Co-execute submittals when so specified.
- C. Review submittals to verify compliance with Contract Documents.
- D. Submit submittals to the Engineer for review.

**1.02 RELATED WORK**

- A. Section III, General Conditions.
- B. Section 01330, Submittals and Acceptance.
- C. Section 01600, Materials and Equipment.
- D. Section 01650, Delivery, Storage, and Handling.

**1.03 SUBMITTALS**

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Assemble warranties, bonds, and service and maintenance contracts executed by each of the respective manufacturers, suppliers, and subcontractors.
- B. Number of original signed copies required: two each.
- C. Table of Contents: Neatly typed, in sequence of the Specifications. Provide completion information for each item as follows:
  - 1. Product or work item.
  - 2. Firm, address, telephone and fax numbers, and name and email of principal.
  - 3. Scope.
  - 4. Date of beginning of warranty, bond, or service and maintenance contract.

5. Duration of warranty, bond, or service and maintenance contract.
  6. Provide information for Owner's personnel:
    - a. Proper procedure in case of failure.
    - b. Instances that might affect the validity of warranty or bond.
  7. Contractor, with address, telephone and fax numbers, and the name and email of responsible principal.
- D. Submittal of warranties, bonds, and service and maintenance contracts shall be included in submittals for review and before Final Completion with actual dates included.
- E. The Contractor's obligation to correct defective or nonconforming Work shall run for 1 year (or such longer period may otherwise be specified in the Contract Documents) beginning from the date Substantial Completion is achieved.

#### 1.04 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and this Section.
- B. All mechanical and electrical equipment together with devices of whatever nature and all components which are furnished and/or installed by the Contractor shall be guaranteed.
- C. The guarantee shall be against the manufacturing and/or design inadequacies, materials, and workmanship not in conformity, improper assembly, hidden damage, failure of devices and/or components, excessive leakage, or other circumstances which would cause the equipment to fail under normal design and/or specific operating conditions for 1 year or such longer period as may be shown and/or specified from and after the date of Substantial Completion.
- D. The Contractor shall replace and install each piece of equipment, device, or component which shall fail within the term specified above of the guarantee with reasonable promptness without increase in the Contract Price. If the Contractor fails to provide timely repairs as specified in this Section, the Owner shall issue a claim against the Contractor's Bond. In some instances, if approved by the Owner, the Contractor may be allowed to repair the equipment.

## 1.05 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01785**  
**RECORD DOCUMENTS**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. This Section details the minimum requirements for the Contractor for maintenance and recording of Record Documents.

**1.02 RELATED WORK**

- A. Section 01000, Project Requirements.
- B. Section 01330, Submittals and Acceptance.
- C. Section 01650, Delivery, Storage, and Handling.
- D. Section 01780, Warranties and Bonds.

**1.03 SUBMITTALS**

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. The Contractor shall store documents and samples in the Contractor's field office apart from documents used for construction and shall do the following:
  - 1. Provide files and racks for storage of documents.
  - 2. Provide cabinet or secure storage space for storage of samples.
- B. The Contractor shall institute a computerized record control program.
- C. The Contractor shall make documents and samples available at all times for inspection by the Engineer.
- D. At Contract closeout, the Contractor shall transmit Record Documents and samples with cover letter to the Engineer, listing the following:
  - 1. Date.
  - 2. Project title and number.
  - 3. Contractor's name and addresses.
  - 4. Number and title of each Record Document.
  - 5. Signature of Contractor or its authorized representative.
  - 6. Contract Section and Subsection numbers.
  - 7. Location.

- E. Before assembling and submitting records, the Contractor shall review for completeness the records maintained by its subcontractors.
- F. Tracings of all Construction Documents and Shop Drawings made by the Contractor, subcontractors, and suppliers of materials or equipment shall be corrected to show the Work as actually completed or installed.

#### 1.04 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

### PART 2 PRODUCTS (NOT USED)

### PART 3 EXECUTION

#### 3.01 PROJECT RECORD

- A. The Contractor shall label and file Record Documents and samples in accordance with the corresponding Specification Section number. Each document shall be labeled "PROJECT RECORD" in neat, large, printed letters. Record Documents shall be maintained in a clean, dry, and legible condition. Record documents shall not be used for construction purposes.

#### 3.02 RECORDING

The Contractor shall record construction information as follows:

- A. Record and update daily Record information from field notes on a set of opaque Drawings and to the satisfaction of the Engineer.
- B. Provide felt tip marking pens, maintaining separate colors for each major system, for recording information.
- C. Record information concurrently (daily) with construction progress. Work shall not be concealed until required information is recorded.

- D. Mark Record Drawings to reflect the following:
1. Measured horizontal and vertical locations of underground utilities and appurtenances referenced to permanent surface improvements.
  2. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of construction.
  3. Field changes of dimension and detail.
  4. Changes made by modifications.
  5. Details not on original Construction Drawings.
- E. CAD Requirements for Record Drawings: The Contractor shall provide the Engineer with a complete set of Record Drawings in the latest version of AutoCAD format upon completion of the Work. No additional compensation will be allowed for the Contractor to provide the Record Drawings. The Contractor shall use the AutoCAD Drawings furnished by the Engineer for this purpose. Record Drawings must be submitted in the AutoCAD format of the Contract Drawings. No other CAD software or format will be accepted. It is Contractor's sole responsibility to ensure that the Record Drawings conform to the following CAD requirements:
1. Drawings shall be submitted to the Engineer on CD-ROM. Each CD shall be clearly labeled with the appropriate project number, client name, date, and file names included on each CD. If files are compressed, a description of the compression software must be included along with a copy of the appropriate uncompressing software.
  2. All changes to Drawings must be done in accordance with the appropriate scale of the Drawing revised and shall be delineated by placing a "cloud" around the areas revised and adding a revision triangle indicating the appropriate revision number.
  3. Each Drawing must have the revision block completed to indicate the revision number, date, and initials of the person revising the Drawing. The description of the revision must say "Record Drawing." This procedure must be followed for every Drawing even when no changes are made to the Drawing.
  4. All revisions to Drawings must be put on separate layers with the layer names prefixed Record followed by the appropriate existing layer name. The colors and line types of the appropriate existing layers shall be adhered to when creating new layers.
  5. The Contractor shall supply one full set of Record Drawings on reproducible black line prints and five full sets of opaque copies.

- F. The Contractor shall have the Licensed Land Surveyor certify the Record Drawings as being correct and complete.

END OF SECTION

**SECTION 01810**  
**WATERTIGHTNESS TEST FOR HYDRAULIC STRUCTURES**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. The Contractor shall furnish all labor, materials, and incidentals required and perform tightness testing of water-containing structures as listed in this Section and all retesting until the structures meet the requirements as specified in this Section.

**1.02 RELATED WORK**

- A. Section 01330, Submittals and Acceptance.
- B. Section 01650, Delivery, Storage, and Handling.
- C. Section 01780, Warranties and Bonds.
- D. Division 3, Concrete.

**1.03 SUBMITTALS**

- A. Submit shop drawings in accordance with Section 01330, Submittals and Acceptance.
- B. Submit to the Engineer the results of each watertightness test of each structure. The submittal format shall be similar to that shown in Figure A attached to the end of this Section.

**1.04 REFERENCE STANDARDS**

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. The testing of reinforced concrete tanks or water containment structures shall conform to the following standards and as modified in this Section:
  - 1. American Concrete Institute (ACI) 350—Reinforced concrete water-retaining structures, 1R and as specified.

## 1.05 QUALITY ASSURANCE

- A. Coordinate timing and procedures for obtaining testing water and structure testing with the Owner well in advance of the actual testing.
- B. Water Source and Disposal:
  - 1. Water for testing shall be provided by the Owner.
  - 2. Water shall be plant reuse water. The Contractor shall supply all labor, equipment, and materials. The 72-hour water-tightness test shall include at a minimum monitoring water barrels, rain gauges, measuring devices, and weather monitoring.
  - 3. Test water shall be disposed of by the Contractor in an approved manner. Water shall not be disposed of by discharging it onto the ground surface of public or private land.

## 1.06 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

## 1.07 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

## PART 2 PRODUCTS (NOT USED)

## PART 3 EXECUTION

### 3.01 GENERAL

- A. The Contractor shall prepare structures for testing as follows:
  - 1. Inspect the structure to be tested for potential leakage paths such as cracks, voids, etc. and repair any leakage paths in compliance with the provisions specified in this Section or as approved by the Engineer.
  - 2. Thoroughly clean the structure to be tested of dirt, mud, and construction debris before beginning watertightness tests. The floor and sumps shall be flushed with water to provide a clean surface ready for testing.
  - 3. Inlet and outlet pipes not required to be operational for the tests may be temporarily sealed or bulkheaded before testing.

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4. Confirm the adequacy of seals around valves and reset or seal as approved by the Engineer. Estimates of valve leakage will not be allowed as adjustments to the measured tank or structure leakage.

## 3.02 TESTING PROCEDURES

### A. Conditions of Testing

1. The Contractor shall not begin initial filling of concrete structures until all concrete elements of the structure have been repaired and rehabilitated and the designed compressive strength of the concrete used in the repairs nor less than 14 days after the tank repair and rehabilitation or when the coating systems have been fully cured in accordance with the manufacturer's recommendations.
2. The Contractor shall fill unlined or partially lined concrete structures to the maximum operating water surface level and maintain the water at that level for at least 72 hours before beginning watertightness tests to minimize water absorption into the concrete during testing. The testing of fully lined concrete structures may be started as soon as the structure is filled.

### B. Testing Procedures

1. The duration of the test shall not be less than that required for a drop in the water surface of 1/2-inch based on the calculated maximum allowable leakage rate for 3 days.
2. Loss-of-volume measurements shall be taken at 24-hour intervals. The loss of volume is usually determined by measuring the drop in water surface elevation and computing the change in volume of the contained water. Measure water surface elevation at not less than two locations at 180° apart and preferably at four locations 90 degrees apart. Record water temperature 18 inches below the water surface when taking the first and last sets of measurements.

### C. Reports

1. Submit to the Engineer watertightness test results for each structure tested on the form shown in Figure A or a form with a similar format.
2. Notify the Owner and Engineer of the scheduling of tests 3 working days before the tests. The Engineer and Owner may monitor any watertightness testing performed on the structures.

### 3.03 ACCEPTANCE

- A. The following conditions shall be considered as NOT meeting the criteria for acceptance regardless of the actual loss of water volume from the structure:
  - 1. Groundwater leakage into the structure through floors, walls, or wall-floor joints.
  - 2. Structures which exhibit flowing water from joints, cracks, or from beneath the foundation (except for underdrain systems).
  - 3. Lined concrete structures on which moisture can be picked up by a dry hand from the exterior surface of the walls.
  
- B. The watertightness of concrete tanks and structures shall be considered acceptable when loss of water volume is within the criteria listed below:
  - 1. For unlined tanks with a sidewater depth of 25 feet or less, loss of volume not exceeding 0.1 percent in 24 hours.
  - 2. For tanks with lined walls and a sidewater depth of 30 feet or less, loss of volume not exceeding 0.06 percent in 24 hours. Steel diaphragms in concrete walls shall be considered the same as a wall liner.
  - 3. For completely lined tanks, loss of volume not exceeding 0.025 percent in 24 hours.

### 3.04 REPAIRS AND RETESTING

- A. The Contractor may retest structures failing the watertightness test and not exhibiting visible leakage after an additional stabilization period of 7 days. Tanks failing this second test shall be repaired before further testing.
  
- B. The Contractor shall repair structures which fail the watertightness test and structures showing visible leakage in compliance with the provisions specified in this Section or as approved by the Engineer.
  
- C. Repairs and retesting of tanks shall be accomplished at no additional cost to the Owner.

### 3.05 SCHEDULE (THE ENGINEER SHOULD IDENTIFY THE STRUCTURES FOR A SPECIFIC PROJECT)

- A. The following structures, where applicable, shall be tested for watertightness:
  - 1. Sludge Holding Tank.

FIGURE A  
WATERTIGHTNESS TEST REPORT

PROJECT \_\_\_\_\_

SUBMITTED BY \_\_\_\_\_

STRUCTURE\* \_\_\_\_\_

TEST DATES \_\_\_\_\_

Allowable loss of water volume \_\_\_\_\_ percent in 24 hours.

Measured loss of water volume \_\_\_\_\_ percent in 24 hours.

TEST READINGS

Water temperature at start \_\_\_\_\_ degrees F    Water temperature at end \_\_\_\_\_ degrees F

| Date     | Time  | Location 1 | Location 2 | Location 3 | Location 4 | Initials |
|----------|-------|------------|------------|------------|------------|----------|
| 1. _____ | _____ | _____      | _____      | _____      | _____      | _____    |
| 2. _____ | _____ | _____      | _____      | _____      | _____      | _____    |
| 3. _____ | _____ | _____      | _____      | _____      | _____      | _____    |
| 4. _____ | _____ | _____      | _____      | _____      | _____      | _____    |
| 5. _____ | _____ | _____      | _____      | _____      | _____      | _____    |

Change in level \_\_\_\_\_

Average change in level \_\_\_\_\_

Correction for precipitation/evaporation \_\_\_\_\_

Corrected change in level = CL = \_\_\_\_\_

(CD x (surface area) x (100)) = measured percent water loss in 24 hours.

(initial water volume) x (number of test days)

Notes and field observations\*\*

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\* Attach a sketch showing a plan of the structure and measurement locations.

\*\* Place date and initials at the beginning of each entry.

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END OF SECTION

**SECTION 01815**  
**MAINTENANCE OF PLANT OPERATION**  
**AND SEQUENCE OF CONSTRUCTION**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. The existing water pollution control facilities will be maintained in continuous operation by the Owner at all times during the entire construction period. The Contractor shall schedule and conduct his work such that it will not impede any treatment process, create potential hazards to operating equipment and/or personnel, reduce the quality of the plant effluent, or cause odor or other nuisance.
- B. The Contractor shall schedule his operations to conform to the requirements specified herein and shall include in his construction schedule all events which will impact operation of the existing treatment facilities.
- C. The Owner will continue to operate the treatment facilities during the construction period and will be responsible for maintaining effluent quality. The Contractor shall fully cooperate with the Owner, coordinate the construction schedule with the Owner and Engineer, and provide the necessary labor, equipment, and materials to prevent interruption to flow and treatment. The Owner and Engineer reserve the right to modify or expand the schedule during construction to meet prevailing conditions.
- D. The Contractor shall not make any alterations to affect operation of the treatment facility without giving 2 weeks prior written notice to the Owner and Engineer requesting authorization to proceed. Except as noted herein, the Owner will perform all operation of existing valves or equipment.
- E. Operation of valves or equipment by the Owner may be limited on specific occasions because of process limitations or unavailability of personnel. Delays caused by such limitations shall be expected and shall not be the basis for claim of extra costs by the Contractor.
- F. The work specified in this Section shall be accomplished at such times that will be convenient to the Owner. Overtime work by the Contractor to conform to these requirements shall be considered as normal procedure under this Contract, and the Contractor shall make no claim for extra compensation resulting from this overtime work.

- G. To maintain continuous treatment facilities operation during construction, a phased demolition, removal, and construction sequence shall be prepared by the Contractor. Specific constraints are outlined in this Section. The Contractor shall submit to the Engineer a detailed sequence of construction to complete the work while maintaining plant operation.
- H. The Contractor shall furnish all temporary materials and equipment that may be required to complete the work of this Contract.
- I. The Contractor shall be responsible for recording and reporting the details of all equipment used as part of Bypass, times of Owner-equipment shutdown, hours of Owner-equipment shutdown, Owner's resources used (water, electricity, etc., if any), processes affected, etc.

## 1.02 RELATED WORK

- A. Section 01330, Submittals and Acceptance, for construction schedule.
- B. Section 01650, Delivery, Storage, and Handling.
- C. Section 01780, Warranties and Bonds.
- D. Section 02220, Demolition and Modifications.

## 1.03 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Submit a complete description of procedures to maintain plant operation to supplement the construction schedule developed. The description shall include step-by-step procedures, required duration, and specific procedures required to be performed by the Owner's personnel.
- B. Submit complete plans of temporary systems required as part of this contract to maintain plant operations for Owner and Engineer review and acceptance. The plans shall clearly delineate the intended location of these items and the Contractor's proposed method for phasing from existing to temporary to completed facilities.

## 1.04 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

## 1.05 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

## PART 2 PRODUCTS (NOT USED)

## PART 3 EXECUTION

### 3.01 GENERAL

- A. The following constraints shall be applied to all equipment, treatment units, and appurtenances and utility systems on the plant site.
1. Vehicular access for the Owner's personnel to the plant site and to all operating treatment units shall be maintained at all times.
  2. Plant operating personnel shall have access to all areas that remain in operation.
  3. Potable water supply and effluent flushing water supply to the plant shall remain operational at all times.
  4. Sanitary facilities shall remain operational at all times.
  5. Electric power and lighting service shall be uninterrupted.
  6. If underground piping or utilities not shown on the Contract Drawings are encountered, such piping or utilities shall not be disturbed without prior written approval of the Engineer and the Owner.
  7. Before making a change in existing piping, electrical, or control systems, the Contractor shall inform the Owner and Engineer of such change and assist in instructing operations and maintenance personnel in any new operating procedures.
  8. Portions of some pipelines must remain in service while alterations are being made on other portions. Piping systems that must remain in service shall be isolated by placing blind flanges, plugs, or caps on all open ends.
  9. Flow to and through the treatment plant shall not be interrupted.
  10. Provide bypass pumping system and perform bypass pumping as required to complete the Work.
  11. Before shutting down a piece of equipment to allow for rebuilding or re-piping, the Contractor shall have on hand all materials required to reconstruct the piping system in its new arrangement.
  12. All temporary facilities provided by the Contractor must be demonstrated to be operational to the satisfaction of the Engineer before any existing systems can be removed from use. The temporary facilities are critical to the operation of the wastewater treatment facilities. Availability of these facilities must be maintained at all times. The Contractor must respond to

requests from the Engineer and Owner for repair and maintenance immediately (7 days per week, 24 hours per day, including holidays). If the Contractor fails to immediately respond to request for repair and maintenance, such repair and maintenance may be performed by the Owner. All costs associated with such repair and maintenance performed by the Owner shall be the responsibility of the Contractor.

### 3.02 DESCRIPTION OF WORK

- A. The following work is a general summary of the Work to be performed as part of this project in accordance with the Contract Documents and generally include, but is not limited to, the following (See Section 01100, Summary of Work, for additional description of the Work included in this project):
1. Demolition and Removal:
    - a. Sludge Holding Tank Cover, Vent, Piping, Grit, Sludge, Rags, and Walkway with associated Stairs and Hand-Rail.
    - b. Concrete Foundation, Equipment Pads, Stair Footer Support, and Stair Column Support.
  2. Remove and Preserve:
    - a. Dewatering Pumps for Owner use.
    - b. Odor Control Piping for replacement and integration into the new Sludge Holding Tank Cover.
    - c. Plug Valves where indicated on the Contract Drawings for Owner use.
  3. Repair and Refurbish:
    - a. Sludge Holding Tank.
  4. Construction:
    - a. Sludge Holding Tank Aluminum Cover and Mixer.
    - b. Dewatering Pumps, Valves, Piping, and appurtenances.
    - c. Truck Off-Loading and Recirculation Pump, Valves, Piping, and appurtenances.
    - d. Interconnecting Piping between the Anaerobic Digester Feed and 6-inch Sludge Bypass.
    - e. New Concrete Slabs, and Grading, and Drainage Improvements.
    - f. Electrical, and Instrumentation.

- B. The Contractor shall set up temporary dewatering feed pumps, piping, containment, valves, power, and control to allow the operations staff to continue to dewater anaerobic digested biosolids while the Sludge Holding Tank work and new pumps and piping are being installed. The Contractor shall be required to provide temporary dewatering feed pumps during the work. A suitable location for the Contractor to set up the temporary dewatering feed pumps, piping, and containment near the Sludge Holding Tank and Dewatering Building will be discussed with the City staff and a formal plan with layout, operation protocol, and sequencing will be submitted to the Owner and Engineer for approval. The agreed-on plan will be shown on the Contractor's As-Built Drawings. Minimum requirements that outline the responsibility of the Contractor to maintain flow from the anaerobic digester to the dewatering units during the work are shown on the Contract Drawings.

### 3.03 SPECIFIC CONSTRAINTS AND SEQUENCING

- A. The following constraints shall be applied to the sequencing of construction on the project. These constraints and sequencing do not purport to include all constraints for sequencing required for the construction of the project. The Contractor may propose alternate constraints and sequencing with the detailed sequence of construction required in Paragraph 1.01G for approval by the Owner and Engineer. The submittal must demonstrate that all requirements and the scope of work for this Section are met.
1. The scheduled deliveries and removal of the dewatered solids trailers shall not be interrupted during construction. Typical deliveries are to be directly coordinated with the Owner before construction to determine size and frequency. The west asphalt access and south asphalt access to the existing Dewatering Pad shall be used by the Contractor during construction of the new facilities and coordinated with the Owner. The daily transfer of digested sludge from the Anaerobic Digesters shall not be interrupted during construction.
  2. The dewatering of the anaerobically digested sludge from the Sludge Holding Tank shall not be interrupted during construction. The Contractor shall coordinate directly with the Owner before construction to determine frequency and duration of single-load dewatering activities and double-load dewatering activities. The Contractor is to coordinate directly with the Owner to determine the only time when dewatering does not typically occur. The Contractor is responsible for verifying this schedule with the Owner.
  3. The Dewatering Feed Bypass shall remain in service at all times for anaerobic digested sludge. The Contractor shall install temporary Dewatering Bypass Pumps as shown in the Contract Drawings, or as demonstrated in alternative bypass plan proposed by the Contractor and

approved by the Owner and Engineer, and will act as a temporary bypass during the construction and installation of the new dewatering equipment and associated piping, valves, concrete, and electrical. The Dewatering Feed Bypass shall have a dedicated containment area for any potential spills during moving, connecting, disconnecting, or maintaining equipment. The Contractor shall provide all temporary valves, pumps, and piping to perform the required work. Temporary bypass piping shall be constructed and installed in a method similar to the Bypass Piping Plan shown in the Contract Drawings. The Contract Drawings will show a feasible bypass option, but the Contractor may submit another bypass plan for Owner and Engineer approval. The Contractor is responsible for the actual means and methods employed.

4. The Contractor shall be responsible for maintaining all temporary systems during construction including complete containment of the equipment and piping to prevent any pumped contents from spilling to any uncontained, impervious surface.
5. The Contractor shall coordinate with the Engineer and Owner before taking any pumps, pipes, or other equipment out of service. All temporary systems shall be installed and operational, all flow diversion valves shall be checked and operable, and the appropriate flow channel shall be cleaned.
6. Operation responsibility (Owner or Contractor) will be outlined in the detailed Sequence of Construction and Maintenance of Plant Operation Plan provided by the Contractor for Owner and Engineer approval before starting the bypass.

B. Dewatering Feed Pumps:

1. The existing dewatering pumps have the following characteristics. This information is based on record documents and field information and should be confirmed by the Contractor:

|                   |   |
|-------------------|---|
| Number of Pumps:  | Three – (One Belt Filter Press, One Centrifuge, One Standby). |
| Pump Type:        | Progressing Cavity.   |
| Manufacturer:     | Moyno.  |
| Design Flow:      | 200 gallons per minute.                                       |
| Design TDH:       | 120 feet.   |
| Existing Pump HP: | 10.   |
| Voltage:          | 230/460.  |
| Phase:            | Three.  |
| Hertz:            | 60.   |

2. Once the dewatering bypass piping and containment has been completely constructed as indicated in the Contract Drawings, the Contractor shall coordinate directly with the Owner to take the Dewatering Pumps offline during a timeframe when there are no scheduled dewatering activities and the Digested Sludge from the Anaerobic Digester shall be diverted directly to the Contractor-provided Dewatering Feed Bypass Pumps for the duration of construction activities.
3. At least three Dewatering Feed Pumps shall remain in service during construction at all times after initial conversion to bypass. One pump shall be dedicated to the Belt Filter Press, one pump shall be dedicated to the Centrifuge, and one pump shall be standby with all three pumps capable of pumping to either the Belt Filter Press or the Centrifuge through the isolation of valves. The Contractor shall provide temporary power and perform any work required to maintain operation of the relocated Anaerobically Digested Sludge Dewatering System.
4. The Contractor shall have a minimum of one operating dewatering pump relocated to the bypass area with all electrical, piping, and appurtenance required for operation. The Contractor shall connect the dewatering bypass system to the Sludge Holding Tank during the schedule agreed to with the Owner when the Dewatering Operation is not occurring. The remaining dewatering pumps will be connected to the dewatering bypass no less than 3 days after initial connection and bypass startup.

#### C. Odor Control Reconnection

1. The Contractor shall ensure the Odor Control Piping is stored and protected on the pipe bridge during the Work describe herein. When the construction on the Sludge Holding Tank is completed, the Contractor may reconnect the Odor Control Piping to the Sludge Holding Tank at the discretion of the Owner.
2. Modifications may be needed to reconnect the existing Odor Control Piping to the penetration provided by the selected cover manufacturer. The Contractor shall coordinate this with the cover manufacturer and shall be responsible for the material and labor associated with the Odor Control piping modifications during reconnection.

END OF SECTION

## SECTION 01820 TRAINING

### PART 1 GENERAL

#### 1.01 SCOPE OF WORK

The Contractor shall do the following:

- A. Instruct and train the Owner's personnel in the operation and maintenance of the equipment and systems supplied and/or installed under this Contract.
- B. Incorporate operation and maintenance data and training services furnished by the suppliers into the training program such as shop drawings, equipment manuals, and start-up engineering and training assistance.
- C. Ensure that system suppliers provide a qualified training instructor to help the Contractor train the Owner's employees in the proper operation and maintenance of all equipment and systems.
- D. Prepare instructors and training materials required for complete factory, field, classroom, and hands-on training.
- E. Furnish training videos and manuals during the training program.
- F. Include in the total Contract Price the cost for training equipment; preparing training manuals; conducting classroom instructions; performing field, factory, and hands-on training; and coordinating and incorporating training service provided by suppliers and all other activities required to provide a comprehensive training program of sufficient length, as determined by the Owner.
- G. Conduct two separate training sessions for all items discussed in this document: one for the morning staff (7:00 A.M.) and one for the afternoon staff (2:00 P.M.).

#### 1.02 RELATED WORK

- A. Division III, General Equipment.
- B. Section 01000, Project Requirements.
- C. Section 01600, Materials and Equipment.
- D. Section 01650, Delivery, Storage, and Handling.
- E. Section 01780, Warranties and Bonds.
- F. Section 01830, Operations and Maintenance Manuals.
- G. Section 11000, General Equipment Requirements.

## 1.03 SUBMITTALS (NOT USED)

## 1.04 WORK SEQUENCE

- A. All factory training programs, if required, shall be completed before start-up of the Owner's system and shall use equipment similar to the Owner's equipment.
- B. The field training programs shall be conducted in accordance with the approved schedule.
- C. Individuals requiring training shall be trained in small groups during Mondays through Fridays. The Contractor will normally provide training during two separate training sessions: one for the morning staff (7:00 A.M.) and one for the afternoon staff (2:00 P.M.).
- D. The hands-on training shall be conducted with a maximum of 10 students per instructor.
- E. The Contractor shall coordinate and submit a training schedule to the Engineer 30 days before the first training event.

## 1.05 QUALITY ASSURANCE

- A. Preparation of training materials and instructions to be provided shall be performed by personnel:
  - 1. Trained and experienced in operation and maintenance of equipment and systems installed under this Contract.
  - 2. Familiar with the training requirements of the Owner.
- B. The Contractor shall furnish résumés, including three outside references, for each instructor to be used in the training program.
- C. The Engineer and Owner may review the résumés. Based on the review of the résumés and contacts with references, the Engineer shall approve, request additional information, or reject proposed instructors for the training program. If a proposed instructor is rejected, the Contractor shall submit the résumé and references of another candidate within a reasonable time.

## 1.06 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

## 1.07 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

## 1.08 TRAINING PLAN

- A. At the completion of the Work, the Contractor shall provide a competent and experienced person thoroughly familiar with the Work for not less than 3 days to instruct permanent operating personnel in the operation of equipment and control systems.
- B. Training shall be in accordance with the items herein and Section 11000, General Equipment Requirements.
- C. At least 30 days before training, the Contractor shall submit to the Engineer a detailed training plan including the following:
  1. Title and objectives.
  2. Training schedule.
  3. Prerequisite training and experience of attendees.
  4. Recommended types of attendees (e.g., managers, engineers, operators, maintenance staff).
  5. Course description and outline of course content.
  6. Duration.
  7. Location (e.g., training center or site).
  8. Format (e.g., lecture, self-study, demonstration, hands-on).
  9. Instruction materials and equipment requirements.

## 1.09 FORM OF TRAINING MANUALS

- A. The Contractor shall prepare training packages in the form of an instruction manual for use by the Owner's personnel. At least 30 days before the training, the Contractor shall submit the training packages to the Engineer for acceptance.
- B. Format
  1. Size: 8 1/2 x 11 inches (21.59 x 27.94 cm).
  2. Paper: 20-lb (9.072 kg) minimum, white, for typed pages.

3. Text: Manufacturer's printed data or neatly word processed including the following:
  - a. Table of contents.
  - b. Pretest.
  - c. Learning objectives.
  - d. General operations, theory, and specific equipment information.
4. Drawings
  - a. Provide reinforced punched binder tab, bind in with text.
  - b. Reduce larger drawings and fold to size of text pages, not larger than 11-x-17-inch (27.94-x-43.18-cm).
5. Cover: Identify each volume with the following:
  - a. Title of Project.
  - b. Identity of separate structure or system as applicable.
  - c. Identity of general subject matter covered in the manual.
  - d. Locations.

#### C. Binders

1. Commercial quality three-post binders with durable and cleanable plastic covers.
2. Maximum post width shall be 3 inches (7.62 cm).
3. When multiple binders are used, correlate the information into related consistent groupings.

### 1.10 VIDEOTAPED TRAINING MATERIAL

The Contractor shall do the following:

- A. Produce or provide video training material subject to approval of the Owner.
- B. Furnish four copies of each videotape in DVD format in plastic case with title, the Owner's name, and time on a label in a clear plastic sleeve.
- C. Bear all costs associated with production and provision of the DVDs.

### 1.11 INSTRUCTIONS

- A. At the completion of Work, the Contractor shall provide a competent and experienced person thoroughly familiar with the Work for a period of time as

- directed by the Owner to instruct permanent operating personnel in the operation of equipment and control systems.
- B. The Contractor shall furnish four complete sets of operating instructions applying to each piece of equipment installed in conjunction with this Contract.
  - C. An “As-Installed” diagram of all control wiring and operating instructions shall be mounted in a watertight pocket on the inside door of the control panel of each unit.
  - D. Unless otherwise specified, the Contractor shall provide engraved metal, plastic tags, or instructions on any valve, switch, control, pipe, or other piece of equipment which is not self evident as to its function or mode of operation. This includes, but is not limited to, all exposed piping and all switches. This shall particularly apply to operations which must be manually sequenced.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01830**  
**OPERATIONS AND MAINTENANCE MANUALS**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

The Contractor shall do the following:

- A. Compile product data and related information appropriate for the Owner's maintenance and operation of products furnished under the Contract.
  - 1. Prepare operating and maintenance data as specified in this Section and as referenced in other pertinent sections of the Specifications. The data presented in the O&M Manuals shall be specifically related to this Contract and application.
  - 2. Incorporate maintenance and operation data furnished by the Owner, if any.
- B. Furnish all labor, equipment, materials, and all other items to supply and deliver to the Engineer O&M Manuals for the Work in accordance with the requirements of this Section.
- C. Provide O&M Manuals for all equipment, including instrumentation, electrical, and process control system equipment and software for the entire Facility.

**1.02 RELATED WORK**

- A. Section 01000, Project Requirements.
- B. Section 01330, Submittals and Acceptance.
- C. Section 01785, Record Documents.
- D. Section 01820, Training.

**1.03 SUBMITTALS**

- A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:
  - 1. Manuals shall have individual-component levels containing the following:
    - a. Storage requirements.
    - b. Installation instructions.
    - c. Alignment instructions and tolerances.

- d. Operating instructions.
- e. Troubleshooting instructions.
- f. Lubrication requirements.
- g. Maintenance instructions.
- h. Parts list.
- i. Recommended spare parts list and how to obtain same.

B. Format:

- 1. Size: 8-1/2-x-11-inch (21.59-x-27.94-cm).
- 2. White paper: 20-pound (9.072-kg) minimum.
- 3. Text: Manufacturer's printed data or neatly word-processed.
- 4. Drawings:
  - a. Provide reinforced, punched binder tab, bind in with text.
  - b. Reduce larger drawings and fold to size of text pages but not larger than 11 x 17 inches (27.94 x 43.18 cm).
  - c. Place all drawings at the end of each section and drawing shall be printed on one side only.
- 5. Provide a blank page for each separate product or each piece of operation equipment.
  - a. Provide a word-processed description of the product and major component parts of equipment.
  - b. Provide indexed tabs.
- 6. Cover: Identify each volume with typed or printed title, "OPERATION AND MAINTENANCE INSTRUCTIONS," listing the following:
  - a. Title of Project.
  - b. Identity of separate structure as applicable.
  - c. Identity of general subject matter covered in the manual.

C. Media

- 1. Original word-processed CD shall be delivered to the Engineer.
- 2. All word processing must be done using the latest version of Microsoft Word or as directed by the Engineer.
- 3. All drawings except control system configuration drawings must be submitted on CD using AutoCAD.

D. Binders

1. Filled to not more than 75% capacity.
2. When multiple binders are used, arrange the data into related consistent groupings.

E. The Contractor shall submit the following:

1. Equipment Manuals—Five copies of the O&M Instruction Manual for each piece of equipment shall be submitted to the Engineer with delivery of the equipment. O&M manuals will not include the manufacturer's test results and Record specifications.
  2. Systems O&M Manuals—Five copies of the systems O&M Manuals, bound and indexed and submitted to the Engineer no later than 60 days before the Facility's Phase I start-up. Systems O&M Manuals will be complete except for field results and refinements added as result of demonstrations.
  3. Final O&M Manuals—Five copies of the Final Equipment and Systems O&M Manuals, bound and indexed and submitted to the Engineer before the Substantial Completion under this Contract.
  4. One copy of all Manuals shall be submitted on a USB drive.
  5. The cost of these Manuals submitted shall be included in the total Contract Price.
- F. Any modifications required after final O&M submission shall be made to the manuals by issuance of addenda in the form of change pages to the manual. The addenda will identify where the new data are to be inserted, what data are to be removed, and new index sheets as necessary and list of shop drawings and submittals.

#### 1.04 REFERENCE STANDARDS

Reference standards and recommended practices referred to herein shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. Florida Administrative Code (FAC), Rule 62-600.410, "Operation and Maintenance of Domestic Wastewater Facilities."

## 1.05 QUALITY ASSURANCE

- A. Data shall be prepared by personnel:
  - 1. Trained and experienced in maintaining and operating the described products.
  - 2. Familiar with requirements of this Section.
  - 3. Skilled as a technical writer to the extent required to communicate essential data.
  - 4. Skilled as a draftsman competent to prepare required drawings.

## 1.06 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

## 1.07 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

## 1.08 CONTENTS, EACH VOLUME

- A. Neatly word-processed table of contents for each volume, arranged in systematic order, to include the following:
  - 1. Contractor, name of responsible principal, address, fax number, and telephone number.
  - 2. A list of each product required to be included, indexed to content of the volume.
  - 3. A list with each product, name, address, fax number, and telephone number of the following:
    - a. Subcontractor or installer.
    - b. A list of each product to be included, indexed to content of the volume.
    - c. Identify area of responsibility of each subcontractor or installer, if more than one.
    - d. Local source of supply for parts and replacement.
    - e. Manufacturer.

4. Identify each product by product name and other identifying symbols as set forth in the Contract Documents.

B. Product Data

1. Include only those sheets that are pertinent to the specific product.
2. Annotate each sheet to achieve the following:
  - a. Clearly identify the specific product or part installed.
  - b. Clearly identify data applicable information.
  - c. Delete references to inapplicable information.

C. Drawings

1. Supplement product data with drawings as necessary to illustrate the following clearly:
  - a. Relations of component parts of equipment and systems.
  - b. Control and flow diagrams.
  - c. Owner Tag Numbers.
  - d. Flow directions in all channels and conduits.
2. Coordinate drawings with information in Record Documents to ensure correct illustration of completed installation.
3. Do not use Record Documents as maintenance drawings.

D. Written text as required to supplement product data for the particular installation:

1. Organize in consistent format under separate headings for different procedures.
2. Provide a logical sequence of instructions for each procedure.
3. Describe how the complete system is to operate.

E. Copy of pertinent information related to warranty, bond, and service Contract issued.

1. Provide information sheet for Owner's personnel with the following information:
  - a. Proper procedures in event of failure.
  - b. Instances that might affect the validity of warranties or bonds.

F. Training manuals used in training courses will become part of this Manual.

## 1.09 MANUAL FOR MATERIALS AND FINISHES

A. Content, for architectural products, applied materials, and finishes:

1. Manufacturer's data, giving full information on products:
  - a. Catalog number, size, composition.
  - b. Color and texture designations.
  - c. Information required for re-ordering special-manufactured products.
2. Instructions for care and maintenance:
  - a. Manufacturer's recommendation for types of cleaning agents and methods.
  - b. Cautions against cleaning agents and methods that are detrimental to product.
  - c. Recommended schedule for cleaning and maintenance.

B. Content, for moisture-protected and weather-exposed products:

1. Manufacturer's data, giving full information on products:
  - a. Applicable standards.
  - b. Chemical composition.
  - c. Details of installation.
2. Instructions for inspection, maintenance, and repair.

C. Additional requirements for maintenance data as required by other sections of the Specifications.

## 1.10 MANUAL FOR EQUIPMENT AND SYSTEMS

A. Content, for each electrical, mechanical, instrumentation, and communication system, as appropriate:

1. A table identifying each piece of equipment, each associated control or instrument, the location of the control or instrument, and the function of the control or instrument.

2. A description of the system and its component parts:
  - a. Function, normal operating characteristics, and limiting conditions for the system, the sub-system, and the component parts.
  - b. Performance curves, engineering data, and tests.
  - c. Complete nomenclature and commercial numbers of replaceable parts.
3. Circuit directories of panel board:
  - a. Electrical service.
  - b. Controls.
  - c. Communications.
4. As-installed color-coded wiring diagrams.
5. Instrument loop diagrams showing the path that a control or instrumentation signal takes from its origin to the action it takes.
  - a. An electrical schematic for each item.
  - b. A chart listing the controls/instruments in a loop identifying the equipment's abbreviated symbol, a description of the symbol, design criteria, process flow, quantity supplied, and manufacturer's model and serial number.
6. Operating procedures:
  - a. Routine and normal operating instructions.
  - b. Sequences required.
  - c. Special operating instructions.
  - d. Emergency operating instructions.
7. Maintenance procedures:
  - a. Routine operations.
  - b. Guide to "trouble-shooting."
  - c. Disassembly, repair, and re-assembly.
  - d. Alignment, adjustment, and checking.
8. The manufacturer's printed operating and maintenance instructions.
9. A list of the original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.

10. Other data as required under other sections of the Specifications.
  11. Abnormal and emergency operations:
    - a. Potential overloads.
    - b. Procedures for equipment breakdown.
    - c. Action to be taken in a power outage.
    - d. Identity of alarms by equipment location and action to correct.
    - e. Equipment safety features, requirements, and potential hazards.
  12. Programming manuals for programmable devices including list of standard programming.
- B. Content, for each unit of equipment and system, as appropriate:
1. Description of unit and component parts:
    - a. Function, normal operating characteristics, and limiting conditions.
    - b. Performance curves, engineering data, and tests.
    - c. Complete nomenclature and commercial number of replaceable parts.
    - d. Model number and name plate data for each piece of equipment.
    - e. Assembly drawings.
    - f. List of all special tools required to service equipment and/or systems including where the tools are stored.
  2. Operating procedures:
    - a. Start-up, break-in, routine, and normal operating instructions.
    - b. Regulation, control, stopping, shut-down, and emergency instructions.
    - c. Summer and winter operating instructions.
    - d. Special operating instructions.
    - e. Control settings and ranges.
  3. Maintenance procedures:
    - a. Type and frequency of preventive maintenance activities required for each piece of equipment.
    - b. Guide to "trouble-shooting."
    - c. Disassembly, repair, and re-assembly.
    - d. Alignment, adjusting, and checking.

4. Servicing and lubrication schedule:
    - a. List of lubricants required.
    - b. Period between lubrications.
  5. Manufacturer's printed operating and maintenance instructions. (This is not to be a generalized catalog of the entire product line.)
  6. Description of sequence of operation.
  7. The original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance:
    - a. Predicted life of parts subject to wear.
    - b. Items recommended to be stocked as spare parts.
  8. As-installed control diagrams.
  9. Each Contractor's coordination drawings.
  10. List of the original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.
  11. Other data as required under pertinent sections of the Specifications.
  12. Charts of equipment, instrument, and valve tag numbers with location and function:
    - a. Reference drawing which shows equipment, instrument, or valve location.
    - b. Manufacturer's model and serial number.
    - c. Valve actuator type (manual, hydraulic, electric, or pneumatic).
  13. Local services (process water and air, drains, HVAC, natural gas, and steam).
- C. The Contractor shall prepare and include additional data when the need for such data becomes apparent during instruction of the Owner's personnel.
- D. Additional requirements for O&M data required by other sections of the Specifications.

## PART 2 PRODUCTS

### 2.01 O&M MANUALS

- A. Binders: The manuals shall be supplied in binders that are the same as those provided in Paragraph 1.03D. above.
- B. Electronic Version: Word-processed portions of the manuals shall also be provided on CDs. The electronic version manuals must be capable of being read, edited, and printed with Microsoft Word or Owner-approved file format at the time of the transmittal of documents. The format will be provided to the Contractor upon request. All drawings shall be generated using personal computer and plotter with the software package program from AutoCAD.

### PART 3 EXECUTION (NOT USED)

END OF SECTION

**DIVISION 2**

**SITE CONSTRUCTION**

**SECTION 02220**  
**DEMOLITION AND MODIFICATIONS**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. The Contractor shall furnish all labor, materials, equipment, and incidentals required and demolish, modify, remove, and dispose of work shown on the Drawings and as specified in this Section.
- B. The work includes but is not limited to demolishing, modifying, and removing existing materials, equipment, or work necessary to install the new work as shown on the Drawings and as specified in this Section and to connect with existing work in an approved manner.
- C. The Contractor shall coordinate which items shall be salvaged with the Owner and Engineer before beginning demolition.
- D. Demolition, modifications, and removals which may be specified under other sections shall conform to requirements of this Section.
- E. Demolition and modifications include, but not be limited to, the following:
  - 1. Removal and disposal of existing FRP Sludge Holding Tank cover, associated hardware, FRP vent with damper, and appurtenances, while storing and protecting FRP ducts for future reconnection.
  - 2. Removal and disposal of the contents of the Sludge Holding Tank to clean them in preparation for painting and coating in accordance with Section 02225, Blend Tank Cleaning.
  - 3. Removal and salvage of the existing progressing cavity pumps and centrifugal pump, with associated concrete floor, equipment pads, piping, valves, supports, electrical, control panel, and miscellaneous items as shown on the Drawings.
  - 4. Removal and disposal of the piping entering the Sludge Holding Tank where indicated on the Contract Documents.
  - 5. Removal and salvage, or disposal at the discretion of the Owner, of the existing Walkway, Handrailing, and Stair Structure, including fiberglass stair treads, supports, and landing.
  - 6. Miscellaneous demolition as shown on the Contract Documents including, but not limited to, the 6-inch-high concrete curb and concrete pad to the extents shown, process air piping entering the Sludge Holding Tank,

piping to the extents shown, drain piping to the extents shown, light pole modifications to the extents shown, and hose bibbs.

7. Off-site disposal of excess and unacceptable materials as described below and in Section 02225, Blend Tank Cleaning.

## 1.02 RELATED WORK

- A. Section 01100, Summary of Work.
- B. Section 01330, Submittals and Acceptance.
- C. Section 01350, Environmental Protection Procedures.
- D. Section 01650, Delivery, Storage, and Handling.
- E. Section 01780, Warranties and Bonds.
- F. Section 01815, Maintenance of Plant Operation and Sequence of Construction.
- G. Section 02225, Blend Tank Cleaning.

## 1.03 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Submit to the Engineer six copies of proposed methods and operations of demolition of the structures and modifications before beginning work. Include in the schedule the coordination of shutoff, capping, and continuation of utility service as required.
- B. Furnish a detailed sequence of demolition and removal work to ensure the uninterrupted progress of the Owner's operations. The sequence shall be compatible with sequence of construction and shutdown coordination requirements.
- C. Before beginning demolition work, the Contractor shall complete all modifications necessary to bypass the affected structure. Actual work shall not begin until the Engineer has observed and approved the modifications and authorized beginning the demolition work in writing.

## 1.04 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

## 1.05 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

## 1.06 JOB CONDITIONS

### A. Protection

1. The Contractor shall perform the work in accordance with Section III – General Conditions Article 6.9 Safety and Protection.
2. The Contractor shall conduct the demolition and removal work to prevent damage or injury to structures, equipment, piping, instrumentation, conduit, light fixtures, etc., and occupants of the structures and to adjacent features which might result from falling debris or other causes, and so as not to interfere with the use and free and safe passage to and from adjacent structures.

### B. Scheduling: Carry out operations so as to avoid interference with operations and work in the existing facilities.

### C. Notification: At least 10 business days before beginning demolition or removal, notify the Engineer in writing of the proposed schedule of the demolition or removal. The Owner shall inspect the existing equipment and identify and mark those items which are to remain the property of the Owner. No removals shall be started without the permission of the Engineer.

### D. Conditions of Structures

1. The Owner and the Engineer assume no responsibility for the actual condition of the structures to be demolished or modified.
2. Conditions existing at the time of inspection for bidding purposes will be maintained by the Owner insofar as practicable. However, variations within a structure may occur before the start of demolition work.

### E. Repairs to Damage

1. The Contractor shall notify the Owner and the Engineer immediately following any damages to existing facilities.
2. The Contractor shall promptly repair damage caused to adjacent facilities by demolition operations when directed by the Engineer and at no cost to the Owner. Repairs shall be made to a condition at least equal to that which existed before construction.

3. All materials used for repairs shall match existing materials and be of equal quality or better.

F. Traffic Access

1. The Contractor shall conduct demolition and modification operations and remove equipment and debris to ensure minimum interference with roads onsite and to ensure minimum interference with occupied or used facilities.
2. Special attention is directed towards maintaining safe and convenient access to the existing facilities by plant personnel and plant associated vehicles.

**1.07 RULES AND REGULATIONS**

- A. When applicable and as deemed required, the Florida Building Code (latest edition) or the City shall control the demolition, modification or alteration of the existing buildings or structures.
- B. No building or structure or any part thereof shall be demolished until the Contractor has obtained a Demolition Permit from the City Building Department. The fee for this permit shall be the Contractor's responsibility.

**1.08 DISPOSAL OF MATERIAL**

- A. Salvageable material and equipment shall become the property of the Owner. The Contractor shall coordinate which items should be salvaged with the Owner and Engineer before demolition. The Contractor shall dismantle all such items to a size that can be readily handled and deliver them to a designated storage area.
- B. All other material and items of equipment shall become the Contractor's property and must be removed from the site and disposed of in accordance with the Federal, State, and local rules and regulations.
- C. Storing or selling removed items on the site will not be allowed.

**PART 2 PRODUCTS (NOT USED)**

**PART 3 EXECUTION**

**3.01 GENERAL**

- A. All materials and equipment removed from existing work shall become the property of the Contractor, except for those which the Owner has identified and

marked for the Owner's use. All materials and equipment marked by the Owner to remain shall be carefully removed so as not to be damaged and shall be cleaned and stored on or adjacent to the site in a protected place specified by the Engineer or loaded onto trucks provided by the Owner.

- B. The Contractor shall dispose of all demolition materials, equipment, debris, and all other items—except those marked by the Owner to remain—off the site and in conformance with all existing applicable laws and regulations.

C. Pollution Controls

1. The Contractor shall perform the Work in accordance with Section IV – Technical Specifications – 207 Erosion and Sediment Control. The Contractor shall prevent any of the Sludge Holding Tank contents from reaching the storm drains.
2. Use water sprinkling, temporary enclosures, and other suitable methods to limit the amount of dust and dirt rising and scattering in the air to the lowest practical level. Comply with governing regulations pertaining to environmental protection.
  - a. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, and pollution.
  - b. Clean adjacent structures, facilities, and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to conditions existing before starting the work.
3. If it is necessary to remove any abandoned Asbestos Cement (AC) pipe and/or appurtenances to accommodate the Work, the Contractor must furnish all permits, labor, material, services, insurance, tools, equipment, and notifications in accordance with EPA, OSHA, State, and all other applicable agencies to handle and remove asbestos material.

### 3.02 STRUCTURAL REMOVALS

- A. The Contractor shall remove structures to the lines and grades shown unless otherwise directed by the Engineer.
- B. All demolition debris shall be removed and taken from the site, unless otherwise approved by the Engineer.
- C. After parts or all of slabs and like work which tie into new work or existing work are removed, the point of junction shall be neatly repaired so as to leave only finished edges and surface exposed.

### **3.03 DEMOLITION, REPLACEMENT, AND REPAIR**

- A. Structural elements shall not be overstressed. The Contractor shall be responsible for shoring and/or bracing as required and indicated on the Contract Drawings for adequate structural support as a result of work performed.
- B. The shoring and/or bracing shall remain in place until the repair mortar and/or concrete in each stage has attained design strength.

### **3.04 CLEAN-UP**

- A. The Contractor shall remove from the site all debris resulting from the demolition operations as it accumulates. Upon completion of the work, the Contractor shall remove all materials, equipment, waste, and debris of every sort and shall leave the premises clean, neat, and orderly.

**END OF SECTION**

**SECTION 02225**  
**BLEND TANK CLEANING**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. This Section includes the work necessary for the removal and disposal of tank contents. This task includes but is not limited to removing, loading, transporting, and properly disposing of the tank contents including liquid, sludge, scum, rags, grit, hair, grease, solids, and semi-solids off site in accordance with applicable federal, state, and local regulations.
- B. This Section also covers the work necessary to complete the tank cleaning activities including pressure washing, scraping, rinsing, and drying of tank internals to otherwise prepare the tank for structural inspection.

**1.02 RELATED WORK**

- A. Section III – General Conditions.
- B. Section IV – Technical Specifications.
- C. Section IVa – Supplemental Technical Specifications.
- D. Section 01815, Maintenance of Plant Operation and Sequence of Construction.

**1.03 SUBMITTALS**

The Contractor shall submit the following items in accordance with Section III – General Conditions Article 6.11.1:

- A. Before the work begins, the Contractor shall submit, to the Engineer for review, a suitable work plan. The work plan shall include, but is not limited to, the following:
  - 1. Written procedure and time schedule for shut down, cleaning and startup, including a description of the activities to be performed for the tank and estimated dates from start and finish of required work on the facility.
  - 2. The proposed procedures for; dewatering; odor control; layout of equipment and piping; determining partial payment amounts; general housekeeping; a site health and safety plan; providing needed manpower and equipment to complete the work in a timely manner; and disposal of dewatered contents at the disposal site of their choice in accordance with State and Federal rules.

3. The spill containment plans for both the on-site activities and hauling to the disposal site. Spills of any nature caused by the Contractor shall be controlled and cleaned immediately. All spills on site must be recorded with the volume and actions taken to clean the area and reported to the Owner and Engineer. The Owner will be responsible for reporting to FDEP or SWO.
  4. Photos or videos of the site to document existing condition before this work and after the project is completed.
- B. The Contractor or Subcontractor shall submit to the Engineer upon request certificates signed and dated by each employee certifying that the employee who will enter the tank has: received training in Confined Space Entry Procedure, understands the health implications and risks involved, understands the use and limits of the equipment to be used; and understands engineering and other hazard control techniques and procedures.
- C. Submit to the Owner two copies of proposed methods and operations of demolition of the structures and modifications before beginning work. Include in the schedule the coordination of shutoff, capping, and continuation of utility service as required.

## 1.04 QUALIFICATIONS

- A. The Contractor shall have been in the business of cleaning tanks (and demolishing) for at least 5 years.
- B. The Contractor shall be a licensed General Contractor in the state of Florida and Pinellas County.
- C. The Contractor shall demonstrate that all employees working on the site have been trained in Confined Space Entry and have had the requisite refresher training.

## 1.05 RULES AND REGULATIONS

- A. The City of Clearwater Public Works shall control the cleaning, demolition, modification, or alteration of the existing buildings or structures.

## PART 2 PRODUCTS (NOT USED)

## PART 3 EXECUTION

### 3.01 GENERAL

- A. The Contractor shall coordinate all activities with the Engineer and Owner personnel before proceeding with work. In situations where the operation of the plant conflicts with the Contractor's work, the operation of the plant shall take precedence.
- B. The work shall be performed in accordance with the schedule submitted by the Contractor and approved by the Owner and Engineer.
- C. The Contractor shall place his equipment, vehicles, and temporary piping so that it does not interfere with plant operations or the ongoing construction activities at the plant.
- D. All piping, wiring, adapters, and switches required to connect to the Owner's water and electric power supply shall be provided by the Contractor. Before connecting, the Contractor shall coordinate with the Owner. The Contractor shall provide his own source of electrical power to operate all equipment for the completion of the work if commercial utility power is not available.
- E. Contractor shall conduct work in a way as to minimize odors 24-hours a day while emptying and cleaning each tank. Owner and Engineer reserve the right to stop or postpone the work if odors become objectionable. No additional compensation will be paid the Contractor because the cleaning work was postponed for objectionable odors.
- F. The Contractor shall use the existing manways and access points in the tank to perform cleaning and follow confined space entry procedures as required to comply with local and state requirements.
- G. The Contractor shall cover and isolate all work areas with disposable plastic sheeting and strategically place drip pans at pumps, joints, disconnected piping, tank manholes, clean-outs, drops, etc. to prevent possible contamination and minimize spills.

### 3.02 SAFETY CONSIDERATIONS

- A. The Contractor shall perform the work in accordance with Section III – General Conditions Article 6.9 Safety and Protection.
- B. The Contractor is responsible, at all times, for protecting the health and safety of his workers. Neither the Engineer nor the Owner will be responsible for any

injury occurring to the Contractor's workers. Neither the Engineer nor the Owner will be responsible for enforcing the Contractor's construction ways and means nor will they be responsible for enforcing OSHA standards. While conducting cleaning operations, the Contractor shall always have a superintendent in responsible charge at the site. This person shall have the authority to make management decisions pertaining to the project.

- C. All Contractors and subcontractors performing work under this Contract must utilize appropriate protective clothing, equipment, goggles, gloves, face masks, etc., as necessary to undertake the work in a safe manner.
- D. The Contractor shall isolate close, secure, divert, de-energize, lockout and apply tags-plus applications to all valves, piping and associated equipment as found in 29 CFR 1915.89.
- E. Each tank is a confined space and the Contractor is responsible for compliance with OSHA Confined Space Entry Procedures, as found in 29 CFR Part 1910.146 and 29 CFR 1926 Subpart AA.
- F. The Contractor is responsible for providing forced fresh air ventilation and continuously monitoring the atmosphere inside each confined space to determine the appropriate level of protection for his personnel during cleaning operations or Engineer's personnel during an inspection.

### 3.03 DEWATERING, CLEANING AND DISPOSAL

- A. The removal of all contents inside the designated tank including water, sludge, scum, grit, grease, rags, solids, and semi-solids shall be removed by the Contractor, whether or not the material is pump-able. The methods necessary to remove all of the material in the tank shall be determined by the Contractor.
- B. The Contractor is responsible for provided inert gas purging, ventilation, supplies, supervision, electrical power, temporary lighting, backflow prevention devices, safety equipment, storage, temporary scaffolding, and incidentals required to conduct the work.
- C. The Contractor is responsible for purging each tank with inert gases before the tank is accessed or contents removed (when applicable).
- D. The Contractor is responsible for dewatering the materials removed from the tank and adding chemicals, as necessary, for odor control to the tank contents to meet all Federal, State, and Local regulatory requirements.

- E. Dewatered sludge shall be stored in a fully covered container or be disposed of within 24 hours. In no case shall material that is dewatered during the day and not stored properly remain on site past the end of the same day, defined as 4:00 p.m.
- F. The Contractor shall coordinate the location of temporary dewatering facilities with the Owner.
- G. The Contractor is responsible for transportation and disposal of the tank contents in accordance with local and state regulations. The Contractor shall verify with City, County, and State officials any load limitations, required by these agencies, on bridges and access roads to the disposal site. The Contractor shall be responsible for all costs associated with traffic violations or other claims incurred as a result of the hauling operations for the duration of the Contract. This includes ensuring that all loads are within legal limits.
- H. The Contractor shall supply copies of weight tickets, waste manifests and bill of ladings to the Owner in a clear and comprehensive manner.
- I. The Contractor is responsible for pressure washing the interior tank walls and interior mechanical equipment. The Contractor shall also isolate the sludge withdrawal pipes to prevent debris from entering downstream systems. During power-washing operations, the Contractor shall be careful not to erode the concrete surfaces of the existing structure. Any damage caused to the tank by the cleaning and removal of contents shall be the responsibility of the Contractor.
- J. Water required for dilution, wash down and related purposes will be available from the Owner's reclaimed water system and provided at current system pressure. The Owner may also provide the Contractor potable water for cleaning and wash water applications. If potable water is used, the Contractor is required to obtain a water meter from the Owner's customer service department.
- K. Tank cleaning shall be completed to the satisfaction of the Owner and Engineer including removing all hardened or calcified deposits and otherwise preparing the tank for structural inspection.
- L. The Contractor is responsible for collecting and disposing of sewage, contaminated liquids, sludge, scum, grit, grease, rags, solids, and semi-solids, at local or state-approved treatment facilities.
- M. The Contractor is responsible for collecting and disposing of filtrate, wash water from cleaning, and other refuse material that is produced during the cleaning operations. The filtrate and wash water may be piped to the head end of the treatment plant for disposal as long as it is of a quality no worse than the centrate or filtrate. A sample may be required to demonstrate the quality of the centrate,

filtrate, or wash water. The Contractor will coordinate with the Owner and Engineer to determine the water quality parameters required to demonstrate the recycling of centrate, filtrate, and wash water will not adversely impact plant operations based on the cleaning chemical used. The Owner will require an analysis of the filtrate or wash water prior to approving its introduction into the plant process.

- N. The Contractor is responsible for preventing and/or abating any spills of tank contents, cleaning water or other liquids onto the Owner's facility site.
- O. The Owner shall approve all cleaning products used by the contractor in cleaning the tank and equipment prior to usage. The Owner, at its sole discretion, has the right to disapprove any cleaning product that it deems harmful to the facility.
- P. The Contractor shall not allow any residuals, free liquids from the tank, or filtrate from the dewatering operations to enter storm drains, roadways, waterways, or any other land, either public or private. In the event that a spill occurs, the Contractor shall immediately notify the Owner, take the necessary steps to control and clean the spill under Owner direction, and shall pay any fines levied against the Owner as a result of the spill. The Contractor shall be responsible for satisfying state reporting requirements to the Owner and Engineer. The Owner shall be responsible for satisfying State reporting requirements to FDEP or SWO.

### 3.04 CLEAN-UP

- A. The Contractor shall remove from the site all debris resulting from cleaning and demolition operations as it accumulates. Upon completion of the work, the Contractor shall remove all materials, equipment, waste, and debris of every sort and shall leave the premises clean, neat, and orderly in a similar or better condition than what existed prior to start of this work.
- B. The Contractor shall return any laydown or other work areas to pre-construction conditions.

END OF SECTION

**SECTION 02230  
SITE PREPARATION**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. The Contractor shall furnish all labor, materials, and equipment required and perform all site preparation, complete as shown on the Contract Drawings and as specified in this Section.
- B. The Contractor shall obtain all permits required for site preparation before proceeding with the work, including clearing and tree removal.
- C. The areas to be cleared, grubbed, and stripped within public rights-of-way and utility easements shall be minimized to the extent possible for the scope of pipeline work and in consideration of the actual means and methods of construction used. No unnecessary site preparation shall be performed within these areas.

**1.02 RELATED WORK**

- A. Section 01330, Submittals and Acceptance.
- B. Section 01350, Environmental Protection Procedures.
- C. Section 01650, Delivery, Storage, and Handling.
- D. Section 01780, Warranties and Bonds.
- E. Section 02305, Earthwork for Utilities.
- F. Section 02920, Seeding and Sodding.

**1.03 SUBMITTALS**

- A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance.
- B. Submit to the Engineer copies of all permits required before clearing, grubbing, and stripping work.

**1.04 WARRANTIES**

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

## 1.05 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

## PART 2 PRODUCTS (NOT USED)

## PART 3 EXECUTION

### 3.01 CLEARING

- A. The Contractor shall cut and remove all timber, trees, stumps, brush, shrubs, roots, grass, weeds, rubbish, and any other objectionable material resting on or protruding through the surface of the ground.
- B. The Contractor shall preserve and protect trees and other vegetation designated on the Drawings or directed by the Engineer to remain as specified below.

### 3.02 GRUBBING

- A. The Contractor shall grub and remove all stumps, roots in excess of 1-1/2 inches in diameter, matted roots, brush, timber, logs, concrete rubble, and other debris encountered to a depth of 18 inches below original grade or 18 inches beneath the bottom of foundations, whichever is deeper.
- B. The Contractor shall refill all grubbing holes and depressions excavated below the original ground surface with suitable materials and compact to a density conforming to the surrounding ground surface in accordance with Section 02305, Earthwork for Utilities.

### 3.03 STRIPPING

- A. The Contractor shall strip topsoil from all areas to be occupied by buildings, structures, and roadways and all areas to be excavated or filled.
- B. Topsoil shall be free from brush, trash, large stones, and other extraneous material. Avoid mixing topsoil with subsoil.
- C. The Contractor shall stockpile and protect topsoil until it is used in landscaping, loaming, and seeding operations and dispose of surplus topsoil after all work is completed.

### 3.04 DISPOSAL

- A. Dispose of material and debris from site preparation operations by hauling such materials and debris to an approved offsite disposal area in accordance with Federal, State, and local rules and regulations. No rubbish or debris of any kind shall be buried on the site.
- B. Burning of cleared and grubbed materials or other fires for any reason will not be permitted.

### 3.05 PROTECTION

- A. Trees and other vegetation designated on the Contract Drawings or directed by the Engineer to remain shall be protected from damage by all construction operations by erecting suitable barriers, guards, and enclosures, or by other approved means. The Contractor shall conduct clearing operations in a manner to prevent falling trees from damaging trees and vegetation designated to remain and to the work being constructed. The Contractor shall provide for the safety of employees and others.
- B. The Contractor shall maintain protection until all work in the vicinity of the work being protected has been completed.
- C. The Contractor shall not operate heavy equipment or stockpile materials within the branch spread of existing trees.
- D. The Contractor shall immediately repair any damage to existing tree crowns, trunks, or root systems. Roots exposed and/or damaged during the work shall immediately be cut off cleanly inside the exposed or damaged area. Treat cut surfaces with an acceptable tree wound paint and topsoil spread over the exposed root area.
- E. When work is completed the Contractor shall remove all dead and downed trees. Live trees shall be trimmed of all dead and diseased limbs and branches. All cuts shall be cleanly made at their juncture with the trunk or preceding branch without injury to the trunk or remaining branches. Cuts over 1 inch in diameter shall be treated with an acceptable tree wound paint.
- F. The Contractor shall restrict construction activities to those areas within the limits of construction designated on the Drawings, within public rights-of-way, and within easements provided by the Owner. Adjacent properties and improvements on these properties, public or private, which become damaged by construction operations shall be promptly restored to their original condition to the full satisfaction of the property owner.

- G. The Contractor shall remove trees damaged beyond saving, through no fault of the Contractor, as directed by the Engineer.

END OF SECTION

**SECTION 02240  
DEWATERING**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. This Section covers the work necessary to complete the dewatering activities. All work in this Section shall be done in accordance with the requirements of the Environmental Resource Permit and Water Use Permit (if required) as issued by the Southwest Florida Water Management District (SWFWMD).
- B. In addition to the requirements listed in this Section, the Contractor shall obtain, if required, and comply with all requirements of the Generic Permit for the Discharge of Ground Water From Any Non-Contaminated Site Activity as described in FAC 62-621-300.
- C. Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control groundwater flow into excavations and permit construction to proceed on dry, stable subgrades.
  - 1. Maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, that excavation does not flood, and that damage to subgrades and permanent structures is prevented.
  - 2. Prevent surface water from entering excavations by grading, dikes, or other means.
  - 3. Remove dewatering system if no longer needed.
- D. The Contractor shall dewater so as to prevent damage to existing work. The Contractor shall repair or replace damage resulting from the dewatering activities promptly, remedy environmental damage as approved by the Engineer, and pay any and all fines levied to Contractor at no additional cost or time to the Owner.
- E. The Dewatering Plan shall be signed and sealed by the licensed professional engineer responsible for its preparation.
- F. The Contractor shall design the dewatering system. The Contractor shall be responsible for obtaining whatever investigations are necessary, before bidding, to design the dewatering system.

## 1.02 RELATED WORK

- A. Section 01330, Submittals and Acceptance.
- B. Section 01350, Environmental Protection Procedures.
- C. Section 01650, Delivery, Storage, and Handling.
- D. Section 01780, Warranties and Bonds.

## 1.03 SUBMITTALS

The Contractor shall submit the following in accordance with Section 01330, Submittals and Acceptance:

- A. Before construction, the Contractor shall obtain a dewatering permit from the SWFWMD as required. At a minimum, the dewatering plan submitted with the dewatering application shall include the following:
  - 1. Duration of dewatering for each area.
  - 2. Number and size of pumps.
  - 3. Method of dewatering each area.
  - 4. Methods for routing/containing the discharge.
  - 5. Methods of isolating dewatering areas.
  - 6. Time dewatering structure will be in place.
  - 7. Proposed discharge points.

Five copies of the plan shall be submitted to the Engineer for record purposes only.

- B. The Contractor shall be responsible for determining if a Water Use Permit will be required. If a Water Use Permit is required, it is the Contractor's responsibility to obtain the required information from the Engineer and Owner to complete the Water Use Permit application to submit with the Dewatering Plan. If a Water Use Permit is required, the Contractor shall submit five copies of the application to the Owner/Engineer for submittal purposes only.
- C. The Contractor shall be responsible for obtaining a Generic Permit for the Discharge of Produced Ground Water from any Non-Contaminated Site Activity as set forth in FDEP Rule 62-621.300(2), FAC. The Contractor shall obtain the required permit form 62-621.300(2) and the required information from the Engineer and Owner to complete the Generic Permit for the Discharge of Produced Ground Water from any Non-Contaminated Site Activity application to submit with the Dewatering Plan. The Contractor shall submit five copies of the application to the Owner/Engineer for submittal purposes only.

- D. Provide photographs or videotape, sufficiently detailed, of existing conditions of adjoining properties, facilities, and other construction and site improvements that might be later misconstrued as damage caused by dewatering operations.
- E. Submit Record Drawings at Project closeout identifying and locating utilities and other subsurface structural, electrical, or mechanical items encountered during dewatering.
  - 1. Note locations and capping depth of wells and well points.

#### 1.04 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with water disposal requirements of authorities having jurisdiction.
- B. Pre-installation Conference: Conduct conference at the Project site to present and discuss dewatering means, methods, and monitoring program.
- C. Identify a person who shall be present at all times during the execution of this portion of the Work and who shall be thoroughly familiar with the dewatering system being installed for this Project, the referenced standards, environmental and permit requirements, the requirements of this Work, and who shall direct all work performed under this Section.
- D. It shall be the responsibility of the Contractor to determine the water levels before and during the dewatering work.

#### 1.05 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

#### 1.07 QUALIFICATIONS

- A. The Contractor shall provide at least one person who shall be present at all times during the execution of this portion of the Work and who shall be thoroughly familiar with the dewatering system being installed, the referenced standards, the

requirements of this Work, and who shall direct all work performed under this Section.

- B. The Contractor shall be responsible for determining the water level before beginning excavation and construction.

#### 1.08 PRE-BID INSPECTION AND TESTING

- A. Before bidding, the Contractor shall perform a detailed site inspection and, if desired, obtain the Owner's permission to perform site-specific testing as he deems necessary to obtain all required information relative to project dewatering requirements.
- B. The Contractor shall include as part of his Bid the total cost of all surface and subsurface dewatering as required to construct the Project in complete compliance with the Drawings and these Specifications.

#### 1.09 PROJECT CONDITIONS

- A. The Contractor shall not interrupt utilities serving facilities occupied by Owner or others unless approved by the Owner and Engineer and then only after arranging to provide temporary utility services according to requirements indicated.
- B. Survey adjacent structures and improvements, employing a professional land surveyor licensed in Florida to establish exact elevations at fixed points to monitor settlement. Clearly identify monitoring points and reference vertical datum, and benchmarks. Monitor and record existing initial elevations.
  - 1. During dewatering, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations for comparison with original elevations. Promptly notify the Engineer if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction and existing structures.

#### PART 2 PRODUCTS (NOT USED)

#### PART 3 EXECUTION

##### 3.01 DEWATERING SYSTEM

- A. The dewatering system shall be adequate to drain the soils to be excavated to the extent that the piezometric water level in the construction area is a minimum of 2 feet below the bottom of the excavation, side slopes of excavations, or bottom of the footings at all times, or as otherwise required to obtain the specified

compaction and installation conditions. Pipeline trenches must be dewatered at least 18 inches below the trench bottom.

- B. If layered soils are encountered, the hydrostatic head in the zone below the subgrade elevation shall be relieved to prevent uplift.
- C. Unless otherwise noted and before any excavating below or within 2 feet above the groundwater level, a dewatering system shall be placed into operation to lower water levels to the extent specified previously and then shall be operated continuously 24 hours a day, 7 days a week, throughout the excavation to maintain and protect all work until the work has been completed to the satisfaction of the Engineer.
- D. Where used, well points shall be installed in an Engineer-approved manner and in sufficient numbers to provide the necessary removal of water as stated previously. Well points and header piping shall be installed so that traffic on public thoroughfares and site access roads will not be impeded.
- E. The Contractor shall be solely responsible for the arrangement, location, and depths of the dewatering system necessary to accomplish the specified work. The dewatering system shall stay in full operation until not less than 90% of the total building load is applied, as will be determined by the Engineer, or until excavations and trenches have been backfilled and compacted.
- F. To prevent excessive noise, exhaust from all pumps and engines shall be silenced and muffled.
- G. Wellpoint or surface water pump discharge shall be controlled to prevent erosion, undermining, and all other damage and be piped to approved locations.
- H. With the Engineer's assistance, the Contractor is responsible for determining what approvals and permits are required to comply with any and all applicable regulations and permitting requirements relating to dewatering activities. With the Engineer's assistance the Contractor shall obtain all necessary approvals and permits and comply with any and all applicable regulations and permitting requirements concerning all dewatering activities, including pumpage and discharge. The Contractor is solely responsible for all costs associated with the proper implementation of dewatering activities.
- I. The Contractor shall perform all dewatering work in strict compliance with Section 01350, Environmental Protection Procedures, and the Contract Drawings.
- J. Excavations shall be kept free from water during the placing of concrete and for 36 hours after or until concrete forms are removed.

- K. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.
  - 1. Prevent surface water and subsurface or groundwater from entering excavations, ponding on prepared subgrades, or flooding the site and surrounding area.
  - 2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.
- L. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
  - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from the Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- M. Install sufficient dewatering equipment to drain water-bearing strata above and below the bottom of foundations. If excavating through layered soils, relieve any potential groundwater hydrostatic head in the zones below to prevent uplift.
  - 1. Open-sump pumping which leads to loss of fines, subgrade softening, and slope instability shall not be permitted.
- N. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water in a manner that avoids flooding or accumulation on private property. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.

### 3.02 OBSERVATION WELLS

- A. The Contractor shall install observation wells as may be required to record accurate water levels.
- B. The Contractor shall be responsible for maintaining all observation wells and observing and recording the elevation of the piezometric water levels daily.
- C. Wells damaged or destroyed shall be replaced at no additional cost to the Owner.

### 3.03 CLEANUP

- A. Upon completing dewatering elsewhere on the Project, the Contractor shall remove all equipment and leave the project site in a neat, clean, and acceptable condition satisfactory to the Owner. Wellpoint holes and excavations shall be adequately backfilled and compacted to prevent settlement.

END OF SECTION

**SECTION 02305**  
**EARTHWORK FOR UTILITIES**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. The Contractor shall provide all materials, equipment, labor, and work necessary to completely construct the project in accordance with the Contract Documents. This work includes but is not limited to the following:
  - 1. Excavating and removing unsatisfactory materials.
  - 2. Preparing trench foundations.
  - 3. Providing satisfactory material for all trenches as specified and as required.
  - 4. Obtaining, storing, maintaining, and disposing of materials.
  - 5. Dewatering, shoring, and sheeting.
  - 6. Placing, compacting, testing, final grading, and demolishing subgrade.
  - 7. Performing all other work required by the Contract Documents.
- B. The Contractor is responsible for performing all work so as not to damage existing roadways, facilities, utilities, structures, etc. and shall repair and replace such damage to equal or better than its original undamaged condition without cost to the Owner.
- C. The Contractor shall examine the site before submitting a bid, taking into consideration all conditions that may affect the work.
- D. The Contractor shall coordinate all additional subsurface investigations and testing included with this work with the Engineer before performing the excavation and foundation preparation work. In general, if the Contractor finds different and unsuitable/unsatisfactory soil conditions during the work, the Contractor shall notify the Engineer and the Owner immediately.

**1.02 RELATED WORK**

- A. Section 01350, Environmental Protection Procedures.
- B. Section 02230, Site Preparation.
- C. Section 02240, Dewatering.

## 1.03 SUBMITTALS

The Contractor shall submit the following shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:
  1. Classification according to ASTM D2487 of each on-site and borrow soil material proposed for fill and backfill.
  2. Laboratory compaction curve according to ASTM D1557 for each onsite and borrow soil material proposed for fill and backfill.
- B. The Contractor shall submit records before the start of this work. The Contractor shall verify that the existing conditions are correct as shown on the plans and mentioned in these Specifications. The Contractor shall note any discrepancies found immediately and notify the Owner and Engineer.

The records shall include the following:

1. Location of all existing underground utilities, structures, etc. surrounding the areas to be excavated that may be impacted by the work.
2. Location of test excavations.
3. Location of inspections.

## 1.04 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply:

- A. OSHA Excavation Safety Standards, 29 CFR 1926, Subpart P
- B. Florida Trench Safety Act (90-96, Laws of Florida)
- C. American Society for Testing and Materials (ASTM)
  1. ASTM D1556/D1556M—Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
  2. ASTM D1557—Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>)).

3. ASTM D2487—Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
4. ASTM D2937—Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method.
5. ASTM D3282—Standard Practice for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes.
6. ASTM D3740—Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
7. ASTM D6938—Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
8. ASTM E329—Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.

D. American Wood Protection Association (AWPA)

1. AWPA C1—All Timber Products—Preservative Treatment by Pressure Processes.
2. AWPA C3—Piles – Preservative Treatment by Pressure Processes.

## 1.05 QUALITY ASSURANCE

- A. Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E329 to conduct soil materials and definition testing, as documented according to ASTM D3740.
- B. The Contractor shall do the following:
1. Ensure that excavations provide adequate working space and clearance for the work to be performed and for installing piping and buried utilities. In no case shall excavation faces be undercut.
  2. Ensure that foundation surfaces are clean and free of loose material of any kind when pipelines and buried utilities are placed on them.
  3. Excavate, trench, and backfill in compliance with applicable requirements of governing authorities having jurisdiction.
  4. Ensure that shoring and sheeting for excavations are designed by a Florida-registered Professional Engineer and are in accordance with the Occupational Safety and Health Administration (OSHA) Document 2226, *Safe Working Practices—Excavating and Trenching*.
  5. Before beginning any excavation or grading, ensure the accuracy of all survey data indicated on the Contract Drawings and in these Specifications and/or as provided. If the Contractor discovers any inaccuracies, errors, or omissions in the survey data, the Contractor shall immediately notify the Owner so that proper adjustments can be anticipated or ordered. If the

Contractor begins any excavation or grading, this shall be considered an acceptance of the survey data by the Contractor, after which time the Contractor has no claim against the Owner resulting from alleged errors, omissions, or inaccuracies of the survey data.

6. Ensure that tolerances for excavation are  $\pm 0.10$  foot to the required line and to the required grade. Tolerance for compaction of in-place material shall be  $\pm 0.10$  foot to the required grade.
7. Ensure that all trench materials derived from the project site and imported to this site are examined, tested, and classified by an Engineer-approved soils testing laboratory.
8. Remove unsatisfactory materials and unsuitable materials including muck, silts, peat, and other loose and very loose compressible soils from excavations before placing pipe foundation, bedding, and buried utilities.

## 1.06 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

## 1.07 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

## 1.08 PROJECT CONDITIONS

- A. Existing Utilities: The Contractor shall not interrupt utilities serving facilities occupied by the Owner or others unless permitted to do so in writing by the Engineer and then only after arranging to provide temporary utility services according to the requirements indicated.
  1. Notify the Engineer not less than 2 days in advance of proposed utility interruptions.
  2. Do not proceed with utility interruptions without the Engineer's written permission.
  3. Contact utility-locator service and obtain utility locations for the Project Area before excavating.
- B. The Contractor shall demolish and completely remove from the site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

## 1.09 DEFINITIONS

- A. *Backfill*: Soil material or controlled low-strength material used to fill an excavation.
  - 1. *Initial Backfill*: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
  - 2. *Final Backfill*: Backfill placed over initial backfill to fill a trench.
- B. *Base Course*: The course placed between the subbase course and hot-mix asphalt paving.
- C. *Bedding Course*: The course placed over the excavated subgrade in a trench before laying pipe.
- D. *Borrow Soil*: Satisfactory soil imported from off-site for use as fill or backfill.
- E. *Drainage Course*: The course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- F. *Excavation*: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
  - 1. *Authorized Additional Excavation*: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by the Engineer. Authorized additional excavation and replacement material will be paid for according to the Contract provisions for unit prices.
  - 2. *Bulk Excavation*: Excavation more than 10 feet in width and more than 30 feet in length.
  - 3. *Unauthorized Excavation*: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by the Engineer. Unauthorized excavation, as well as remedial work directed by the Engineer, shall be without additional compensation.
- G. *Fill*: Soil materials used to raise existing grades.
- H. *Structures*: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- I. *Subgrade*: The surface or elevation remaining after completing excavation, or the top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

- J. *Utilities:* On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

## 1.10 TESTING REQUIREMENTS

- A. The Contractor shall furnish a soil survey for satisfactory material and samples of materials.
- B. Testing for source material, for classification, and for prequalification of material (on or off site) shall be performed by an independent testing agency retained by the Contractor and approved by the Engineer.
- C. Testing for in-place compacted fill shall be performed by the same independent testing agency as approved by the Engineer and retained by the Contractor.
- D. The number and location of the tests shall be as specified in these Specifications and as directed by the Engineer during construction.
- E. The Contractor shall coordinate activity with the Engineer and the testing agency to permit testing as directed in the presence of the Engineer.
- F. The cost of all testing to achieve specified requirements shall be borne by the Contractor.
- G. The costs of any and all retests due to failure to achieve specified requirements shall be solely borne by the Contractor and are not reimbursable under this contract.
- H. All materials proposed for use shall be tested as follows:

| Material                    | Required Test  | Min. No. Tests   |
|-----------------------------|--|--|
| Satisfactory Soil Materials | Soil Classification using ASTM D2487 (including all tests contained therein) | One per source of materials to determine conformance with materials specified in these Specifications; additional tests whenever there is any apparent change. |
|                             | Soil moisture-density relationship using Modified Proctor ASTM D1557         | One per source of material or apparent change in material.   |

I. Soil materials shall be tested during construction as follows:

| Material  | Required Test   | Min. No. Tests   |
|---|---|--|
| Satisfactory<br>Soil Material<br>in-place after<br>compaction | Field Density<br>ASTM D1556/D1556M –<br>Sand Cone Method, or<br>ASTM D6938-Nuclear<br>Density Method, or<br>ASTM D2937-Drive<br>Cylinder Method | For each layer of trench bottom subgrade<br>before addition of soil materials, refill,<br>bedding, and backfill, and for each 400<br>lineal feet of trench or fraction thereof,<br>whichever is greater; two tests for each<br>drainage, manhole, or wet well structure;<br>additional test whenever there is any<br>change in native soil, groundwater, or soil<br>moisture conditions. |

J. The approved testing agency shall transmit copies of required laboratory test results as follows:

1. One copy to the Owner.
2. Two copies to the Engineer.
3. Two copies to the Contractor.

The laboratory test reports shall include, at a minimum, project title; project location; location of sample; source, time, and date of testing; testing agency's name, address, and telephone number; and test results. Each test report shall be signed and sealed by the Professional Engineer representing the testing agency as specified in these Specifications.

K. The approved testing agency shall transmit copies of field-testing results as follows:

1. One copy to the Owner.
2. Two copies to the Engineer.
3. Two copies to the Contractor.

The field test reports shall include, at a minimum, project title; project location; location of sample(s) tested; time of testing; date of testing; testing person's full name; testing agency name, address, and telephone number; and test results.

L. No soil material shall be used until 1) the Engineer has reviewed and approved test reports and 2) the Contractor submits certification that the soil material proposed for construction is clean and meets gradation and other parameters specified in these Specifications.

- M. At no cost to the Owner, the Contractor shall remove and replace or correct all materials and work which tests indicate do not conform, in the opinion of the Engineer, to the requirements of these Specifications.
- N. The results of in-place density tests shall be considered satisfactory if the density in each instance is equal to or greater than the specified density. Soil moisture content at the time of testing shall conform to requirements of these Specifications.
- O. Where the tests reveal unsatisfactory compaction, the Contractor shall re-excavate, backfill, recompact, and/or rework the backfill as required to obtain the required degree of compaction over the entire depth of the excavation.
- P. The testing agency shall transmit to the Engineer copies of all testing agency invoices submitted to the Contractor for payment. Invoices shall clearly indicate specific services and date and time services are rendered and shall indicate if the invoiced testing cost is an initial test of the Contractor's work or is a re-test required due to the Contractor's failure to initially achieve the specified requirements.

## PART 2 PRODUCTS

### 2.01 STRUCTURAL MATERIALS

- A. Materials used for shoring and bracing, such as sheet piling, uprights, stringers, and crossbraces, shall be in good serviceable condition. Any timber used shall be sound and free from large or loose knots.

### 2.02 TRENCH SOIL MATERIALS

- A. Materials used for trench construction shall be free of clumps of clay, rock or gravel, debris, waste, frozen materials, and other deleterious matter as determined by the Engineer and shall be satisfactory soil materials as follows:

| Area Classification         | Soil Materials   |
|-----------------------------|--|
| In excavations and trenches | Excavated and borrow material that has been sampled, tested, and approved as "Satisfactory Soil Material." |

## B. Satisfactory Soil Materials

### 1. Soil Classification Groups

Satisfactory soil materials for each trench shall be as follows:

| Satisfactory Soil Material (ASTM D3282, Soil Classification Groups) |  |                |
|---|--|----------------|
| In-situ Foundation  | Bedding, Haunching, and Initial Backfill | Final Backfill |
| SW<br>SP  | SW<br>SP                                 | SW<br>SP       |

### 2. Maximum Particle Size Limitations for Satisfactory Soil Materials

The maximum allowable particle size for satisfactory soil materials within each trench for each type of utility shall be as follows:

| Conduit   | Maximum Allowable Particle Size |   |                |
|---|---------------------------------|---|----------------|
|   | In-situ Foundation              | Bedding, Haunching, and Initial Backfill                      | Final Backfill |
| Plastic Pipe (PVC, CPVC, HDPE, etc.) less than 6-inch-diameter  | See Note 1                      | 1/2 inch  | 3 inches       |
| Plastic Pipe (PVC, CPVC, HDPE, etc.) 6-inch-diameter and Larger | See Note 1                      | 3/4 inch  | 3 inches       |
| Concrete Pipe   |                                 |   |                |
| Steel Pipe  |                                 |   |                |
| Ductile Iron Pipe   |                                 |   |                |
| Fiberglass Pipe   | See Note 1                      | 3/4 inch or three times the wall thickness, whichever is less | 3 inches       |
| Other Conduit Materials   | See Note 2                      | See Note 2  | See Note 2     |

- (1) There is no requirement when satisfactory undisturbed native soil material is used. Disturbed portions of the foundation and/or unsatisfactory native soil material shall be replaced with satisfactory soil materials meeting all the requirements for Bedding.
- (2) The maximum allowable particle size shall be in accordance with the manufacturer's written recommendation.

### 3. Additional Requirements of Satisfactory Materials

Satisfactory soil materials shall be free of debris, waste, frozen materials, vegetation, or other deleterious matter. Soils within 4 inches of the exterior surface of the pipe shall be free of gravel, stones, or other materials which may abrade the pipe surface.

C. Unsatisfactory Materials

Unsatisfactory soil materials shall mean ASTM D2487, Soil Classification Groups GW, GP, GM, GC, SC, CL, ML, OL, CH, MH, OH, and PT and other highly organic soils and soil materials of any classification that have a moisture content at the time of compaction beyond the range of 1 percentage point below and 3 percentage points above the optimum moisture content of the soil material as determined by moisture-density relations test.

## PART 3 EXECUTION

### 3.01 GENERAL REQUIREMENTS

The Contractor shall do the following:

- A. Carefully verify by hand methods the location of all surrounding underground utilities before performing utility excavations and trenches.
- B. Protect utilities to be left in place from damage.
- C. Do not interrupt existing utilities serving facilities occupied and used by the Owner, except when permitted in writing by the Owner.
- D. Protect bench-marks, survey points, and existing structures, roads, sidewalks, monitoring wells, paving, curbs, etc. against damage from equipment, vehicular or foot traffic, settlement, lateral movement, undermining, washout, and all construction-related activities.
- E. Repair and replace damage to existing facilities to equal or better than their original undamaged condition without cost to the Owner and to the approval of the Engineer.
- F. Excavate and trench in ways that will prevent surface water and subsurface water from flowing into excavations and will also prevent flooding of the site and surrounding area.
- G. Protect excavations and trenching by shoring, bracing, sheet piling, underpinning, or other methods as required to prevent cave-ins or loose dirt from falling into excavations and trenches.
- H. Do not operate earth-moving equipment within 5 feet of walls of concrete structures for depositing or compacting backfill material.
- I. Compact the backfill material placed next to concrete walls with hand-operated tampers or similar equipment that will not damage the structure.

- J. Excavate, fill, backfill, and grade to elevations required by the Contract Documents.
- K. Pile excavated materials suitable for backfill in an orderly manner a sufficient distance from excavations to prevent overloading, slides, and cave-ins.
- L. Do not obstruct access ways, roadways, and plant facilities.
- M. Dewater excavations and trenches in accordance with Section 02240, Dewatering.
- N. Refer to the Contract Drawings for additional requirements related to earthwork and protection of existing features.

### 3.02 TRENCH EXCAVATION

- A. Before excavating the trench, the Contractor shall prepare the surface including clearing and grubbing as specified in Section 206 of the City's Standard Technical Specifications.
- B. The Contractor shall be required to fully comply with all applicable OSHA Excavation Safety Standards and to abide by them as covered by the most current version of the Florida Trench Safety Act (90-96, Laws of Florida).
- C. The Contractor shall ensure that mechanical equipment used for trench excavation shall be of a type, design, and construction and shall be so operated that conduit/utility, when accurately laid to specified alignment, will be centered in the trench with adequate clearance between the conduit/utility and sidewalls of the trench. Undercutting the trench sidewall to obtain clearance will not be permitted.
- D. The Contractor shall not use mechanical equipment in locations where its operation would cause damage to trees, buildings, culverts, other existing property, utilities, structures, etc. above or below ground. In all such locations, the Contractor shall use hand excavating methods.
- E. The Contractor shall not use blasting.
- F. The Contractor shall cut trenches sufficiently wide to enable proper installation of services and to allow for testing and inspection. The Contractor shall also trim and shape trench bottoms and leave them free of irregularities, lumps, and projections. Trench width shall be excavated as specified on the Contract Drawings.
- G. The Contractor shall construct trench walls so as to avoid side wall collapse or sloughing. Trenches shall be either braced or open construction in accordance

with the Contract Documents. No separate payment will be made for any special procedure used in connection with the excavation.

- H. Where sheeting and bracing are not required, the Contractor shall construct trench walls in the bottom of the excavation as vertical as possible to the maximum height allowable by OSHA. Trench walls above this height shall be sloped to guard against side wall collapse or sloughing as specified on the Contract Drawings.
- I. Where sheeting and bracing are required, the sheeting and bracing system shall meet the requirements in these Specifications.
- J. Excavations shall be to the design elevations shown on the Contract Drawings or as specified, unless unsatisfactory or unsuitable foundation materials are encountered in the bottom of the excavation. Where unsatisfactory or unsuitable foundation materials are encountered, this material shall be undercut and removed as indicated on the Contract Drawings and replaced with satisfactory soil material meeting all the requirements for Bedding. The lift thicknesses and compaction requirements for the replacement soil shall also meet the requirements for Bedding.
- K. The Contractor shall be careful not to overexcavate except where necessary to remove unsatisfactory or unsuitable materials, irregularities, lumps, rock, and projections. Unnecessary overexcavation shall be replaced as specified in these Specifications at the Contractor's sole expense.
- L. The Contractor shall accurately grade bedding soil materials at the bottoms of the trenches to provide uniform bearing and support for each section of conduit/utility at every point along its entire length except where it is necessary to excavate the bedding for conduit/utility bells (e.g., pipe bells), etc. or for proper sealing of conduit/utility joints. Abrupt changes in grade of the trench bottom shall be avoided.
- M. The Contractor shall dig bell holes and depressions after the bedding has been graded to ensure that the conduit/utility rests on the prepared bedding for as much of its full length as practicable. Bell holes and depressions shall be only of such length, depth, and width as required to make the joint.
- N. The Contractor shall do the following:
  - 1. Pile all excavated material in a manner that will not endanger the work or erode the stormwater management facilities or water courses.
  - 2. Avoid obstructing sidewalks, driveways, and plant facilities.
  - 3. Leave hydrants, valve pit covers, valve boxes, or other utility controls unobstructed and accessible.

- 4. Keep gutters, drainage inlets, natural water courses, and miscellaneous drainage structures clear or make other satisfactory provisions for their proper operation.
- O. The Contractor shall keep all satisfactory materials that are suitable for use/reuse in the trench construction separated from unsatisfactory materials.
- P. Except where otherwise authorized, indicated, or specified, the Contractor shall replace, at the Contractor's own expense, all materials excavated below the bottom of concrete walls, footings, slabs on grade, and foundations with concrete or flowable fill, as directed by the Engineer.
- Q. The Contractor shall adhere to these Additional Excavation Requirements for piping:
  - 1. Excavate trenches so that the piping can be laid to the lines, grades, and elevations indicated on the Contract Drawings.
  - 2. For piping designated to be laid to a minimum cover requirement, grade trenches to avoid high and low points to the extent practical. Record Drawings of such pipes shall present top-of-pipe and grade elevations at all high and low points along each pipe segment, at the end points of each pipe segments, and at intervals not to exceed 100 feet along each pipe segment. If, in the opinion of the Engineer, additional air release and/or vacuum relief valves are required, the Contractor shall install the additional items as directed by the Engineer.
  - 3. Except at locations specifically indicated otherwise on the Contract Drawings, the required minimum cover over the top of the pipe from finished grade for various pipe diameters shall be as follows:

|               | Pipe Diameter   |         |          |         |
|---------------|-----------------|---------|----------|---------|
|               | 48 inch or less | 66 inch | 72 inch  | 96 inch |
| Minimum Cover | 3 feet          | 4 feet  | 4.5 feet | 5 feet  |

Continue dewatering operations along each pipe segment until the required minimum cover is provided. During the dewatering operations, the ground water level in the trench shall remain at all times a minimum of 1 foot below bottom of trench excavations.

- R. The Contractor shall adhere to these Additional Excavation Requirements for Electrical Utilities:
  - 1. Avoid abrupt changes in grade of the trench bottom.

2. The required minimum cover over the top of electrical conduits from finished grade shall be as follows:

|               | Electrical Conduits<br>(Lines less than 5 kV) | Electrical Conduits<br>(Lines 5 kV and up) |
|---------------|---|--|
| Minimum Cover | 2 feet  | 3 feet                                     |

3. The required minimum clearance from the bottom of mat foundations and/or footings shall be 2 feet. Provide additional cover where necessary to satisfy the minimum clearance requirement.
4. Provide additional cover depth if necessary to avoid interference of other cables, ducts, piping, structures, and other utilities.

S. The Contractor shall adhere to this Additional Excavation Requirement for Appurtenances:

1. Ensure that excavations for valves and similar appurtenances shall be sufficient to leave at least 12 inches in the clear between the outer surfaces and the embankment or timber used to hold and protect the walls.

### 3.03 PROTECTION OF PERSONS AND PROPERTY

- A. The Contractor shall do the following:
1. Barricade and post excavations with warning signs for the safety of persons. Provide warning lights during hours of darkness.
2. Protect structures, utilities, sidewalks, pavements, and other facilities immediately adjacent to excavations against damage including loading, settlement, lateral movement, undermining, and washout.
- B. Conduct topsoil removal operations to ensure the safety of persons and to prevent damage to existing structures and utilities, construction in progress, trees and vegetation to remain standing, and other property.

### 3.04 SHEETING AND BRACING

- A. Where sheeting and bracing are required to support the side walls of the excavation, the Contractor shall retain a Professional Engineer, registered in Florida, to design sheeting and bracing. The design shall establish requirements for sheeting and bracing and shall comply with all applicable codes; authorities having jurisdiction; and federal, state, and local regulations.
- B. The sole responsibility for the design, methods of installation, and adequacy of sheeting and bracing shall be and shall remain that of the Contractor and the

Contractor's Professional Engineer. The Contractor shall provide all necessary sheeting and bracing or other procedures as required to ensure safe working conditions and to protect the excavations.

- C. Sheeting and bracing shall consist of braced steel sheet piling, trench box, braced wood lagging, and soldier beams or other approved methods.
- D. The Contractor shall immediately fill and compact voids formed outside the sheeting. Where soil cannot be properly compacted to fill the void, the Contractor shall use Class B concrete as backfill at no additional cost to the Owner.
- E. The Contractor shall install sheeting outside the required clearances and dimensions. Sheetинг shall be plumb, securely braced, and tied in position. Sheetинг shall be adequate to withstand all pressure to which it may be subjected. The Contractor shall correct any movement or bulging at no expense to the Owner so as to provide the necessary clearances and dimensions.
- F. The Contractor shall maintain sheeting and bracing in excavations and trenches for the entire time excavations will be open.
- G. The Contractor shall not brace sheeting against pipe being laid. Sheetинг shall be braced so that no concentrated load of horizontal thrust is transmitted to the pipe.
- H. Sheetинг shall not be withdrawn if driven below the spring line of any pipe. The Contractor shall cut off tops as indicated on the Contract Drawings and leave bottoms permanently in place.

### 3.05 BACKFILLING AND COMPACTION

- A. The Contractor shall not backfill trenches until required tests are performed.
- B. Trenches improperly backfilled shall be reopened to the depth required for proper compaction, then refilled and compacted as specified, or the condition shall be otherwise corrected as directed.
- C. The Contractor shall perform the following steps to ensure compaction at the bottom of the trench or excavation before bedding:
  1. Remove disturbed native soil material and/or any soils not meeting the requirement of satisfactory soil material as indicated on the Contract Drawings.
  2. Compact the bottom of the trench excavation (undisturbed native subsurface soil) to no less than 95% of the Modified Proctor maximum dry

density in accordance with ASTM D1557, before placement of foundation, bedding, piping, and backfill.

- D. To backfill below and around pipe to the spring line of the pipe, the Contractor shall do the following:
  - 1. Construct foundation and bedding as indicated on the Contract Drawings before placement of pipe.
  - 2. Install each pipe at proper grade, alignment, and final position.
  - 3. Deposit satisfactory soil material uniformly and simultaneously on each side of pipe in completed course layers to prevent lateral displacement.
  - 4. Compact under pipe haunches and on each side of pipe to the pipe spring line as shown on the Contract Drawings to hold the pipe in the proper position during subsequent pipe backfilling and compaction operations.
  - 5. Construct haunching as indicated on the Contract Drawings.
- E. To trench backfill above pipe spring line to finished grade, the Contractor shall do the following:
  - 1. Deposit satisfactory soil material around and above pipe in uniform layers as shown on the Contract Drawings.
  - 2. Backfill and compact trenches from the spring line of the pipe to the top of the trench in completed course layers as shown on the Contract Drawings.
  - 3. Use material previously defined in these Specifications as satisfactory soil material.
  - 4. Compact by hand or mechanical tampers.

### 3.06 DISPOSAL OF EXCESS AND WASTE MATERIALS

- A. The Contractor shall remove and legally dispose of waste materials, including excavated material classified as unsatisfactory soil material, trash, and debris from the property at no additional cost to the Owner.

END OF SECTION

**SECTION 02370**  
**EROSION AND SEDIMENTATION CONTROL**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. The Contractor shall take every reasonable precaution throughout construction to prevent the erosion of soil and the sedimentation of streams, bays, storm systems, or other water impoundments, ground surfaces, or other property as required by federal, state, and local regulations.
- B. The Contractor shall provide protective covering for disturbed areas upon suspension or completion of land-disturbing activities. Permanent vegetation shall be established at the earliest practicable time. Temporary and permanent erosion-control measures shall be coordinated to ensure economical, effective, and continuous erosion and siltation control throughout the construction and post-construction period.

**1.02 RELATED WORK**

- A. Section 01330, Submittals and Acceptance.
- B. Section 01650, Delivery, Storage, and Handling.
- C. Section 01780, Warranties and Bonds.
- D. Section 02920, Seeding and Sodding.

**1.03 SUBMITTALS**

- A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance.

**1.04 REFERENCE STANDARDS**

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. Florida Department of Transportation (FDOT)
  - 1. FDOT Section 103—Temporary Work Structures.
  - 2. FDOT Section 104—Prevention, Control, and Abatement of Erosion and Water Pollution.

3. FDOT Section 530—Riprap.
4. FDOT Section 982—Fertilizer.
5. FDOT Section 985—Geotextile Fabrics.

## 1.05 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

## 1.06 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

## 1.07 REGULATORY REQUIREMENTS

- A. The Contractor shall prevent damage to properties outside the construction limits from siltation due to construction of the project and assume all responsibilities to the affected property owners for correction of damages which may occur. Erosion-control measures shall be performed conforming to the requirements of and in accordance with plans approved by applicable state and local agencies and as specified by the erosion-control portion shown on the Drawings and as required by these Specifications. The Contractor shall not allow mud and debris to accumulate in the streets or enter drainage ditches, canals, or waterways. Should the Contractor pump water from excavations during construction, appropriate siltation preventative measures shall be taken before the pumped water is discharged into any drainage ditch, canal, or waterway.

## 1.08 PRACTICES

The Contractor shall adhere to the following:

- A. Avoid dumping soil or sediment into any stream bed, pond, ditch, or watercourse.
- B. Maintain an undisturbed vegetative buffer where possible between a natural watercourse and trenching and grading operations.
- C. Avoid equipment crossings of streams, creeks, and ditches where practicable.

## 1.09 EROSION AND SEDIMENT-CONTROL DEVICES AND FEATURES

- A. The Contractor shall construct all devices (silt fences, retention areas, etc.) for sediment control at the locations required to protect federal, state, and local water

bodies and water courses and drainage systems before beginning to excavate the site. All devices shall be properly maintained in place until a structure or paving makes the device unnecessary or until directed to permanently remove the device.

- B. The Contractor shall use mulch to temporarily stabilize areas subject to excessive erosion and to protect seed beds after planting where required.
- C. Filter fabric, hay bales, or other approved methods shall be placed and secured over the grates of each existing inlet, grating, or storm pipe opening near the area of excavation to prevent silt and debris from entering the storm systems.
- D. The Contractor shall use silt fences, hay bales, and floating turbidity barriers as shown on the plans or as directed by the Owner or Owner's Representative to restrict movement of sediment from the site.
- E. The Contractor shall establish vegetative cover on all unpaved areas disturbed by the work.

## PART 2 PRODUCTS

### 2.01 GENERAL

- A. Open-mesh biodegradable mulching cloth.
- B. Fertilizer shall be in accordance with Section 02920, Seeding and Sodding.
- C. Lime shall be Dolomitic Agricultural Ground limestone, in accordance with FDOT Section 982.
- D. Grass shall be in accordance with Section 02920, Seeding and Sodding.
- E. Silt fence shall consist of non-biodegradable filter fabric (Trevira, Mirafi, etc.), in accordance with FDOT Section 985, wired to galvanized wire mesh fencing and supported by wood or metal posts.
- F. Floating or staked turbidity barriers as specified in FDOT Section 985 and FDOT Standard Index 103.
- G. Erosion Stone: FDOT Section 530:
  - 1. Sand-Cement Riprap.
  - 2. Concrete Block.
  - 3. Rubble 20 to 300 pounds each.

- H. Filter Fabric for placing under Riprap shall meet the requirements of FDOT Section 985.
- I. Baled hay or straw in accordance with FDOT Section 104.

## PART 3 EXECUTION

### 3.01 CLEARING

- A. The Contractor shall schedule and perform clearing and grubbing so that subsequent grading operation and erosion-control practices can follow immediately after. Excavation, borrow, and embankment operations will be conducted as a continuous operation. All construction areas not otherwise protected shall be planted with permanent vegetative cover within 30 working days after completing active construction.

### 3.02 STABILIZING

- A. The angle for graded slopes and fills shall be no greater than the angle that can be retained by vegetative cover or other adequate erosion-control devices or structures. All disturbed areas outside of embankment left exposed will, within 30 working days of completion of any phase of grading, be planted or otherwise provided with either temporary or permanent ground cover, devices, or structures sufficient to restrain erosion.

### 3.03 REGULATORY REQUIREMENTS

- A. Whenever land-disturbing activity is undertaken on a tract, a ground cover sufficient to restrain erosion must be planted or otherwise provided within 30 working days on that portion of the tract upon which further active construction is to be undertaken.
- B. If any earthwork is to be suspended for any reason for longer than 30 calendar days, the areas involved shall be seeded with vegetative cover or otherwise protected against excessive erosion during the suspension period. Suspension of work in any area of operation does not relieve the Contractor of the responsibility to control erosion in that area.

### 3.04 VEGETATIVE COVER

- A. Preparation of Seedbed shall be in accordance with Section 02920, Seeding and Sodding.

- B. Disturbed areas along embankments shall be permanently seeded with mix specified in Section 02920, Seeding and Sodding.
- C. The Contractor shall mulch all areas immediately after seeding. Mulch shall be applied and anchored as specified previously in this Section.

### 3.05 MAINTENANCE

- A. The Contractor shall maintain all temporary and permanent erosion-control measures in functioning order. Temporary structures shall be maintained until such time as vegetation is firmly established and grassed areas shall be maintained until completion of the project. Areas which fail to show a suitable stand of grass or which are damaged by erosion shall be immediately repaired. No additional payment will be made to the Contractor for re-establishing erosion-control devices, which may become damaged, destroyed, or otherwise rendered unsuitable for their intended function during the construction of the project.
- B. The Contractor shall remove all silt, sediment, and debris buildup regularly to maintain functioning storm systems and erosion-control devices.

### 3.06 REMOVAL OF SEDIMENT CONTROL DEVICES

- A. Near completion of the project, when directed by the Engineer, the Contractor shall dismantle and remove the temporary devices used for sediment control during construction. All erosion-control devices in seeded areas shall be left in place until the grass is established. The Contractor shall seed areas around devices and mulch after removing or filling temporary control devices.
- B. The Contractor shall clean up all areas at the completion of the project.

END OF SECTION

**SECTION 02700  
PAVING**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. This Section covers the work necessary to provide for the construction of all pavement where indicated on the Drawings.

**1.02 SUBMITTALS**

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Limerock material submittal is to be made to include liquid limit, plastic index, gradation, certification regarding deleterious material, limerock bearing ratio (LBR), Florida Department of Transportation (FDOT) pit number, and other information as required to indicate performance in accordance with the specifications.
- B. Information regarding asphaltic and Portland cement concrete materials and mix shall be submitted as required by the referenced FDOT specifications.

**1.03 REFERENCE STANDARDS**

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time, unless otherwise noted. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. The 2017 editions of the FDOT Standard Specifications for Road and Bridge Construction (Standard Specifications) and Roadway and Traffic Design Standards shall be referred to for construction, workmanship, and quality control as specified with exceptions as noted in this Section.
1. Where the referenced FDOT Specifications cite "the Department," this shall be modified to "the Owner and/or Engineer" by this contract.
  2. The Contractor shall retain an independent testing agency, as approved by the Engineer, to perform all tests, including tests referenced to be performed by the Engineer.

3. Payment for this project is on a Lump-Sum Basis if defined as Lump Sum on the Bid Form. The FDOT sections defining the Basis of Payment shall be applied only when unit price work is defined on the Bid Form.
- B. American Society of Testing and Materials (ASTM)
  1. ASTM D1556/D1556M—Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
  2. ASTM D1557—Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>)).
  3. ASTM D2167—Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
  4. ASTM D6938—Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

## 1.04 QUALITY ASSURANCE

- A. The Contractor shall perform field-density tests along the centerline of construction or as directed by the Engineer and in accordance with the FDOT's *Standard Specifications for Road and Bridge Construction*, latest edition.
- B. The Contractor shall field check the depth of stabilization and/or limerock at each road crossing with a pipeline.
- C. The Engineer may require additional testing as deemed necessary. The Engineer shall interpret test results and the Contractor shall perform remedial work as directed by the Engineer. The Contractor shall provide labor to the Engineer for help in performing tests and/or checking line and grade at no additional cost to the Owner.
- D. Laboratory maximum dry density of soil mixtures at optimum moisture shall be determined by ASTM D1557 for subgrade, stabilized subgrade, and limerock base course.
- E. Field density of stabilized subgrade and soils or soil mixtures in fill or backfill shall be determined by ASTM D1556/D1556M, ASTM D2167, or ASTM D6938 for limerock base course.
- F. Bearing value of stabilized subgrade shall be determined by the methods required for determining LBR according to the FDOT, Standard Specification FM 5-515.
- G. Field density of stabilized subbase shall be 98% or greater of the Modified Proctor maximum dry density, ASTM D1557.

- H. The Engineer shall have sole responsibility for interpreting all test results. The Contractor shall bear the cost of all retests due to failure to achieve specified requirements.

## PART 2 PRODUCTS

### 2.01 GENERAL (NOT USED)

### 2.02 ROCK BASE

- A. The following sections of the Standard Specifications shall apply:

1. Section 200-1, Description.
2. Section 200-2, Materials.

### 2.03 STABILIZING MATERIALS

- A. The following sections of the Standard Specifications shall apply:

1. Section 160-1, Description.
2. Section 160-2, Materials.

### 2.04 PRIME AND TACK COATS FOR BASE COURSES

- A. The following sections of the Standard Specifications shall apply:

1. Section 300-1, Description.
2. Section 300-2, Materials.

### 2.05 ASPHALT

- A. The following sections of the Standard Specifications shall apply:

1. Section 334-1, Description.
2. Section 334-2, Materials.
3. Section 334-3, General Composition of Mixture.
4. Section 334-5, Acceptance of the Mixture.

## **2.06 CEMENT CONCRETE PAVEMENT**

A. The following sections of the Standard Specifications shall apply:

1. Section 350-1, Description.
2. Section 350-2, Materials.

## **2.07 TRAFFIC STRIPES AND MARKINGS**

A. The following sections of the Standard Specifications shall apply:

1. Section 711-1, Description.
2. Section 711-2, Materials.

## **PART 3 EXECUTION**

### **3.01 EXCAVATION AND EMBANKMENT**

A. The following sections of the Standard Specifications shall apply:

1. Section 120-1, Description.
2. Section 120-2, Classifications of Excavation.
3. Section 120-3, Preliminary Soils Investigation.
4. Section 120-4, Removal of Unsuitable Materials and Existing Roads.
5. Section 120-5, Disposal of Surplus and Unsuitable Material.
6. Section 120-6.1, Materials for Borrow.
7. Section 120-7, Materials for Embankment.
8. Section 120-8, Embankment Construction.
9. Section 120-9, Compaction Requirements.
10. Section 120-10, Acceptance Program.
11. Section 120-11, Maintenance and Protection of Work.
12. Section 120-12, Construction.

B. Exceptions

1. Section 120-4.1, Subsoil Excavation: Unsuitable soils shall be those in Classifications A-6, A-7, or A-8 in the American Association of State Highway and Transportation Officials (AASHTO) System.
2. Section 120-4.2, Construction Over Existing Old Road: Where removal of existing pavement is called for, it shall be removed to the full depth as indicated in the cross-sections and replaced with new limerock and paving or other treatment in accordance with the Drawings and details.
3. Section 120-5.3, Disposal of Paving Materials: Disposing of muck on side slopes shall not apply.

4. Section 120-9.2.1, General: Laboratory maximum dry density shall be determined by Modified Proctor, ASTM D1557. Field densities shall be determined by ASTM D1556/D1556M, ASTM D2167, or ASTM D6938. All embankments shall be compacted to not less than 95% of the maximum dry density, as determined by modified Proctor, ASTM D1557.
5. Section 120-12.1, Construction Tolerances: No tolerance greater than 0.1 foot above or below the plan cross-section will be allowed.

### 3.02 STABILIZING

- A. The following sections of the Standard Specifications shall apply:
  1. Section 160-3, Construction Methods.
  2. Section 160-4, Acceptance Program.
- B. Exceptions
  1. Section 160-2.4, Granular Subbase: Contractor may not substitute 6 inches of Granular Subbase for 12 inches of Stabilization unless such substitution is specifically indicated on the Drawings.
  2. Section 160-4.2.1.2, Undertolerance in Bearing Value Requirements: no undertolerance will be acceptable.

### 3.03 LIMEROCK BEARING RATIO AND DENSITIES

- A. Stabilized finish grade and stabilized shoulders shall have a minimum LBR value of 40 unless indicated otherwise on the Contract Drawings.
- B. Field density of stabilized finished grade shall be a minimum of 98% of the Modified Proctor maximum dry density as specified in ASTM D1557 to a minimum depth of 12 inches as shown on the Drawings.

### 3.04 PRIME AND TACK COATS

- A. The following sections of the Standard Specifications shall apply:
  1. Section 300-3.1, Pressure Distributor.
  2. Section 300-3.2, Sampling Device.
  3. Section 300-3.3. Temperature Sensing Device.
  4. Section 300-5, Cleaning Base and Protection of Adjacent Work.
  5. Section 300-6, Weather Limitations.
  6. Section 300-7, Application of Prime Coat.
  7. Section 300-8, Application of Tack Coat.

### **3.05 ROCK BASE**

A. The following sections of the Standard Specifications shall apply:

1. Section 200-3, Equipment.
2. Section 200-4, Transporting Rock.
3. Section 200-5, Spreading Rock.
4. Section 200-6, Compacting and Finishing Base.
5. Section 200-7, Acceptance Program.
6. Section 200-8, Priming and Maintaining.

B. Exceptions

1. Section 200-7.2.1, Density: The minimum density that will be acceptable for paved areas will be 98% of the maximum dry density as determined by Modified Proctor, ASTM D1557.
2. Section 200-7.3.1.2, Depth and Surface Testing Requirements: Thickness of base shall be measured at intervals not to exceed 200 feet.

### **3.06 ASPHALT**

A. The following sections of the Standard Specifications shall apply:

1. Section 320-6, Preparation of the Mixture.
2. Section 320-7, Transportation of the Mixture.
3. Section 330-1, Description.
4. Section 330-2, Quality Control (QC) Requirements.
5. Section 330-3, Limitations of Operations.
6. Section 330-4, Surface Preparation.
7. Section 330-5, Paving Equipment.
8. Section 330-6, Placing Mixture.
9. Section 330-7, Compacting Mixture.
10. Section 330-8, Joints.
11. Section 330-9, Surface Requirements.
12. Section 330-10, Protection of Finished Surface.

### **3.07 CEMENT CONCRETE PAVEMENTS**

A. The following sections of the Standard Specifications shall apply:

1. Section 350-3, Equipment.
2. Section 350-4, Subgrade Preparation.
3. Section 350-5, Setting Forms.
4. Section 350-6, Protection from Weather.

5. Section 350-7, Placement of Reinforcement.
6. Section 350-8, Placing Concrete.
7. Section 350-9, Striking-off, Consolidating, and Finishing Concrete.
8. Section 350-10, Final Finish.
9. Section 350-11, Curing.
10. Section 350-12, Joints.
11. Section 350-13, Surface Requirements.
12. Section 350-14, Thickness Determinations.

### 3.08 PAVEMENT REPAIR

- A. At his own expense the Contractor shall repair all damage to pavement as a result of work under this Contract in a manner satisfactory to the Engineer. Pavement shall be repaired to match the original surface material thickness and original grade. However, the asphalt concrete thickness shall not be less than 2 inches. The repair shall include preparing the subgrade, placing and compacting the applicable base, priming the limerock base, and placing and maintaining the surface treatment as specified in this Section.
- B. The width of all repairs shall extend at least 12 inches beyond the limit of the damage and as shown on the Contract Drawings. The edge of the pavement to be left in place shall be cut to a true edge with a saw or other approved method to provide a clean edge to abut the repair. The line of the repair shall be reasonably uniform with no unnecessary irregularities.

### 3.09 JOINTS

- A. General pavement joints within asphalt or concrete driveways and roadways and where specified or directed by the Engineer, shall be mechanically sawed butt joints. The edges of asphalt pavement shall be trimmed to straight lines which a roller can follow or formed.

### 3.10 TRAFFIC STRIPES AND MARKINGS

- A. The following sections of the Standard Specifications shall apply:
  1. Section 711-3, Equipment.
  2. Section 711-4, Application.
  3. Section 711-5, Contractor's Responsibility for Notification.
  4. Section 711-6, Protection of Newly Applied Traffic Stripes and Markings.

END OF SECTION

**SECTION 02920**  
**SEEDING AND SODDING**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

A. This Section includes requirements for the following areas of work:

1. Fine grading.
2. Preparation of areas to receive seeding and sodding.
3. Fertilizing of areas to receive seeding and sodding.
4. Maintenance.
5. Seeding.
6. Hydroseeding.
7. Sodding of new areas to receive seeding and sodding.
8. Mulching.

**1.02 RELATED WORK**

- A. Section 01330, Submittals and Acceptance.
- B. Section 01650, Delivery, Storage, and Handling.
- C. Section 01780, Warranties and Bonds.
- D. Section 02370, Erosion and Sedimentation Control.

**1.03 SUBMITTALS**

- A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance.
- B. Certificates:
  1. Fertilizer, seed, hydroseed, and sod shall be accompanied by certificate from vendors certifying these items meet the requirements of these Specifications, stating botanical name, percentage by weight, and percentage of purity.

**1.04 REFERENCE STANDARDS**

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of

this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. FS O-F-241—Fertilizers, Mixed, Commercial.
- B. American Society for Testing and Materials (ASTM)—Equivalent AASHTO standards may be substituted as approved.
- C. The Florida Department of Transportation (DOT) Standard Specifications for Road Bridge Construction (Standard Specifications) shall be referred to for both specific and general standards for materials, construction, workmanship, and quality control as specified in this Section with exceptions, as noted herein. Note that any reference in the Standard Specifications to the terms “Department” or “District Materials Engineer” shall be replaced by the term “Owner.”
- D. Section IV, Technical Specifications.

## 1.05 QUALITY ASSURANCE

- A. The Contractor shall provide seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.

## 1.06 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

## 1.07 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.
- B. Deliver, store, protect, and handle products to the site and prevent damage from wetness and weather conditions.
- C. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable.
- D. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of the manufacturer.

- E. No sod that has been cut for more than 72 hours may be used unless specifically authorized. A letter of certification from the grassing Contractor as to when the sod was cut and what type shall be provided to the Engineer upon delivery of the sod to the job site.

## 1.08 MAINTENANCE

- A. Maintenance shall be as indicated under Part 3, Execution, of this Section.

## 1.09 DEFINITIONS

- A. *Weeds:* Weeds include but are not limited to Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

## 1.10 REGULATORY REQUIREMENTS

- A. The Contractor shall comply with regulatory agencies for fertilizer and herbicide composition.

# PART 2 PRODUCTS

## 2.01 TOPSOIL

- A. The Contractor shall provide topsoil from off-site borrow or from project on-site excavation as approved by the Engineer.

## 2.02 SEED MIXTURE

- A. The Contractor shall comply with the City requirements in Section IV Item 902 and as follows:

1. For sod and seeded areas, fertilize with a complete granular fertilizer on Bahia and St. Augustine grasses at the rate of 1 pound of nitrogen per 1,000 square feet. Fertilizer shall be commercial grade, mixed granules, with 30% to 50% of the nitrogen being in slow or controlled release form. The ratio of nitrogen to potash will be 1:1 or 2:1 for complete fertilizer formulations. Phosphorus shall be no more than one-quarter the nitrogen level. They shall also contain magnesium and micronutrients (i.e., manganese, iron, zinc, copper, etc.).

## 2.03 FERTILIZER FOR SOD

- A. The Contractor shall comply with the City requirements in Section IV Item 902.
- B. The Contractor shall provide commercial fertilizer of neutral character, with some elements derived from organic sources, containing not less than 8% phosphoric acid, 8% potassium, and percentage of nitrogen required to provide less than 1.0 pound of actual nitrogen per 1,000 square feet of area. Provide nitrogen in form that will be available to the seeded and sodded area during initial period of growth. The chemical designation shall be 5-10-10.
- C. The Contractor shall ensure that the fertilizer is delivered to the site in labeled bags or containers.

## 2.04 FERTILIZER FOR SEED

- A. The Contractor shall comply with the City requirements in Section IV Item 902.
- B. Fertilizer: FS O-F-241, Type I, Grade A; recommended for grass, with 50% of the elements derived from organic sources, of a proportion necessary to eliminate any deficiencies of topsoil to the following proportions:
  1. Seeded Areas – 5% nitrogen, 10% phosphoric acid, 10% soluble potash.

## 2.05 WATER FOR SEEDING AND SODDING

- A. Water shall be free of acid, alkali, or organic materials and shall have a pH of 7.0 to 8.5. The Contractor shall provide all water needed for grassing by providing permanent or temporary piping valves and temporary trucks to convey water from the source to the point of use. The Contractor shall provide any meters required and pay for water used if the water is taken from a public water system. Water shall be free of petroleum products, pesticides, and any other deleterious impurities.

## 2.06 EROSION-CONTROL FABRIC

- A. The Contractor shall provide 70% agricultural straw with 30% coconut fiber matrix stitches with degradable nettings designed to degrade within 18 months. Erosion-control anchors shall be as recommended by the manufacturer.

## 2.07 STRAW MULCH

- A. Straw mulch shall be used on all newly graded and top-soiled areas sloped 3:1 or steeper to protect areas against washouts and erosion. Straw mulch shall consist of

threshed straw of oats, wheat, barley, or rye that is free from noxious weeds, mold, or other objectionable material. The straw mulch shall contain at least 50% by weight of material that is 10 inches or longer. Straw shall be in an air-dry condition and suitable for placement with blower equipment.

## 2.08 TACKIFIER

- A. Latex acrylic copolymer shall be Soil Sealant with coalescing agent as manufactured by Soil Stabilization Products Company, Inc., Merced, CA, or equal and shall be used as straw mulch tackifier.

## PART 3 EXECUTION

### 3.01 COORDINATION OF WORK

- A. The Contractor shall coordinate all work activities to provide for establishing grass cover at the earliest possible time in the construction schedule to minimize erosion of topsoil.

### 3.02 SOIL PREPARATION

Concerning soil preparation, the Contractor shall do the following:

- A. Dispose of any existing sod, growth, rocks, or other obstructions which might interfere with tilling, seeding, sodding, or later maintenance operations. Remove stones over 1-1/2 inches in any dimensions and sticks, roots, rubbish, and other extraneous matter. Remove from work area or site: do not stockpile.
- B. Till to a depth of not less than 12 inches. Thoroughly loosen and pulverize topsoil.
- C. Grade areas to be seeded and sodded to a smooth, even surface with loose, uniformly firm texture. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas which can be planted in the immediate future.
- D. Moisten prepared areas to be seeded and sodded before planting if the soil is dry. Water thoroughly and allow the surface to dry off before seeding and sodding. Do not create a muddy soil condition.
- E. Restore prepared areas to specified condition if eroded or otherwise disturbed after the fine grading and before planting.

- F. Spread the planting soil mixture to depth required to meet thickness, grades, and elevations indicated after light rolling and natural settlement. Do not spread if the material is frozen or if the subgrade is frozen.
- G. Preparing Unchanged Grades:
  - 1. Where seeding and sodding in areas that have not been altered or disturbed by excavating, grading, or stripping operations, prepare soil as follows:
    - a. Till to a depth of not less than 12 inches.
    - b. Apply soil amendments and initial fertilizers.
    - c. Remove high areas and fill in depressions.
    - d. Till soil to a homogeneous mixture of fine texture, free of lumps, clods, stones, roots, and other extraneous matter.
- H. Allow for a 3-inch sod thickness in areas to be added next to paving.
- I. Before preparing unchanged areas, remove existing grass, vegetation, and turf. Dispose of such material outside of the Owner's property: do not turn over into soil being prepared for seeding and sodding.
- J. Place approximately one-half of the total amount of planting soil required. Work into the top of the loosened subgrade to create a transition layer and then place the remainder of the planting soil.

### 3.03 FERTILIZING FOR SEEDING

- A. Seeding: The Contractor shall spread fertilizer uniformly at a rate of 10 pounds per 1,000 square feet.
- B. Apply after smooth raking of topsoil and before roller compaction.
- C. Do not apply fertilizer at same time or with same machine as will be used to apply seed.
- D. Mix thoroughly into upper 2 inches of topsoil.
- E. Lightly water to aid the dissipation of fertilizer.

### 3.04 SEEDING

- A. Apply seed at the rate designated on the schedule evenly in two intersecting directions. Rake in lightly.

- B. Do not seed areas in excess of that which can be mulched on the same day.
- C. Do not sow immediately following rain, when ground is too dry, or during windy periods.
- D. Roll seeded area with appropriate equipment to achieve seed embedment and soil compaction.
- E. Apply water with a fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.

### 3.05 HYDRO-SEEDING

- A. Apply seeded slurry with a hydraulic seeder at the rate designated on schedule evenly in two intersecting directions.
- B. Do not hydro-seed area in excess of that which can be mulched on the same day.
- C. Apply water with a fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.

### 3.06 SEED PROTECTION

- A. When seeding is complete, apply straw mulch at a rate of 4,000 pounds/acre. Apply tackifier as required.
- B. Cover seeded slopes where grade is 4 inches per foot or greater with erosion fabric. Roll fabric onto slopes without stretching or pulling.
- C. Lay fabric smoothly on surface, bury top end of each section in 6-inch-deep excavated topsoil trench. Provide a 2- to 4-inch overlap of adjacent rolls. Backfill the trench and rake smooth, level with the adjacent soil.
- D. Secure outside edges and overlaps in accordance with the manufacturer's recommendations.
- E. Lightly dress slopes with topsoil to ensure close contact between fabric and soil.
- F. At the sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges a minimum of 6 inches.

### **3.07 SODDING NEW AREAS**

When sodding new areas, the Contractor shall do the following:

- A. Before laying sod, contact the Engineer to observe soil preparation work. Lay sod within 24 hours of the time of stripping. Do not plant dormant sod or if the ground is frozen.
- B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod strips; do not overlap. Stagger to offset joints in adjacent courses. Employ installation methods to avoid damage to subgrade or sod. On slopes install the sod with an overlap that allows water to flow over the adjacent strip and not under it. Tamp or roll lightly to ensure contact with subgrade. Work sifted soil into minor cracks between pieces of sod; remove excess to avoid smothering adjacent grass.
- C. Anchor sod on slopes greater than 3:1 with wood pegs as required to prevent slippage.
- D. Water sod thoroughly with a fine spray immediately after planting.

### **3.08 RECONDITIONING SEEDED AND SODDED AREAS**

The Contractor shall ensure that seeded and sodded areas are properly reconditioned by doing the following:

- A. Recondition seeded and sodded areas that are damaged by work operations, including storage of materials or equipment and movement of vehicles. Also recondition seeded and sodded areas where settlement or washouts occur or where minor regrading is required. Recondition other existing seeded and sodded areas where indicated.
- B. Provide fertilizer, topsoil, seed, or sod amendments as specified for new seeded and sodded areas and as required to provide satisfactory reconditioning. Provide new planting soil as required to fill low spots and meet new finish grades.
- C. Cultivate bare and compacted areas thoroughly to provide a good deep planting bed.
- D. Remove diseased or unsatisfactory seeded and sodded areas; do not bury into soil. Remove topsoil containing foreign materials resulting from operations including oil drippings, stone, gravel, and other construction materials. Replace with new topsoil.

- E. Where substantial seeding and sodding remains (but is thin), mow, rake, aerate if compacted, fill low spots, remove humps and cultivate soil, fertilize, and seed. Remove weeds before seeding or, if extensive, apply selective chemical weed killers as required. Apply a seedbed mulch, if required, to maintain moist condition.
- F. Water newly planted areas and keep moist until new grass is established.

### 3.09 PROTECTION

- A. The Contractor shall erect barricades, warning signs, and fencing to protect newly planted areas from traffic. Maintain barricade fencing and warning signs throughout the maintenance period until project is substantially completed.

### 3.10 MAINTENANCE

To maintain the seeded and sodded area, the Contractor shall do the following:

- A. Mow sod to a height of 2 inches as soon as there is enough top growth to cut with a mower. Remove no more than 40% of grass leaf growth in initial or subsequent mowing. Do not delay mowing until grass blades bend over and become matted.
- B. Maintain grass growth by watering, fertilizing, weeding, mowing, trimming, and other operations such as rolling, re-grading, and replanting as required to establish a smooth, acceptable seeding and sodding, free from eroded or bare areas.
- C. Remove weeds by pulling or chemical treatment.
- D. Perform maintenance until the date of final completion of project.
- E. Apply the second fertilizer application after the first mowing and when grass is dry. Use fertilizer which will provide not less than 1.0 pound of actual nitrogen per 1,000 square feet of seeded and sodded areas.
- F. Replant bare areas using the same materials specified for seeded and sodded areas.
- G. Watering: Provide and maintain temporary piping, hoses, and watering equipment as required to convey water from water sources and to keep seeded and sodded areas uniformly moist as required for proper growth. Do not apply more than 1 inch of water per week to sustain grass growth.

- H. Lay out temporary watering system and arrange watering schedule to avoid walking over muddy areas. Use equipment and water to prevent puddling and water erosion and displacing seed or mulch (if any).
- I. Apply water in sufficient quantities and as often as seasonal conditions require to keep the grassed areas moist.
- J. Provide supplemental water and irrigation to sod areas when the rainfall is not adequate to maintain soil moisture necessary for growth of the grass. The Contractor is responsible for determining the quantities of water required and when to irrigate. This obligation shall remain in full force and effect until final acceptance of the work by the Owner and shall be provided at no additional cost to the Owner.

The Owner, at its discretion, may relieve the Contractor of this obligation at such time as the Owner is able to provide irrigation if available. This action, however, does not relieve the Contractor of the provisions and guarantees set forth in the Contract Documents.

### 3.11 ACCEPTANCE OF SEEDED OR SODDED AREAS

- A. When seeding or sodding work, including maintenance, is substantially complete, the Engineer and the Owner will, upon request, observe to determine satisfactory growth and acceptability:
  - 1. The term "Satisfactory Growth" as used in this Section is defined as even plant growth in healthy condition without bare spots larger than 1 square foot in seeded areas and without bare spots in sodded areas. Bare spots in sodded areas shall be resodded. The Contractor shall maintain all grassed and sodded areas until satisfactory growth has been demonstrated at project final completion. If the subsequent stand of grass is found contaminated with weeds or other obnoxious or undesirable growth, the Contractor shall eliminate such undesirable growth at the Contractor's own expense.
- B. The Contractor shall re-plant rejected work and continue specified maintenance until the work is accepted by the Engineer and the Owner and found to be acceptable.
- C. Sodded areas will be acceptable provided requirements, including maintenance, have been complied with and a healthy, well-rooted, even-colored, viable seeded or sodded area is established, free of weeds, open joints, bare areas, and surface irregularities.

### **3.12 CLEANUP**

- A. The Contractor shall promptly remove soil and debris created by seeding and sodding work from paved areas. Clean wheels of vehicles before they leave the site to avoid tracking soil onto surfacing of roads, walks, or other paved areas.

**END OF SECTION**

**DIVISION 3**

**CONCRETE**

**SECTION 03100**  
**CONCRETE FORMWORK**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. The Contractor shall furnish all labor, materials, equipment, and incidentals required to design, install, and remove formwork for cast-in-place concrete as shown on the Drawings and as specified in this Section.
- B. Secure to forms as required or set for embedment as required all miscellaneous metal items, sleeves, reglets, anchor bolts, inserts, and other items furnished under other sections and required to be cast into concrete or approved in advance by the Engineer.

**1.02 RELATED WORK**

- A. Section 03200, Concrete Reinforcement.
- B. Section 03250, Concrete Joints and Joint Accessories.
- C. Section 03300, Cast-In-Place Concrete.
- D. Section 03600, Grout.

**1.03 SUBMITTALS**

- A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:
  - 1. Form release agent.
  - 2. Form ties.
- B. Samples
  - 1. Demonstrate to the Engineer on a designated area of the concrete substructure exterior surface that the form release agent will not adversely affect concrete surfaces to be painted, coated, or otherwise finished and will not affect the forming materials.
  - 2. Certify that the form release agent is suitable for use in contact with potable water after 30 days (non-toxic and free of taste and odor).

## **1.04 REFERENCE STANDARDS**

Reference standards and recommended practices referred to in this Section shall be in accordance with the currently effective Florida Building Code (FBC). The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

**A. American Concrete Institute (ACI)**

1. ACI 301—Specifications for Structural Concrete.
2. ACI 318—Building Code Requirements for Structural Concrete and Commentary.
3. ACI 347R—Guide to Formwork for Concrete.

**B. American Plywood Association (APA)**

1. Material grades and designations as specified.

**C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.**

## **1.05 SYSTEM DESCRIPTION**

- A. General:** Architectural Concrete is wall, slab, beam, or column concrete which will have surfaces exposed to view in the finished work. It includes similar exposed surfaces in water-containment structures from the top of walls to 2 feet below the normal water surface in open tanks and basins.
- B. Formwork:** shall be designed and erected in accordance with the requirements of ACI 301 and ACI 318 and as recommended in ACI 347R and shall comply with all applicable regulations and codes. The design shall consider any special requirements due to the use of plasticized and/or retarded set concrete.

## **PART 2 PRODUCTS**

### **2.01 GENERAL**

- A.** The use of a manufacturer's name and model or catalog number is to establish the standard of quality and general configurations desired.

### **2.02 MATERIALS**

- A.** Forms for cast-in-place concrete shall be made of wood, metal, or other approved material. Construct wood forms of sound lumber or plywood of suitable

dimensions and free from knotholes and loose knots. Where used for exposed surfaces, dress and match boards. Sand plywood smooth and fit adjacent panels with tight joints. Metal forms may be used when approved by the Engineer and shall be of an appropriate type for the class of work involved. All forms shall be designed and constructed to provide a flat, uniform concrete surface requiring minimal finishing or repairs.

B. Wall Forms

1. Forms for all exposed exterior and interior concrete walls shall be "Plyform" exterior-grade plywood panels manufactured in compliance with the APA and bearing the trademark of that group or an equal acceptable to the Engineer. Provide B grade or better veneer on all faces to be placed against concrete during forming. The class of material and grades of interior plies shall be of sufficient strength and stiffness to provide a flat, uniform concrete surface requiring minimal finishing and grinding.
2. All joints or gaps in forms shall be taped, gasketed, plugged, and/or caulked with an approved material so that the joint will remain watertight and will withstand placing pressures without bulging or creating surface patterns.

C. Rustication strips shall be at the location and shall conform to the details shown on the Drawings. Moldings for chamfers and rustications shall be milled and planed smooth. Rustications and corner strips shall be of a nonabsorbent material, compatible with the form surface, and fully sealed on all sides to prohibit the loss of paste or water between the two surfaces.

D. Column Forms

1. Rectangular columns shall be formed as specified for wall forms. All corners shall have a 3/4-inch chamfer unless otherwise noted on the Drawings.

E. Form Release Agent

1. Coat all forming surfaces in contact with concrete using an effective, non-staining, non-residual, water-based, bond-breaking form coating unless otherwise noted. Form release agents used in potable water containment structures shall be suitable for use in contact with potable water and shall be non toxic and free of taste or odor.

**F. Form Ties**

1. Form ties encased in concrete other than those specified in the following paragraphs shall be designed so that after removal of the projecting part no metal shall remain within 1-1/2 inches of the face of the concrete. The part of the tie to be removed shall be at least 1/2 inch diameter or be provided with a wood or metal cone at least 1/2 inch diameter and 1-1/2 inches long. Form ties in concrete exposed to view shall be the cone washer type.
2. Form ties for exposed exterior and interior walls shall be as specified in the preceding paragraph except that the cones shall be of approved wood or plastic.
3. Flat bar ties for panel forms, if used, shall have plastic or rubber inserts having a minimum depth of 1-1/2 inches and sufficient dimensions to permit proper patching of the tie hole.
4. Ties for liquid containment structures shall have an integral waterstop that is tightly welded to the tie.
5. Common wire shall not be used for form ties.
6. Alternate form ties consisting of tapered-through bolts at least 1 inch diameter at the smallest end or through bolts that use a removable tapered sleeve of the same minimum size may be used at the Contractor's option. Obtain the Engineer's acceptance of the system and spacing of ties before ordering or purchase forming. Clean, fill, and seal the form tie hole with non-shrink cement grout. The Contractor shall be responsible for watertightness of the form ties and any repairs needed.

**PART 3 EXECUTION**

**3.01 GENERAL**

- A. Forms shall be used for all cast-in-place concrete, including sides of footings. Forms shall be constructed and placed so that the resulting concrete will be of the shape, lines, dimensions, and appearance indicated on the Drawings.
- B. Forms for walls shall have removable panels at the bottom for cleaning, inspection, and joint surface preparation. Forms for walls of considerable height shall have closable intermediate inspection ports. Tremies and hoppers for placing concrete shall be used to allow concrete inspection, prevent segregation, and prevent the accumulation of hardened concrete on the forms above the fresh concrete.
- C. Molding, bevels, or other types of chamfer strips shall be placed to produce blockouts, rustications, or chamfers as shown on the Drawings or as specified in this Section. Chamfer strips shall be provided at horizontal and vertical projecting corners to produce a 3/4-inch chamfer. Rectangular or trapezoidal moldings shall

be placed in locations requiring sealants where specified or shown on the Drawings. Sizes of moldings shall conform to the sealant manufacturer's recommendations.

- D. Forms shall be sufficiently rigid to withstand construction loads and vibration and to prevent displacement or sagging between supports. Construct forms so that the concrete will not be damaged by their removal. The Contractor shall be entirely responsible for the adequacy of the forming system.
- E. Before form material is reused, all surfaces to be in contact with concrete shall be thoroughly cleaned, all damaged places repaired, all projecting nails withdrawn, and all protrusions smoothed. Reuse of wooden forms for other than rough finish will be permitted only if a "like new" condition of the form is maintained.

### 3.02 FORM TOLERANCES

- A. Forms shall be surfaced, designed, and constructed in accordance with the recommendations of ACI 347R and shall meet the following additional requirements for the specified finishes:
  - 1. Formed Surface Exposed to View: Edges of all form panels in contact with concrete shall be flush within 1/16 inch and forms for plane surfaces shall be such that the concrete will be planed within 3/16 inch in 4 feet. Forms shall be tight to prevent the passage of mortar, water, and grout. The maximum deviation of the finish wall surface at any point shall not exceed 1/4 inch from the intended surface as shown on the Drawings. Form panels shall be arranged symmetrically and in an orderly manner to minimize the number of seams.
  - 2. Formed surfaces not exposed to view or buried shall meet requirements of Class "C" Surface in ACI 347R.
  - 3. Formed rough surfaces including mass concrete, pipe encasement, electrical duct encasement, and other similar installations shall have no minimum requirements for surface smoothness and surface deflections. The overall dimensions of the concrete shall be plus or minus 1 inch.

### 3.03 FORM PREPARATION

- A. Wood forms in contact with the concrete shall be coated with an effective release agent before the forms are installed.
- B. Steel forms shall be thoroughly cleaned and mill scale and other ferrous deposits shall be sandblasted or otherwise removed from the contact surface for all forms, except those used for surfaces receiving a rough finish. All forms shall have the contact surfaces coated with a release agent.

### **3.04 REMOVAL OF FORMS**

- A. The Contractor shall be responsible for all damage resulting from removing the forms. Forms and shoring for structural slabs or beams shall remain in place in accordance with ACI 301 and ACI 347R. Form removal shall conform to the requirements specified in Section 03300, Cast-In-Place Concrete, and a curing compound applied.

### **3.05 INSPECTION**

- A. The Engineer on site shall be notified when the forms are complete and ready for inspection at least 6 hours before the proposed concrete placement.
- B. Failure of the forms to comply with the requirements specified in this Section or to produce concrete complying with requirements of this Section shall be grounds for rejection of that portion of the concrete work. Rejected work shall be repaired or replaced as directed by the Engineer at no additional cost to the Owner. Such repair or replacement shall be subject to the requirements of this Section and approval of the Engineer.

**END OF SECTION**

**SECTION 03180**  
**CONCRETE COATING SYSTEM**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. Furnish and install all labor, materials, equipment, and incidentals required to supply and install the concrete coating system on the interior surfaces of the Sludge Holding Tank as indicated in the Contract Documents.

**1.02 10-YEAR LIMITED WARRANTY**

- A. Manufacturer shall provide a 10-year limited warranty for coating system.

**1.03 REFERENCES**

- A. American Society for Testing and Materials (ASTM)

1. ASTM D4258—Standard Practice for Surface Cleaning Concrete for Coating.
2. ASTM D4259—Standard Practice for Abrading Concrete.
3. ASTM D4263—Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
4. ASTM D4414—Standard Practice for Measurement of Wet Film Thickness by Notch Gages.
5. ASTM D4541—Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
6. ASTM D4787—Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates.

- B. NACE International (NACE)

1. NACE SP0188—Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.

- C. Steel Structures Painting Council (SSPC)

1. SSPC PA-9—Measurement of Dry Coating Thickness Using Ultrasonic Gages.
2. SSPC SP-1—Solvent Cleaning.
3. SSPC SP-7/NACE No. 4—Brush-Off Blast Cleaning.
4. SSPC SP-10/NACE No. 2—Near-White Blast Cleaning.

5. SSPC SP-12/NACE No. 5—Surface Preparation and Cleaning of Metals.
6. SSPC SP-13/NACE No. 6—Surface Preparation of Concrete.

D. International Concrete Repair Institute (ICRI)

1. ICRI 310.1R - Exposed Reinforcing bar (Rebar) Repair.
2. ICRI-CSP 1 - Concrete Surface Profile 1.
3. ICRI-CSP 2 - Concrete Surface Profile 2.
4. ICRI-CSP 3 - Concrete Surface Profile 3.
5. ICRI-CSP 4 - Concrete Surface Profile 4.
6. ICRI-CSP 5 - Concrete Surface Profile 5.
7. ICRI-CSP 6 - Concrete Surface Profile 6.

**1.04 SUBMITTALS**

- A. Submit for review, complete detailed shop drawings for all materials furnished under this Section.
- B. The Contractor shall furnish the Engineer with a detailed list of previous jobs and references substantiating the requirement. Records of such jobs showing project name, owner's name and contact information, engineer's name and contact information, date of completion, and results of subsequent inspections and tests shall be submitted as verification of performance. The coating system manufacturer shall submit a letter stating that the proposed applicator is qualified to apply the coatings specified herein and that all components proposed for use in the project are acceptable and will not adversely affect the finish coating system or its warranty.
- C. The manufacturer of the coating system shall furnish an affidavit attesting to the successful use of its material as a coating for concrete structures for a minimum period of 5 years in wastewater conditions recognized as corrosive or otherwise detrimental to concrete.
- D. Name, address, and detailed qualifications of the applicator to which the Contractor intends to award the work under this Section. Qualifications shall include, but not be limited to, a list of installations that are currently in service and documentation that the firm is currently a qualified applicator of the proposed materials by the supplier or manufacturer.

**1.05 QUALITY ASSURANCE**

- A. The coatings system manufacturer shall provide a representative to visit the jobsite at intervals during surface preparation and coating as may be required for product application quality assurance, to determine compliance with the

supplier's instructions and these Specifications, and as may be necessary to resolve field problems attributable to, or associated with, the manufacturer's products furnished under this Contract.

- B. The following minimum site visits shall be provided for inspections by the coating system manufacturer's representative:
  1. Before surface preparation, inspection of all concrete surfaces specified in this Section to be coated. At this time, the manufacturer's representative shall review and recommend the surface preparation and repair procedures with the applicator.
  2. Inspection of all prepared surfaces before repair activities. At this time, the manufacturer's representative shall approve the surface preparation for repair coating application.
  3. Inspection of all areas of exposed reinforcing steel after application of the bonding agent and before application of repair coating.
  4. Post-repair inspection before application of the coating system. At this time, the manufacturer's representative shall approve the re-surfaced surfaces for the final coating application.
  5. The manufacturer shall visit the site during the coating application to ensure that the application process is proceeding in accordance with its recommendations.
  6. A post-installation inspection shall be provided by the manufacturer's representative before issuance of a guarantee for the work specified herein.
  7. The manufacturer's factory representative shall submit all inspection reports to the Engineer within 5 days of each site visit documenting its observations and certifying the suitability of the applicator's work for the coating application.
- C. The coating system applicator shall have a minimum of 5 years' practical experience in applying the approved coating system.
- D. It is the responsibility of the Contractor to inspect and provide substrate surfaces that are prepared in accordance with these Specifications and the printed directions and recommendations of the Manufacturer's representative.
- E. Report in writing to the Engineer, with a copy to manufacturer, of deficiencies that could impair work. Surfaces must be approved by the coating system manufacturer and the installing Contractor before application of the coating.

## PART 2 PRODUCTS

### 2.01 COATING SYSTEMS

- A. The coating system shall be one of the systems as described in the Contract Documents and outlined below.
1. Green Monster Liner
    - a. Cementitious Surfacer shall be Green Monster Liner 30 and shall be applied at a minimum of 1/2 inch thickness and as required to bring the existing structure up to original thickness.
    - b. Apply primer in accordance with the manufacturer's requirements.
    - c. Apply one coating of Green Monster Liner 30 at a minimum DFT of 125 mils.
  2. Sauereisen – Sewergard 210
    - a. Cementitious Surfacer shall be Sauereisen Underlayment No. F-121 and shall be applied at a minimum of 1/2 inch thickness and as required to bring the existing structure up to original thickness.
    - b. Apply one coating of Sewergard 210T on surfaces at a minimum DFT of 125 mils.
    - c. Apply one coating of Sewergard 210G on surfaces at a minimum DFT of 20 mils.
  3. Tenemec – Series 436 PermaShield FR.
    - a. Cementitious surfacer shall be Tenemec Series 218 and shall be applied at a minimum of 1/16 inch thickness and as required to bring the existing structure up to original thickness and to fill voids and bugholes to create a monolithic surface.
    - b. Prime surfaces with Tenemec Series N69 at a minimum DFT of 6 mils.
    - c. Apply one coating of Tenemec Series 436 Perma-Shield FR on surfaces at a minimum DFT of 100 to 110 mils.
- B. The coating system shall be applied by a qualified applicator trained in handling, mixing and application of the material including the required surface cleaning and preparation. The applicator shall have a minimum of 5 years of experience installing the product and shall be approved for installation by the manufacturer. A list of references of projects in Florida using the specified coating system shall be provided to the City and Engineer for review.

## PART 3 EXECUTION

### 3.01 GENERAL

- A. Before any work being performed, the Contractor shall notify the owners of any property that may be affected by the construction.
- B. Surface preparation shall be performed in accordance with Manufacturer's requirements and at a minimum shall remove all deteriorated materials, dirt, oil, grease, and all other bond inhibiting materials from the surface by dry or wet mechanical means, i.e., high-pressure washing, sandblasting, grinding, etc., as approved by the Engineer.
- C. Where existing reinforcement is exposed the reinforcement shall be cleaned of all rust and coated with a corrosion inhibitor as recommended by the coating Manufacturer.
- D. Installation, curing and testing shall be performed in accordance with the Manufacturer's specifications and requirements.
- E. In all cases where coating work must be performed in a non-flow condition the Contractor shall be responsible for coordinating and facilitating all flow diversion and bypass pumping during the coating operation.
- F. New Portland cement concrete structures shall have endured a minimum of 28 days since manufacture before commencing coating installation. Should earlier coating be required, coating product manufacturer shall recommend specifications including appropriate cure assessment testing and use of specialty primers and sealers.

### 3.02 REPAIRS AND SURFACE PREPARATION

- A. Excessive debris, sediment, root intrusion, or other foreign materials which may impact the effectiveness of the surface preparation process shall be removed before the commencement thereof.
- B. Offset structural components, lids, covers, frames, etc., shall be repaired, replaced, or reset before the commencement of surface preparation.
- C. External soil/fill voids shall be remediated and/or stabilized by replacement or injection of stabilizing grout as determined appropriate by the Engineer.

- D. Oils, grease, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants which may affect the performance and adhesion of the coating to the substrate shall be removed in accordance with SSPC-SP 1 – Solvent Cleaning.
- E. Choice of surface preparation method(s) should be per the coating manufacturer's recommendation which shall be based upon the condition of the structure and concrete or masonry surface, potential contaminants present, access to perform work, and the required cleanliness and profile of the prepared surface to receive the repair and/or coating product(s).
- F. Surface preparation method(s) shall be as required by the coating manufacturer's requirements.
- G. Whichever method(s) are used, they shall be performed in a manner that provides a uniform, sound, clean, and neutralized surface suitable for the specified coating product(s).
  - 1. Resulting surface profile of the prepared concrete substrate shall be (as described in ICRI Technical Guideline No. 03732):
    - a. For application of cementitious materials: At least an ICRI CSP-3.
    - b. For application of coating products: At least an ICRI CSP-3.
  - 2. Concrete and/or mortar damaged by corrosion, chemical attack or other means of degradation shall be removed so that sound substrate remains:
    - a. In conditions where severe chemical/microbiological attack has occurred the prepared substrate shall exhibit a pH of 8 to 12 or as required by the coating manufacturer. Additional cleaning and/or contaminated substrate removal may be required to achieve the specified pH level.
- H. At the time of the recoating, the amount of flash rust shall be no greater than "No Flash Rust" as defined in SSPC-SP 12.
- I. Before the application of the coating product, repairs shall be completed to ensure the following:
  - 1. All inflow and infiltration shall be eliminated by use of appropriate repair material(s), such as hydraulic cements and/or chemical grouts.

2. All repairs to joints, pipe seals, steps, mechanical penetrations, benches, invert, pipes or other appurtenances to be coated shall be completed and repaired surfaces prepared according to this Section.
  - a. Benches or other horizontal surfaces shall have adequate slope (1 inch rise per lineal foot minimum) to minimize the retention of debris following surcharge.
  - b. Inverts or flow channels shall be smooth without lips, rough edges, or other features which may cause debris to collect; contoured to minimize turbulent flow; and be sloped to promote adequate flow from the inlet(s) to the outlet pipe.
  - c. All joints, pipe seals, steps, or other penetrations shall be sealed against inflow, infiltration, and exfiltration and be adequately filled, smoothed, and contoured to promote monolithic coating application.
- J. Areas where reinforcing steel has been exposed shall be repaired in accordance with the Project Engineer's recommendations, as shown on the Drawings and at the minimum all exposed steel shall be prepared before coating with the coating product specified or other approved primer as specified by the coating product manufacturer.

### 3.03 FIELD QUALITY CONTROL AND TESTING

- A. The Contractor shall give the City and Engineer a minimum of 3 days' advance notice of the start of any field surface preparation work or coating application work, and a minimum of 7 days' advance notice of the start of any surface preparation work.
- B. The Contractor shall furnish, until final acceptance of such coatings, inspection devices in good working condition for the detection of holidays and measurement of dry-film thicknesses of protective coatings. Dry-film thickness gages shall be made available for the City's and Engineer's use at all times while coating is being done, until final acceptance of such coatings. The Contractor shall furnish the services of a trained operator of the holiday detection devices until the final acceptance of such coatings.
- C. Coating system thickness shall be inspected to ensure compliance with the specifications herein.
  1. During application a wet film thickness gauge, meeting ASTM D4414, Standard Practice for Measurement of Wet Film Thickness by Notched Gages, shall be used. Measurements shall be taken, documented, and attested to by the Contractor for submission to the Owner.

2. After the coating product(s) have cured in accordance with manufacturer recommendations, coating system thickness may be measured according to SSPC-PA 9, Measurement of Dry Coating Thickness Using Ultrasonic Gages.
- D. High-voltage holiday detection for coating systems installed in corrosive environments, when it can be safely and effectively employed, shall be performed to ensure monolithic protection of the substrate. After the coating product(s) have cured in accordance with manufacturer recommendations, all surfaces shall be inspected for holidays in accordance with NACE SP0188, Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates, or ASTM D4787, Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates. All detected holidays shall be marked and repaired according to the coating product(s) manufacturer's recommendations.
  1. Test voltage shall be a minimum of 100 volts per mil of coating system thickness.
  2. Detection of a known or induced holiday in the coating product shall be confirmed to ensure proper operation of the test unit.
  3. All areas repaired shall be retested following cure of the repair material(s).
  4. In instances where high voltage holiday detection is not feasible a close visual inspection shall be conducted, and all possible holidays shall be marked and repaired as described above.
  5. Documentation of areas tested, equipment employed, results, and repairs made shall be submitted to the Owner/Engineer by the Contractor.
- E. Visual inspection shall be made by the City, the Engineer, or their representative. Any deficiencies in the finished coating affecting the performance of the coating system or the operational functionality of the structure shall be marked and repaired according to the recommendations of the coating product(s) manufacturer.
- F. Inspection by the City, the Engineer, their representative, or the waiver of inspection of any particular portion of the Work, shall not relieve the Contractor of its responsibility to perform the work in accordance with these Specifications.
- G. Before demobilization from the site, the Contractor shall remove all construction debris, stabilize any spill areas, and wash roadway areas affected by the work.
- H. Inspection by the Owner shall be scheduled after the work is complete and again within the warranty period.

END OF SECTION

**SECTION 03200**  
**CONCRETE REINFORCEMENT**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. The Contractor shall furnish all labor, materials, equipment, and incidentals required and install all concrete reinforcement complete as shown on the Drawings and as specified in this Section.
- B. Furnish only all deformed steel reinforcement required to be entirely built into concrete masonry unit construction.

**1.02 RELATED WORK**

- A. Section 03100, Concrete Formwork.
- B. Section 03250, Concrete Joints and Joint Accessories.
- C. Section 03300, Cast-In-Place Concrete.
- D. Section 03600, Grout.

**1.03 SUBMITTALS**

- A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:
  1. Reinforcing steel. Placement drawings shall conform to the recommendations of ACI SP-66. All reinforcement in a concrete placement shall be included on a single placement drawing or cross referenced to the pertinent main placement drawing. The main drawing shall include the additional reinforcement (around openings, at corners, etc.) shown on the standard detail sheets. Bars to have special coatings and/or to be of special steel or special yield strength are to be clearly identified.
  2. Bar bending details. The bars shall be referenced to the same identification marks shown on the placement drawings.
  3. Schedule of all placements to contain synthetic reinforcing fibers. The amount of fibers per cubic yard to be used for each of the placements shall be noted on the schedule. The name of the manufacturer of the fibers and the product data shall be included with the submittal.

B. The Contractor shall submit test reports, in accordance with Section 01330, Submittals and Acceptance, of each of the following items:

1. Certified copy of mill test on each steel proposed for use showing the physical properties of the steel and the chemical analysis.
2. Welder's certification. The certification shall be in accordance with AWS D1.4/D1.4M when welding of reinforcement is required.

## 1.04 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be in accordance with the currently effective Florida Building Code (FBC). The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. American Society for Testing and Materials (ASTM)

1. ASTM A615/A615M—Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
2. ASTM A704/A704M—Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement.
3. ASTM A706/A706M—Standard Specification for Deformed and Plan Low-Alloy Steel Bars for Concrete Reinforcement.
4. ASTM A767/A767M—Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
5. ASTM A775/A775M—Standard Specification for Epoxy-Coated Steel Reinforcing Bars.
6. ASTM A884/A884M—Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement.
7. ASTM A934/A934M—Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars.
8. ASTM A996/A996M—Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement.
9. ASTM A1064/A1064M—Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed for Concrete.

B. American Concrete Institute (ACI)

1. ACI 301—Specifications for Structural Concrete.
2. ACI 318—Building Code Requirements for Structural Concrete and Commentary.
3. ACI SP-66—ACI Detailing Manual.

- C. Concrete Reinforcing Steel Institute (CRSI)
  - 1. Manual of Standard Practice.
- D. American Welding Society (AWS)
  - 1. AWS D1.4/A1.4M—Structural Welding Code – Reinforcing Steel.

## 1.05 QUALITY ASSURANCE

- A. Provide services of a manufacturer's representative, with at least 2 years experience in the use of the reinforcing fibers for a preconstruction meeting and assistance during the first placement of the material.

## 1.06 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

## 1.07 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.
- B. Reinforcing steel shall be substantially free from mill scale, rust, dirt, grease, or other foreign matter.
- C. Reinforcing steel shall be shipped and stored with bars of the same size and shape fastened in bundles with durable tags, marked in a legible manner with waterproof markings showing the same "mark" designations as those shown on the submitted Placing Drawings.
- D. Reinforcing steel shall be stored off the ground and kept free from dirt, oil, or other injurious contaminants.

## PART 2 PRODUCTS

### 2.01 MATERIALS

- A. Materials shall be new, of domestic manufacture, and shall comply with the following material specifications.

- B. Deformed Concrete Reinforcing Bars: ASTM A615/A615M, Grade 60 deformed bars.
- C. Concrete Reinforcing Bars required on the Drawings to be Welded: ASTM A706/A706M.
- D. Welded Steel Wire Fabric: ASTM A1064/A1064M. Provide in flat sheets.
- E. Welded Deformed Steel Wire Fabric: ASTM A1064/A1064M.
- F. Welded Plain Bar Mats: ASTM A704/A704M and ASTM A615/A615M Grade 60 plain bars.
- G. Fabricated Deformed Steel Bar Mats: ASTM A1064/A1064M and ASTM A615/A615M Grade 60 deformed bars.
- H. The following alternate materials are allowed:
  - 1. ASTM A615/A615M Grade 60 may be used for ASTM A706/A706M provided the following requirements are satisfied:
    - a. The actual yield strength of the reinforcing steel based on mill tests shall not exceed the specified yield strength by more than 18,000 psi. Retests shall not exceed this value by more than an additional 3,000 psi.
    - b. The ratio of the actual ultimate tensile strength to the actual tensile yield strength of the reinforcement shall not be less than 1.25.
    - c. The carbon equivalency (CE) of bars shall be 0.55 or less.
- I. Reinforcing Steel Accessories
  - 1. Plastic Protected Bar Supports: CRSI Bar Support Specifications, Class 1 Maximum Protection.
  - 2. Stainless Steel Protected Bar Supports: CRSI Bar Support Specifications, Class 2 Moderate Protection.
  - 3. Precast Concrete Block Bar Supports: CRSI Bar Support Specifications, Precast Blocks. Blocks shall have equal or greater strength than the surrounding concrete.
  - 4. Steel Protected Bar Supports: #4 Steel Chairs with plastic or rubber tips.
- J. Tie Wire
  - 1. Tie Wires for Reinforcement shall be 16-gauge or heavier, black annealed wire, or stranded wire.

- K. Mechanical reinforcing steel butt splices shall be positive connecting taper threaded-type employing a hexagonal coupler such as Lenton rebar splices as manufactured by Erico Products Inc., Solon, OH, or equal. They shall meet all ACI 318 Building Code requirements. Bar ends must be taper threaded with coupler manufacturer's bar threader to ensure proper taper and thread engagement. Bar couplers shall be torqued to the manufacturer's recommended value.
1. Unless otherwise noted on the Drawings, mechanical tension splices shall be designed to produce a splice strength in tension or compression of not less than 125% of the ASTM-specified minimum yield strength of the rebar.
  2. Compression-type mechanical splices shall provide concentric bearing from one bar to the other bar and shall be capable of developing the ultimate strength of the rebar in compression.

L. Fiber Reinforcement

1. Synthetic reinforcing fiber for concrete shall be 100% polypropylene collated, fibrillated fibers as manufactured by Fibermesh Company of Synthetic Industries Inc., Chattanooga, TN, Fibermesh or equal. Fiber length and quantity for the concrete mix shall be in strict compliance with the manufacturer's recommendations as approved by the Engineer.

## 2.02 FABRICATION

- A. Fabrication of reinforcement shall be in compliance with the CRSI *Manual of Standard Practice*.
- B. Bars shall be cold bent. Bars shall not be straightened or rebent.
- C. Bars shall be bent around a revolving collar having a diameter of not less than that recommended by the ACI 318.
- D. Bar ends that are to be butt spliced, placed through limited diameter holes in metal, or threaded shall have the applicable end(s) saw cut. Such ends shall terminate in flat surfaces within 1-1/2 degrees of a right angle to the axis of the bar.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Surface condition, bending, spacing, and tolerances of placement of reinforcement shall comply with the *CRSI Manual of Standard Practice*. The Contractor shall be solely responsible for providing an adequate number of bars and maintaining the spacing and clearances shown on the Drawings.
- B. Except as otherwise indicated on the Drawings, the minimum concrete cover of reinforcement shall be as follows:
  1. Concrete cast against and permanently exposed to earth: 3 inches.
  2. Concrete exposed to soil, water, sewage, sludge and/or weather: 2 inches (including bottom cover of slabs over water or sewage).
  3. Concrete not exposed to soil, water, sewage, sludge, and/or weather:
    - a. Slabs (top and bottom cover), walls, joists, shells, and folded plate members: 1 inch.
    - b. Beams and columns (principal reinforcement, ties, spirals, and stirrups): 1-1/2 inches.
- C. Reinforcement which will be exposed for a considerable length of time after being placed shall be coated with a heavy coat of neat cement slurry.
- D. No reinforcing steel bars shall be welded either during fabrication or erection unless specifically shown on the Drawings or specified in this Section or unless prior written approval has been obtained from the Engineer. All bars that have been welded, including tack welds, without such approval shall be immediately removed from the work. When welding of reinforcement is approved or called for, it shall comply with AWS D1.4/D1.4M.
- E. Reinforcing steel interfering with the location of other reinforcing steel, conduits, or embedded items may be moved within the specified tolerances or one bar diameter, whichever is greater. Greater displacement of bars to avoid interference shall only be made with the approval of the Engineer. Do not cut reinforcement to install inserts, conduits, mechanical openings, or other items without the prior approval of the Engineer.
- F. Securely support and tie reinforcing steel to prevent movement during concrete placement. Secure dowels in place before placing concrete.

- G. Reinforcing steel bars shall not be field bent except where shown on the Drawings or specifically authorized in writing by the Engineer. If authorized, bars shall be cold bent around the standard diameter spool specified in the CRSI. Do not heat bars. Closely inspect the reinforcing steel for breaks. If the reinforcing steel is damaged, replace, Cadweld, or otherwise repair as directed by the Engineer. Do not bend reinforcement after it is embedded in concrete unless specifically shown otherwise on the Drawings.

### 3.02 REINFORCEMENT AROUND OPENINGS

- A. Unless specific additional reinforcement around openings is shown on the Drawings, provide additional reinforcing steel on each side of the opening equivalent to one half of the cross-sectional area of the reinforcing steel interrupted by an opening. The bars shall have sufficient length to develop bond at each end beyond the opening or penetration.

### 3.03 SPLICING OF REINFORCEMENT

- A. Splices designated as compression splices on the Drawings, unless otherwise noted, shall be 30 bar diameters but not less than 12 inches. The lap splice length for column vertical bars shall be based on the bar size in the column above.
- B. Tension lap splices shall be provided at all laps in compliance with ACI 318. Splices in adjacent bars shall be staggered. Class A splices may be used when 50% or less of the bars are spliced within the required lap length. Class B splices shall be used at all other locations.
- C. Splicing of reinforcing steel in concrete elements noted to be "tension members" on the Drawings shall be avoided whenever possible. However, if required for constructability, splices in the reinforcement subject to direct tension shall be welded to develop, in tension, at least 125% of the specified yield strength of the bar. Splices in adjacent bars shall be offset the distance of a Class B splice.
- D. Install wire fabric in as long lengths as practicable. Wire fabric from rolls shall be rolled flat and firmly held in place. Splices in welded-wire fabric shall be lapped in accordance with the requirements of ACI 318 but not less than 12 inches. The spliced fabrics shall be tied together with wire ties spaced not more than 24 inches on center and laced with wire of the same diameter as the welded wire fabric. Do not position laps midway between supporting beams or directly over beams of continuous structures. Offset splices in adjacent widths to prevent continuous splices.
- E. Mechanical reinforcing steel splicers shall be used only where shown on the Drawings. Splices in adjacent bars shall be offset by at least 30 bar diameters.

Mechanical reinforcing splices are only to be used for special splice and dowel conditions approved by the Engineer.

### 3.04 ACCESSORIES

- A. Determine, provide, and install accessories such as chairs, chair bars, and the like in sufficient quantities and strength to adequately support the reinforcement and prevent its displacement during the erection of the reinforcement and the placement of concrete.
- B. Use precast concrete blocks where the reinforcing steel is to be supported over soil.
- C. Stainless steel bar supports or steel chairs with stainless-steel tips shall be used where the chairs are set on forms for a concrete surface that will be exposed to weather, high humidity, or liquid (including bottom of slabs over liquid-containing areas). Use of galvanized or plastic-tipped metal chairs is permissible in all other locations unless otherwise noted on the Drawings or specified in this Section.
- D. Alternate methods of supporting top steel in slabs, such as steel channels supported on the bottom steel or vertical reinforcing steel fastened to the bottom and top mats, may be used if approved by the Engineer.

### 3.05 INSPECTION

- A. In no case shall any reinforcing steel be covered with concrete until the installation of the reinforcement, including the size, spacing, and position of the reinforcement has been observed by the Engineer and the Engineer's release to proceed with the concreting has been obtained. The Engineer shall be given ample prior notice of the readiness of placed reinforcement for observation. The forms shall be kept open until the Engineer has finished his/her observations of the reinforcing steel.

END OF SECTION

**SECTION 03250**  
**CONCRETE JOINTS AND JOINT ACCESSORIES**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. The Contractor shall furnish all labor, materials, equipment, and incidentals required and install accessories for concrete joints as shown on the Drawings and as specified in this Section.

**1.02 RELATED WORK**

- A. Section 03100, Concrete Formwork.
- B. Section 03200, Concrete Reinforcement.
- C. Section 03300, Cast-In-Place Concrete.
- D. Section 03360, Concrete Finishes.
- E. Section 03600, Grout.
- F. Section 05500, Metal Fabrications.

**1.03 SUBMITTALS**

- A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:
  - 1. Standard waterstops: Product data, including catalogue cut, technical data, storage requirements, splicing methods, and conformity to ASTM standards.
  - 2. Special waterstops: Product data, including catalogue cut, technical data, location of use, storage requirements, splicing methods, installation instructions, and conformity to ASTM standards.
  - 3. Premolded joint fillers: Product data, including catalogue cut, technical data, storage requirements, installation requirements, location of use, and conformity to ASTM standards.
  - 4. Bond breaker: Product data, including catalogue cut, technical data, storage requirements, installation requirements, location of use, and conformity to ASTM standards.
  - 5. Expansion joint dowels: Product data on the complete assembly, including dowels, coatings, lubricants, spacers, sleeves, expansion caps, installation requirements, and conformity to ASTM standards.
  - 6. Compressible joint filler: Product data, including catalogue cut, technical data, storage requirements, installation requirements, location of use, and conformity to ASTM standards.

7. Bonding agents: Product data, including catalogue cut, technical data, storage requirements, product life, application requirements, and conformity to ASTM standards.

B. Certifications

1. Certification that all materials used within the joint system are compatible with each other.
2. Certification that materials used in the construction of joints are suitable for use in contact with potable water 30 days after installation.

#### 1.04 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be in accordance with the currently effective Florida Building Code (FBC). The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. American Society for Testing and Materials (ASTM)

1. ASTM A675/A675M—Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties.
2. ASTM C881/C881M—Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
3. ASTM C1059/C1059M—Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete.
4. ASTM D1751—Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
5. ASTM D1752—Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.

B. US Army Corps of Engineers (CRD)

1. CRD C572—Specifications for Polyvinylchloride Waterstop.

#### 1.05 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

## 1.06 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

## PART 2 PRODUCTS

### 2.01 GENERAL

- A. The use of the manufacturer's name and model or catalog number is to establish the standard of quality and general configuration desired.
- B. All materials used together in a given joint (bond breakers, backer rods, joint fillers, sealants, etc.) shall be compatible with one another. Coordinate selection of suppliers and products to ensure compatibility. Under no circumstances shall asphaltic bond breakers or joint fillers be used in joints receiving sealant.
- C. All chemical sealant type waterstops shall be products specifically manufactured for the purpose for which they will be used and the products shall have been successfully used on similar structures for more than 5 years.

### 2.02 MATERIALS

- A. Premolded Joint Filler
  - 1. Premolded joint filler structures: Self-expanding cork, premolded joint filler shall conform to ASTM D1752, Type III. The thickness shall be 3/4 inch unless shown otherwise on the Drawings.
  - 2. Premolded joint filler sidewalk and roadway concrete pavements or where fiber joint filler is specifically noted on the Drawings: The joint filler shall be asphalt impregnated fiber board conforming to ASTM D1751. Thickness shall be 3/4 inch unless otherwise shown on the Drawings.
- B. Bond Breaker
  - 1. Bond breaker tape shall be an adhesive-backed glazed butyl or polyethylene tape which will satisfactorily adhere to the premolded joint filler or concrete surface as required. The tape shall be the same width as the joint.
  - 2. Except where tape is specifically called for on the Drawings, bond breaker for concrete shall be either bond breaker tape or a nonstaining type bond prevention coating such as Williams Tilt-up Compound by Williams

Distributors Inc.; Silcoseal 77, by SCA Construction Supply Division, Superior Concrete Accessories, or equal.

C. Bonding Agent

1. Epoxy bonding agent shall be a two-component, solvent-free, moisture-insensitive, epoxy-resin material conforming to ASTM C881/C881M, Type II. The bonding agent shall be Sikadur 32 Hi Mod by Sika Corporation of Lyndhurst, NJ; Concessive Liquid (LPL) by Master Builders of Cleveland, OH; or equal. Acrylic may be used if approved by the Engineer.

D. Compressible Joint Filler

1. The joint filler shall be a non-extruded watertight strip material use to fill expansion joints between structures. The material shall be capable of being compressed at least 40% for 70 hours at 68°F and subsequently recovering at least 20% of its original thickness in the first half hour after unloading. Compressible joint filler shall be Evasote 380 E.S.P, by E Poxy Industries, Inc., RAVENA, NY, Sikaflex 1a by Sika, or equal.

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. Construction Joints

1. Make construction joints only at locations shown on the Drawings or as approved by the Engineer. Any additional or relocation of construction joints proposed by the Contractor must be submitted to the Engineer for written approval.
2. Additional or relocated joints should be located where they least impair the strength of the member. In general, locate joints within the middle third of spans of slabs, beams, and girders. However, if a beam intersects a girder at the joint, offset the joint a distance equal to twice the width of the member being connected. Locate joints in walls and columns at the underside of floors, slabs, beams, or girders and at tops of footings or floor slabs. Do not locate joints between beams, girders, column capitals, or drop panels and the slabs above them. Do not locate joints between brackets or haunches and walls or columns supporting them.
3. All joints shall be perpendicular to the main reinforcement. Continue reinforcing steel through the joint as indicated on the Drawings. When joints in beams are allowed, provide a shear key and inclined dowels as approved by the Engineer.

4. Provide sealant grooves for joint sealant where indicated on the Drawings.
5. At all construction joints and at concrete joints designated on the Drawings to be "roughened," uniformly roughen the surface of the concrete to a full amplitude (distance between high and low points or side to side) of approximately 1/4 inch to expose a fresh face. Thoroughly clean joint surfaces of loose or weakened materials by waterblasting or sandblasting and prepare for bonding.
6. Provide waterstops in all wall and slab construction joints in liquid containment structures and at other locations shown on the Drawings.
7. Keyways shall not be used in construction joints unless specifically shown on the Drawings or approved by the Engineer.

B. Expansion Joints

1. Do not extend through expansion joints, reinforcement, or other embedded metal items that are continuously bonded to concrete on each side of joint.
2. Position premolded joint filler material accurately. Secure the joint filler against displacement during concrete placement and compaction. Place joint filler over the face of the joint, allowing for sealant grooves as detailed on the Drawings. Tape all joint filler splices to prevent intrusion of mortar. Seal expansion joints as shown on the Drawings.
3. Expansion joints shall be 3/4 inch wide unless otherwise noted on the Drawings.
4. Where indicated on the Drawings, install smooth dowels at right angles to expansion joints. Align dowels accurately with finished surface. Rigidly hold in place and support during concrete placement. Unless otherwise shown on the Drawings, apply oil or grease to one end of all dowels through expansion joints. Provide plastic expansion caps on the lubricated ends of expansion dowels.
5. Provide center-bulb-type waterstops in all wall and slab expansion joints in liquid containment structures and at other locations shown on the Drawings.

C. Contraction Joints

1. Provide sealant grooves, sealants, and waterstops at contraction joints in slabs on grade or walls as detailed. Provide waterstops at all wall and slab contraction joints in water containment structures and at other locations shown on the Drawings.
2. Contraction joints may be sawed if specifically approved by the Engineer. If contraction joint grooves are sawed, properly time the saw cutting with the time of the concrete set. Start cutting as soon as the concrete has hardened sufficiently to prevent aggregates from being dislodged by the saw. Complete cutting before shrinkage stresses have developed

sufficiently to induce cracking. No reinforcing shall be cut during sawcutting.

3. Extend every other bar of reinforcing steel through contraction joints or as indicated on the Drawings. Where specifically noted on the Drawings, coat the concrete surface with a bond breaker before placing new concrete against it. Avoid coating reinforcement or waterstops with bond breaker at these locations.

END OF SECTION

**SECTION 03300**  
**CAST-IN-PLACE CONCRETE**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. The Contractor shall furnish all labor and materials required and install cast-in-place concrete complete as shown on the Drawings and as specified in this Section.

**1.02 RELATED WORK**

- A. Section 03100, Concrete Formwork.
- B. Section 03200, Concrete Reinforcement.
- C. Section 03250, Concrete Joints and Joint Accessories.
- D. Section 03360, Concrete Finishes.
- E. Section 03600, Grout.

**1.03 SUBMITTALS**

- A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:
  1. Sources of cement, pozzolan, and aggregates.
  2. Material Safety Data Sheets (MSDS) for all concrete components and admixtures.
  3. Air entraining admixture. Product data, including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations, and conformity to ASTM standards.
  4. Water-reducing admixture. Product data, including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations, and conformity to ASTM standards.
  5. High-range water-reducing admixture (plasticizer). Product data, including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations, retarding effect, slump range, and conformity to ASTM standards. Identify proposed locations of use.

6. Concrete mix for each formulation of concrete proposed for use, including constituent quantities per cubic yard, water-cementitious materials ratio, concrete slump, type, and manufacturer of cement. Provide either a. or b. below for each mix proposed:
  - a. Standard deviation data for each proposed concrete mix based on statistical records.
  - b. The curve of water-cementitious materials ratio versus concrete cylinder strength for each formulation of concrete proposed based on laboratory tests. The cylinder strength shall be the average of the 28-day cylinder strength test results for each mix. Provide results of 7- and 14-day tests if available.
7. Sheet curing material. Product data, including catalogue cut, technical data, and conformity to ASTM standard.
8. Liquid curing compound. Product data, including catalogue cut, technical data, storage requirements, product life, application rate, and conformity to ASTM standards. Identify proposed locations of use.

B. Samples

1. Fine and coarse aggregates if requested by the Engineer.

C. Test Reports

1. Fine aggregates—sieve analysis, physical properties, and deleterious substance.
2. Coarse aggregates—sieve analysis, physical properties, and deleterious substances.
3. Cements—chemical analysis and physical properties for each type.
4. Pozzolans—chemical analysis and physical properties.
5. Proposed concrete mixes—compressive strength, slump, and air content.

D. Certifications

1. Certify that admixtures used in the same concrete mix are compatible with each other and with the aggregates.
2. Certify that admixtures are suitable for use in contact with potable water after 30 days of concrete curing.
3. Certify that the curing compound is suitable for use in contact with potable water after 30 days (non-toxic and free of taste or odor).

## 1.04 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be in accordance with the currently effective Florida Building Code (FBC). The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

### A. American Society for Testing and Materials (ASTM)

1. ASTM C31/C31M—Standard Practice for Making and Curing Concrete Test Specimens in the Field.
2. ASTM C33/33M—Standard Specification for Concrete Aggregates.
3. ASTM C39/C39M—Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
4. ASTM C42/C42M—Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
5. ASTM C94/C94M—Standard Specification for Ready-Mixed Concrete.
6. ASTM C143/C143M—Standard Test Method for Slump of Hydraulic-Cement Concrete.
7. ASTM C150/C150M—Standard Specification for Portland Cement.
8. ASTM C171—Standard Specification for Sheet Materials for Curing Concrete.
9. ASTM C173/C173M—Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
10. ASTM C231/C231M—Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
11. ASTM C260/C260M—Standard Specification for Air-Entraining Admixtures for Concrete.
12. ASTM C309—Standard Specification for Liquid-Membrane Forming Compounds for Curing Concrete.
13. ASTM C494/C494M—Standard Specification for Chemical Admixtures for Concrete.
14. ASTM C618—Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
15. ASTM C1017/C1017M—Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.

### B. American Concrete Institute (ACI)

1. ACI 304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete.
2. ACI 305R—Guide to Hot Weather Concreting.
3. ACI 306.1—Standard Specification for Cold Weather Concreting.

4. ACI 318—Building Code Requirements for Structural Concrete and Commentary.
5. ACI 350—Code Requirements for Environmental Engineering Concrete Structures and Commentary.

## 1.05 QUALITY ASSURANCE

- A. Reinforced concrete shall comply with ACI 318; the recommendations of ACI 350; and other stated requirements, codes, and standards. The most stringent requirement of the codes, standards, and this Section shall apply when conflicts exist.
- B. Only one source of cement and aggregates shall be used on any one structure. Concrete shall be uniform in color and appearance.
- C. Thirty days before placing concrete, the Contractor shall discuss with the Engineer the sources of individual materials and batched concrete proposed for use. Discuss placement methods, waterstops, and curing. Propose methods of hot and cold weather concreting as required. Before placing any concrete containing a high-range water-reducing admixture (plasticizer), the Contractor, accompanied by the plasticizer manufacturer, shall discuss with the Engineer the properties and techniques of batching and placing plasticized concrete.
- D. If, during the progress of the work, it is impossible to obtain concrete of the required workability and strength with the materials being furnished, the Engineer may order such changes in proportions or materials, or both, as may be necessary to obtain the desired properties. All changes so ordered shall be made at the Contractor's expense.
- E. If, during the progress of the work, the materials from the sources originally accepted change in characteristics, the Contractor shall, at his/her expense, make new acceptance tests of aggregates and establish new design mixes.
- F. The Contractor shall furnish testing of the following materials to verify conformity with this Section and the stated ASTM Standards:
  1. Fine aggregates for conformity with ASTM C33/C33M—sieve analysis, physical properties, and deleterious substances.
  2. Coarse aggregates for conformity with ASTM C33/C33M—sieve analysis, physical properties, and deleterious substances.
  3. Cements for conformity with ASTM C150/C150M—chemical analysis and physical properties.
  4. Pozzolans for conformity with ASTM C618—chemical analysis and physical properties.

5. Proposed concrete mix designs—compressive strength, slump, and air content.
- G. A firm providing field testing and inspection services will be approved by the Owner. The cost of such work, except as specifically stated otherwise, shall be paid by the Contractor and reimbursed by the Owner under the Concrete Testing Allowance. The following items shall be tested by the Owner to verify conformity with this Section:
1. Concrete placements—compressive strength (cylinders), compressive strength (cores), slump, and air content.
  2. Other materials or products that may come under question.
- H. All materials incorporated in the work shall conform to accepted samples.

## 1.06 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

## 1.07 DELIVERY, STORAGE, AND HANDLING

The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section:

- A. Cement: Store in weathertight buildings, bins, or silos to provide protection from dampness and contamination and to minimize warehouse set.
- B. Aggregate: Arrange and use stockpiles to avoid excessive segregation or contamination with other materials or with other sizes of like aggregates. Build stockpiles in successive horizontal layers not exceeding 3 feet in thickness. Complete each layer before the next is started. Do not use frozen or partially frozen aggregate.
- C. Sand: Arrange and use stockpiles to avoid contamination. Allow sand to drain to a uniform moisture content before using. Do not use frozen or partially frozen aggregates.
- D. Admixtures: Store in closed containers to avoid contamination, evaporation, or damage. Provide suitable agitating equipment to ensure uniform dispersion of ingredients in admixture solutions which tend to separate. Protect liquid admixtures from freezing and other temperature changes which could adversely affect their characteristics.

- E. Pozzolan: Store in weathertight buildings, bins, or silos to provide protection from dampness and contamination.
- F. Sheet Curing Materials: Store in weathertight buildings or off the ground and under cover.
- G. Liquid Curing Compounds: Store in closed containers.

## PART 2 PRODUCTS

### 2.01 GENERAL

- A. The use of the manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.
- B. Like items of materials shall be the end products of one manufacturer in order to provide standardization for appearance, maintenance, and manufacturer's service.

### 2.02 MATERIALS

- A. Materials shall comply with this Section and any applicable State or local requirements.
- B. Cement: Domestic Portland cement complying with ASTM C150/C150M. Air entraining cements shall not be used. The brand of cement shall be subject to approval by the Engineer and one brand shall be used throughout the Work. The following cement type(s) shall be used:
  1. Class A,B,C,D Concrete Type II with the addition of fly ash resulting in C3A being below 5% of total cementitious content, Type III limited to 5% C3A or Type V.
- C. Fine Aggregate: Washed inert natural sand conforming to the requirements of ASTM C33/C33M.
- D. Coarse Aggregate: Well-graded crushed stone or washed gravel conforming to the requirements of ASTM C33/C33M. Grading requirements shall be as listed in ASTM C33/C33M Table 2 for the specified coarse aggregate size number. Limits of Deleterious Substances and Physical Property Requirements shall be as listed in ASTM C33/C33M Table 3 for severe weathering regions. Size numbers for the concrete mixes shall be as shown in Table 1 in this Section.
- E. Water: Potable water free from injurious amounts of oils, acids, alkalis, salts, organic matter, or other deleterious substances.

- F. Admixtures: Admixtures shall be free of chlorides and alkalis (except for those attributable to water). When it is required to use more than one admixture in a concrete mix, the admixtures shall be from the same manufacturer. Admixtures shall be compatible with the concrete mix, including other admixtures, and shall be suitable for use in contact with potable water after 30 days of concrete curing.
1. Air-Entraining Admixture: The admixture shall comply with ASTM C260/C260M. Proportioning and mixing shall be in accordance with the manufacturer's recommendations.
  2. Water-Reducing Agent: The admixture shall comply with ASTM C494/C494M, Type A. Proportioning and mixing shall be in accordance with the manufacturer's recommendations.
  3. High-Range Water-Reducer (Plasticizer): The admixture shall comply with ASTM C494/C494M, Type F, and shall result in non-segregating plasticized concrete with little bleeding and with the physical properties of low water/cement ratio concrete. The treated concrete shall be capable of maintaining its plastic state in excess of 2 hours. Proportioning and mixing shall be in accordance with the manufacturer's recommendations.
  4. Admixtures causing retarded or accelerated setting of concrete shall not be used without written approval from the Engineer. When allowed, the admixtures shall be retarding or accelerating water-reducing or high-range water-reducing admixtures.
- G. Pozzolan (Fly Ash) shall be Class F fly ash complying with ASTM C618 except that the Loss on Ignition (LOI) shall be limited to 3% maximum.
- H. Sheet Curing Materials. Waterproof paper, polyethylene film, or white burlap polyethylene sheeting all complying with ASTM C171.
- I. Liquid Curing Compound. Liquid membrane forming curing compound shall comply with the requirements of ASTM C309, Type 1 D (clear or translucent with fugitive dye) and shall contain no wax, paraffin, or oil. The curing compound shall be approved for use in contact with potable water after 30 days according to NSF 61 (non-toxic and free of taste or odor).

## 2.03 MIXES

- A. An independent testing laboratory acceptable to the Owner engaged by and at the expense of the Contractor shall develop mix designs and testing.
- B. Select proportions of ingredients to meet the design strength and materials limits specified in Table 1 and to produce concrete having proper placability, durability, strength, appearance, and other required properties. Proportion ingredients to

produce a homogenous mixture that will readily work into corners and angles of forms and around reinforcement without permitting materials to segregate or allowing excessive free water to collect on the surface.

- C. The design mix shall be based on standard deviation data of prior mixes with essentially the same proportions of the same constituents or, if such data are not available, be developed by a testing laboratory acceptable to the Engineer and engaged by and at the expense of the Contractor. Mixes based on standard deviation shall be accepted based on the modification factors for standard deviation tests contained in ACI 318. The water content of the concrete mix, determined by laboratory testing, shall be based on a curve showing the relation between water cementitious ratio and 7- and 28-day compressive strengths of concrete made using the proposed materials. The curves shall be determined by four or more points, each representing an average value of at least three test specimens at each age. The curves shall have a range of values sufficient to yield the desired data, including the specified design strengths as modified below, without extrapolation. The water content of the concrete mixes to be used, as determined from the curve, shall correspond to strengths 16% greater than the specified design strengths. The resulting mix shall not conflict with the limiting values for maximum water cementitious ratio and net minimum cementitious content as specified in Table 1.
- D. Compression Tests: Provide testing of the proposed concrete mix or mixes to demonstrate compliance with the specified design strength requirements in conformity with the paragraph above.
- E. Entrained air, as measured by ASTM C231/C231M, shall be as shown in Table 1.
  - 1. If the air-entraining agent proposed for use in the mix requires testing methods other than ASTM C231/C231M to accurately determine air content, make special note of this requirement in the admixture submittal.
- F. Slump of the concrete as measured by ASTM C143/C143M shall be as shown in Table 1. If a high-range water-reducer (plasticizer) is used, the slump indicated shall be that measured before plasticizer is added. Plasticized concrete shall have a slump ranging from 7 to 10 inches.
- G. Proportion admixtures according to the manufacturer's recommendations. Two or more admixtures specified may be used in the same mix provided that the admixtures in combination retain full efficiency and have no deleterious effect on the concrete or on the properties of each other.

**TABLE 1**  
**CONCRETE MIX REQUIREMENTS**

| Class | Design Strength (1) | Cement (2)            | Fine Aggregate (2) | Coarse Aggregate (3) | Cementitious Content (4) |
|-------|---------------------|-----------------------|--------------------|----------------------|--------------------------|
| A     | 2,500               | C150/C150M<br>Type II | C33/C33M           | 57                   | 440 min.                 |
| B     | 3,000               | C150/C150M<br>Type II | C33/C33M           | 57                   | 480 min.                 |
| C     | 4,000               | C150/C150M<br>Type II | C33/C33M           | 57                   | 560 min.                 |
| D     | 5,000               | C150/C150M<br>Type II | C33/C33M           | 57                   | 600 min.                 |
| Class | W/C Ratio (5)       | Fly Ash               | AE Range (6)       | WR (7)               | HRWR (8)                 |
| A     | 0.62 max.           | --                    | 3.5 to 5           | Yes                  | *                        |
| B     | 0.54 max.           | --                    | 3.5 to 5           | Yes                  | *                        |
| C     | 0.44 max.           | 20 to 25%             | 3.5 to 5           | Yes                  | *                        |
| D     | 0.40 max.           | --                    | 3.5 to 5           | Yes                  | *                        |
|       |                     |                       |                    |                      | Slump Range (inches)     |
|       |                     |                       |                    |                      | 1 to 4                   |
|       |                     |                       |                    |                      | 1 to 3                   |
|       |                     |                       |                    |                      | 3 to 5                   |
|       |                     |                       |                    |                      | 3 to 5                   |

**NOTES:**

- (1) Minimum compressive strength in psi at 28 days.
- (2) ASTM designation.
- (3) Size Number in ASTM C33/C33M.
- (4) Cementitious content in lbs/cu yd.
- (5) W/C is Water-Cementitious ratio by weight.
- (6) AE is percent air-entrainment.
- (7) WR is water-reducer admixture.
- (8) HRWR is high-range water-reducer admixture.

\* HRWR used at the Contractor's option.

## PART 3 EXECUTION

### 3.01 MEASURING MATERIALS

- A. Concrete shall be composed of Portland cement, fine aggregate, coarse aggregate, water, and admixtures as specified and shall be produced by a plant acceptable to the Engineer. All constituents, including admixtures, shall be batched at the plant except a high-range water-reducer may also be added in the field.
- B. Measure materials for batching concrete by weighing in conformity with and within the tolerances given in ASTM C94/C94M except as otherwise specified. Scales shall have been certified by the local Weights and Measures official within 1 year of use.

- C. Measure the amount of free water in fine aggregates within 0.3% with a moisture meter. Compensate for varying moisture contents of fine aggregates. Record the number of gallons of water as batched on printed batching tickets.
- D. Admixtures shall be dispensed either manually using calibrated containers or measuring tanks or by an automatic dispenser approved by the manufacturer of the specific admixture.
  - 1. Charge air entraining and chemical admixtures into the mixer as a solution using an automatic dispenser or similar metering device.
  - 2. Inject multiple admixtures separately during the batching sequence.

### 3.02 MIXING AND TRANSPORTING

- A. Concrete shall be ready mixed concrete produced by equipment acceptable to the Engineer. No hand mixing will be permitted. Clean each transit mix truck drum and reverse drum rotation before the truck proceeds under the batching plant. Equip each transit mix truck with a continuous, nonreversible, revolution counter showing the number of revolutions at mixing speeds.
- B. Ready mix concrete shall be transported to the site in watertight agitator or mixer trucks loaded not in excess of their rated capacities as stated on the name plate.
- C. Keep the water tank valve on each transit truck locked at all times. Any addition of water must be directed by the Engineer. Added water shall be incorporated by additional mixing of at least 35 revolutions. All added water shall be metered and the amount of water added shall be shown on each delivery ticket.
- D. All central plant and rolling stock equipment and methods shall comply with ACI 318 and ASTM C94/C94M.
- E. Select equipment of size and design to ensure continuous flow of concrete at the delivery end. Metal or metal lined non-aluminum discharge chutes shall be used and shall have slopes not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal. Chutes more than 20 feet long and chutes not meeting slope requirements may be used if concrete is discharged into a hopper before distribution.
- F. Retempering (mixing with or without additional cement, aggregate, or water) of concrete or mortar which has reached initial set will not be permitted.
- G. Handle concrete from mixer to placement as quickly as practicable while providing concrete of required quality in the placement area. Dispatch trucks from the batching plant so they arrive at the work site just before the concrete is

required, thus avoiding excessive mixing of concrete while waiting or delays in placing successive layers of concrete in the forms.

- H. Furnish a delivery ticket for ready-mixed concrete to the Engineer as each truck arrives. Each ticket shall provide a printed record of the weight of cement and each aggregate as batched individually. Use the type of indicator that returns for zero punch or returns to zero after a batch is discharged. Clearly indicate the weight of fine and coarse aggregate, cement and water in each batch, the quantity delivered, the time any water is added, and the numerical sequence of the delivery. Show the time of day batched and time of discharge from the truck. Indicate the number of revolutions of the truck mixer.

I. Temperature and Mixing Time Control

1. In cold weather, do not allow the as-mixed temperature of the concrete and concrete temperatures at the time of placement in the forms to drop below 40°F.
2. If water or aggregate has been heated, combine water with aggregate in the mixer before cement is added. Do not add cement to mixtures of water and aggregate when the temperature of the mixture is greater than 90°F.
3. In hot weather, cool ingredients before mixing to maintain temperature of the concrete below the maximum placing temperature of 90°F. If necessary, substitute well-crushed ice for all or part of the mixing water.
4. The maximum time interval between adding mixing water and/or cement to the batch and placing concrete in the forms shall not exceed the values shown in Table 2.

TABLE 2  
MAXIMUM TIME TO DISCHARGE OF CONCRETE

| Air or Concrete Temperature<br>(whichever is higher) | Maximum Time |
|--|--------------|
| 80 to 90°F (27 to 32°C)                              | 45 minutes   |
| 70 to 79°F (21 to 26°C)                              | 60 minutes   |
| 40 to 69°F (5 to 20°C)                               | 90 minutes   |

- J. If an approved high-range water-reducer (plasticizer) is used to produce plasticized concrete, the maximum time interval shall not exceed 90 minutes.

### 3.03 CONCRETE APPEARANCE

- A. Concrete mix showing either poor cohesion or poor coating of the coarse aggregate with paste shall be remixed. If this does not correct the condition, the concrete shall be rejected. If the slump is within the allowable limit but excessive bleeding, poor workability, or poor finishability are observed, changes in the concrete mix shall be obtained only by adjusting one or more of the following:
  - 1. The gradation of aggregate.
  - 2. The proportion of fine and coarse aggregate.
  - 3. The percentage of entrained air within the allowable limits.
- B. Concrete for the work shall provide a homogeneous structure which, when hardened, will have the required strength, durability, and appearance. Mixtures and workmanship shall be such that concrete surfaces, when exposed, will require no finishing. When concrete surfaces are stripped, the concrete, when viewed in good lighting from 10 feet away, shall be pleasing in appearance and at 20 feet shall show no visible defects.

### 3.04 PLACING AND COMPACTING

- A. Placing
  - 1. The Contractor shall verify that all formwork completely encloses concrete to be placed and is securely braced before placing concrete. Remove ice, excess water, dirt, and other foreign materials from forms. Confirm that reinforcement and other embedded items are securely in place. Have a competent workman at the location of the placement who can ensure that reinforcing steel and embedded items remain in designated locations while concrete is being placed. Sprinkle semi-porous subgrades or forms to eliminate suction of water from the mix. Seal extremely porous subgrades in an approved manner.
  - 2. Deposit concrete as near its final position as possible to avoid segregation due to rehandling or flowing. Place concrete continuously at a rate which ensures the concrete is being integrated with fresh plastic concrete. Do not deposit concrete that has partially hardened or has been contaminated by foreign materials or on concrete that has hardened sufficiently to cause formation of seams or planes of weakness within the section. If the section cannot be placed continuously, place construction joints as specified or as approved.
  - 3. Pumping of concrete will be permitted. Use a mix design and aggregate sizes suitable for pumping and submit for approval.

4. Remove temporary spreaders from forms when the spreader is no longer useful. Temporary spreaders may remain embedded in concrete only when made of galvanized metal or concrete and if prior approval has been obtained.
  5. Do not place concrete for supported elements until concrete previously placed in the supporting element (columns, slabs, and/or walls) has reached adequate strength.
  6. Where surface mortar is to form the base of a finish, especially surfaces designated to be painted, work coarse aggregate back from forms with a suitable tool to bring the full surface of the mortar against the form. Prevent the formation of excessive surface voids.
7. Slabs
- a. After suitable bulkheads, screeds, and jointing materials have been positioned, the concrete shall be placed continuously between construction joints beginning at a bulkhead, edge form, or corner. Each batch shall be placed into the edge of the previously placed concrete to avoid stone pockets and segregation.
  - b. Avoid delays in casting. If there is a delay in casting, the concrete placed after the delay shall be thoroughly spaded and consolidated at the edge of that previously placed to avoid cold joints. Concrete shall then be brought to correct level and struck off with a straightedge. Bullfloats or darbies shall be used to smooth the surface, leaving it free of humps or hollows.
  - c. Where slabs are to be placed integrally with the walls below them, place the walls and compact as specified. Allow 1 hour to pass between placement of the wall and the overlying slab to permit consolidation of the wall concrete. Keep the top surface of the wall moist so as to prevent cold joints.

8. Formed Concrete

- a. Place concrete in forms using tremie tubes and taking care to prevent segregation. Bottoms of tremie tubes shall preferably be in contact with the concrete already placed. Do not permit concrete to drop freely more than 4 feet. Place concrete for walls in 12- to 24-inch lifts, keeping the surface horizontal. If plasticized concrete is used, the maximum lift thickness may be increased to 7 feet and the maximum free fall of concrete shall not exceed 15 feet.

9. Underwater concreting shall be performed in conformity with the recommendations of ACI 304R. The tremie system shall be used to place underwater concrete. Tremie pipes shall be in the range of 8 to 12 inches in diameter and be spaced at not more than 16 feet on centers nor more than 8 feet from an end form. Where concrete is being placed around a pipe, there shall be at least one tremie pipe on each side of each pipe. Where the tremie system is not practical, direct pumped concrete for underwater placement may be used subject to approval of the system, including details, by the Engineer.

## B. Compacting

1. Consolidate concrete by vibration, puddling, spading, rodding, or forking so that concrete is thoroughly worked around reinforcement, embedded items, and openings and into corners of forms. Puddling, spading, etc., shall be continuously performed along with vibration of the placement to eliminate air or stone pockets that may cause honeycombing, pitting, or planes of weakness.
2. All concrete shall be placed and compacted with mechanical vibrators. The number, type, and size of the units shall be approved by the Engineer in advance of placing operations. No concrete shall be ordered until sufficient approved vibrators (including standby units in working order) are on the job.
3. A minimum frequency of 7,000 rpm is required for mechanical vibrators. Insert vibrators and withdraw at points from 18 to 30 inches apart. At each insertion, vibrate sufficiently to consolidate concrete, generally from 5 to 15 seconds. Do not over vibrate so as to segregate. Keep a spare vibrator on the site during concrete placing operations.
4. Concrete Slabs: Concrete for slabs less than 8 inches thick shall be consolidated with vibrating screeds; slabs 8 to 12 inches thick shall be compacted with internal vibrators and (optionally) with vibrating screeds. Vibrators shall always be placed into concrete vertically and shall not be laid horizontally or laid over.
5. Walls and Columns: Internal vibrators (rather than form vibrators) shall be used unless otherwise approved by the Engineer. In general, for each vibrator needed to consolidate the batch at the point of discharge, one or more additional vibrators must be used to densify, homogenize, and perfect the surface. The vibrators shall be inserted vertically at regular intervals through the fresh concrete and slightly into the previous lift, if any.

6. Amount of Vibration: Vibrators are to be used to consolidate properly placed concrete but shall not be used to move or transport concrete in the forms. Vibration shall continue until:
  - a. Frequency returns to normal.
  - b. Surface appears liquefied, flattened, and glistening.
  - c. Trapped air ceases to rise.
  - d. Coarse aggregate has blended into the surface but has not disappeared.

### 3.05 CURING AND PROTECTION

- A. The Contractor shall protect all concrete work against injury from the elements and defacements of any nature during construction operations.
- B. Curing Methods
  1. Curing Methods for Concrete Surfaces: Cure concrete to retain moisture and maintain specified temperature at the surface for a minimum of 7 days after placement. Curing methods to be used are as follows:
    - a. Water Curing: Keep entire concrete surface wet by ponding, continuous sprinkling, or by covering with saturated burlap. Begin wet cure as soon as concrete attains an initial set and maintain wet cure 24 hours a day.
    - b. Sheet Material Curing: Cover entire surface with sheet material. Securely anchor sheeting to prevent wind and air from lifting the sheeting or entrapping air under the sheet. Place and secure sheet as soon as initial concrete set occurs.
    - c. Liquid Membrane Curing: Apply over the entire concrete surface except for surfaces to receive additional concrete. Curing compound shall NOT be placed on any concrete surface where additional concrete is to be placed, where concrete sealers or surface coatings are to be used, or where the concrete finish requires an integral floor product. Curing compound shall be applied as soon as the free water on the surface has disappeared and no water sheen is visible, but not after the concrete is dry or when the curing compound can be absorbed into the concrete. Application shall be in compliance with the manufacturer's recommendations.

2. Specified applications of curing methods.
  - a. Slabs for Water Containment Structures: Water curing only.
  - b. Slabs on Grade and Footings (not used to contain water): Water curing, sheet material curing, or liquid membrane curing.
  - c. Structural Slabs (other than water containment): Water curing or liquid membrane curing.
  - d. Horizontal Surfaces that Will Receive Additional Concrete, Coatings, Grout, or Other Material that Requires Bond to the Substrate: Water curing.
  - e. Formed Surfaces: None if nonabsorbent forms are left in place 7 days. Water cure if absorbent forms are used. Sheet cured or liquid membrane cured if forms are removed before 7 days. Exposed horizontal surfaces of formed walls or columns shall be water cured for 7 days or until next placement of concrete.
  - f. Concrete Joints: Water cured or sheet material cured.
- C. Finished surfaces and slabs shall be protected from the direct sunlight to prevent checking and crazing.
- D. Cold Weather Concreting:
  1. *Cold weather* is defined as a period when the average daily outdoor temperature drops below 40°F for more than 3 successive days. The average daily temperature shall be calculated as the average of the highest and the lowest temperature from midnight to midnight.
  2. Cold weather concreting shall conform to ACI 306.1 and the additional requirements specified in this Section. Temperatures at the concrete placement shall be recorded at 12-hour intervals (minimum).
  3. The Contractor shall discuss a cold weather work plan with the Engineer. The discussion shall encompass the methods and procedures proposed for use during cold weather, including producing, transporting, placing, protecting, curing, and monitoring the temperature of the concrete. The procedures to be implemented upon abrupt changes in weather conditions or equipment failures shall also be discussed. Cold weather concreting shall not begin until the work plan is acceptable to the Engineer.

4. During periods of cold weather, concrete shall be protected to provide continuous warm, moist curing (with supplementary heat when required) for a total of at least 350 degree-days of curing.
  - a. *Degree-days* are defined as the total number of 24-hour periods multiplied by the average daily air temperature at the surface of the concrete (e.g., 5 days at an average 70°F = 350 degree-days).
  - b. To calculate the weighted average daily air temperature, sum hourly measurements of the air temperature in the shade at the surface of the concrete taking any measurement less than 50°F as 0°F. Divide the sum thus calculated by 24 to obtain the weighted average temperature for that day.
5. Salt, manure, or other chemicals shall not be used for protection.
6. The protection period for concrete being water cured shall not be terminated during cold weather until at least 24 hours after water curing has been terminated.

#### E. Hot Weather Concreting

1. *Hot weather* is defined as any combination of high air temperatures, low relative humidity, and wind velocity which produces a rate of evaporation estimated in accordance with ACI 305R, approaching or exceeding 0.2 lb/sq ft/hr).
2. Concrete placed during hot weather shall be batched, delivered, placed, cured, and protected in compliance with the recommendations of ACI 305R and the additional requirements specified in this Section.
  - a. Temperature of concrete being placed shall not exceed 90°F and every effort shall be made to maintain a uniform concrete mix temperature below this level. The temperature of the concrete shall be such that it will cause no difficulties from loss of slump, flash set, or cold joints.
  - b. All necessary precautions shall be taken to deliver the concrete promptly, to place the concrete promptly upon its arrival at the job, and to provide vibration immediately after placement.
  - c. The Engineer may direct the Contractor to immediately cover plastic concrete with sheet material.
3. The Contractor shall discuss with the Engineer a work plan describing the methods and procedures proposed for concrete placement and curing

during hot weather. Hot weather concreting shall not begin until the work plan is acceptable to the Engineer.

### 3.06 REMOVAL OF FORMS

- A. Except as otherwise specifically authorized by the Engineer, forms shall not be removed before the concrete has attained a strength of at least 30% of its specified design strength, nor before reaching the following number of degree-days of curing (whichever is longer):

TABLE 3  
MINIMUM TIME TO FORM REMOVAL

| Forms for:                  | Degree-Days: |
|-----------------------------|--------------|
| Beams and slabs             | 500          |
| Walls and vertical surfaces | 100          |

(See definition of *degree-days* in Paragraph 3.05D.)

- B. Shores shall not be removed until the concrete has attained at least 70% of its specified design strength and also sufficient strength to support safely its own weight and construction live loads.

### 3.07 INSPECTION AND FIELD TESTING

- A. The batching, mixing, transporting, placing, and curing of concrete shall be subject to the inspection of the Engineer at all times. The Contractor shall advise the Engineer of his/her readiness to proceed at least 24 hours before each concrete placement. The Engineer will inspect the preparations for concreting, including the preparation of previously placed concrete, the reinforcing steel and the alignment, and the cleanliness and tightness of formwork. No placement shall be made without inspection and acceptance by the Engineer.
- B. In compliance with ASTM C31/C31M, the Engineer (or inspector) will take sets of field-control cylinder specimens during the work. The number of sets of concrete test cylinders taken of each class of concrete placed each day shall not be less than one set per day, nor less than one set for each 150 cu yd of concrete, nor less than one set for each 5,000 sq ft of surface area for slabs or walls.
1. A "set" of test cylinders consists of four cylinders: one to be tested at 7 days and two to be tested and their strengths averaged at 28 days. The fourth may be used for a special test at 3 days or to verify strength after 28 days if the 28-day test results are low.
  2. When the average 28-day compressive strength of the cylinders in any set falls below the specified design strength or below proportional minimum

7-day strengths (where proper relation between 7- and 28-day strengths have been established by tests), proportions, water content, or temperature conditions shall be changed to achieve the required strengths.

- C. The Contractor shall cooperate in testing by allowing free access to the work for the selection of samples, providing an insulated closed curing box for specimens, affording protection to the specimens against injury or loss through the operations, and furnishing material and labor required for taking concrete cylinder samples. The cost of taking and shipping specimens will be paid for by the Contractor and reimbursed by the Owner under the Concrete Testing Allowance. Curing boxes shall be acceptable to the Engineer.
- D. In accordance with ASTM C143/C143M, slump tests will be made in the field immediately before placing the concrete. If the slump is greater than the specified range, the concrete shall be rejected.
- E. Air Content: Air content shall be tested for on fresh concrete samples. Air content for concrete made of ordinary aggregates having low absorption shall be tested for in compliance with either the pressure method complying with ASTM C231/C231M or by the volumetric method complying with ASTM C173/C173M. If lightweight aggregates or aggregates with high absorptions are used, the latter test method shall be used.
- F. The Engineer may have cores taken from any questionable area in the concrete work such as construction joints and other locations as required for determining concrete quality. The results of tests on such cores shall be the basis for accepting, rejecting, or determining the continuation of concrete work.
- G. The Contractor shall cooperate in obtaining cores by allowing free access to the work and permitting the use of ladders, scaffolding, and such incidental equipment as may be required. Repair all core holes. The work of cutting and testing the cores will be at the expense of the Contractor. Work found to be acceptable will be reimbursed under the Concrete Testing Allowance.

### 3.08 FAILURE TO MEET REQUIREMENTS

- A. Should the strengths shown by the test specimens made and tested in compliance with the previous provisions fall below the values given in Table 1, the Engineer shall have the right to require changes in proportions outlined to apply to the remainder of the work. Furthermore, the Engineer shall have the right to require additional curing on those portions of the structure represented by the test specimens which failed. The cost of such additional curing shall be at the Contractor's expense. If such additional curing does not give the strength required as evidenced by core and/or load tests, the Engineer shall have the right to require

strengthening or replacing those portions of the structure that fail to develop the required strength. The cost of all such core borings and/or load tests and any strengthening or concrete replacement required because strengths of test specimens are below those specified shall be entirely at the expense of the Contractor. In such cases of failure to meet strength requirements, the Contractor and Engineer shall confer to determine what adjustment, if any, can be made in compliance with sections titled "Strength" and "Failure to Meet Strength Requirements" of ASTM C94/C94M. The "purchaser" referred to in ASTM C94/C94M is the Contractor in this Section.

- B. When the tests on control specimens of concrete fall below the specified strength, the Engineer will permit check tests for strengths to be made by means of typical cores drilled from the structure in compliance with ASTM C42/C42M and ASTM C39/C39M. In the case of cores not indicating adequate strength, the Engineer, in addition to other recourses, may require, at the Contractor's expense, load tests on any one of the slabs, beams, piles, caps, and columns in which such concrete was used. Tests need not be conducted until concrete has aged 60 days.
- C. Should the strength of test cylinders fall below 60% of the required minimum 28-day strength, the concrete shall be rejected and shall be removed and replaced.

### 3.09 PATCHING AND REPAIRS

- A. This Section is intended to require quality work, including adequate forming and proper mixing, placing, and curing of concrete so completed concrete surfaces will require no patching.
- B. Defective concrete and honeycombed areas as determined by the Engineer shall be repaired as specified by the Engineer.
- C. As soon as the forms have been stripped and the concrete surfaces exposed, fins and other projections shall be removed; recesses left by the removal of form ties shall be filled; and surface defects which do not impair structural strength shall be repaired. Clean all exposed concrete surfaces and adjoining work stained by leakage of concrete to the approval of the Engineer.
- D. Immediately after removal of forms remove plugs and break off metal ties as required by Section 03100, Concrete Formwork. Promptly fill holes upon stripping as follows: moisten the hole with water, followed by a 1/16-inch brush coat of neat cement slurry mixed to the consistency of a heavy paste. Immediately plug the hole with a 1-to-1.5-mixture of cement and concrete sand mixed slightly damp to the touch (just short of "balling"). Hammer the grout into the hole until dense and an excess of paste appears on the surface in the form of a spiderweb. Trowel smooth with heavy pressure. Avoid burnishing.

- E. When patching exposed surfaces, employ the same source of cement and sand as used in the parent concrete. Adjust color if necessary by adding proper amounts of white cement. Rub lightly with a fine Carborundum stone at an age of 1 to 5 days if necessary to bring the surface down with the parent concrete. Exercise care to avoid damaging or staining the virgin skin of the surrounding parent concrete. Wash thoroughly to remove all rubbed matter.

### 3.10 SCHEDULE

- A. The following (Table 4) are the general applications for the various concrete classes and design strengths:

TABLE 4  
CONCRETE SCHEDULE

| Class | Design Strength<br>(psi) | Description   |
|-------|--------------------------|---|
| A     | 2,500                    | Concrete fill and duct encasement   |
| B     | 3,000                    | Concrete overlay slabs and pavements  |
| C     | 4,000                    | Walls, slabs on grade, suspended slab and beam systems, columns, grade beams, and all other structural concrete |
| D     | 5,000                    | Prestressed concrete  |

END OF SECTION

**SECTION 03360**  
**CONCRETE FINISHES**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. The Contractor shall furnish all labor, materials, equipment, and incidentals required and finish cast-in-place concrete surfaces as shown on the Drawings and as specified in this Section.

**1.02 RELATED WORK**

- A. Section 03100, Concrete Formwork.
- B. Section 03300, Cast-In-Place Concrete.
- C. Section 03600, Grout.

**1.03 SUBMITTALS**

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Concrete sealer. Confirmation that the sealer is compatible with additionally applied coatings shall also be submitted.

**1.04 REFERENCE STANDARDS**

Reference standards and recommended practices referred to in this Section shall be in accordance with the currently effective Florida Building Code (FBC). The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American Society for Testing and Materials (ASTM)
  - 1. ASTM C33/C33M—Standard Specification for Concrete Aggregates.

**1.05 QUALITY ASSURANCE**

- A. Finishes
  - 1. For concrete which will receive additional applied finishes or materials, the surface finish specified is required for the proper application of the specified manufacturer's products. Where alternate products are approved

- for use, determine if changes in finishes are required and provide the proper finishes to receive these products.
2. Changes in finishes made to accommodate products different from those specified shall be performed at no additional cost to the Owner. Submit the proposed new finishes and their construction methods to the Engineer for approval.

B. Services of Manufacturer's Representative

1. Upon 72 hours notification, make available at no extra cost to the Owner the services of a qualified field representative of the manufacturer of the curing compound, sealer, or hardener to instruct the user on the proper application of the product under prevailing job conditions.

**1.06 WARRANTIES**

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

**1.07 DELIVERY, STORAGE, AND HANDLING**

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

**PART 2 PRODUCTS**

**2.01 MATERIALS**

- A. Chemical hardener shall be Lapidolith by Sonneborn; Hornolith by A.C. Horn; Penalith by W.R. Meadows or equal fluosilicate base material.
- B. Concrete sealer shall be "MasterKure CC 180 WB", by Master Builders Solutions, Shakopee, MN or equal.

**PART 3 EXECUTION**

**3.01 FORMED SURFACES**

- A. Forms shall not be removed before the requirements of Section 03300, Cast-In-Place Concrete, have been satisfied.

- B. Exercise care to prevent damaging edges or obliterating the lines of chamfers, rustications, or corners when removing the forms or performing any other work adjacent to such chamfers, rustications, or corners.
- C. Clean all exposed concrete surfaces and adjoining work stained by leakage of concrete.
- D. Rough Form Finish
  - 1. Immediately after stripping forms and before concrete has changed color, carefully remove all fins and projections.
  - 2. Promptly fill holes left by tie cones and defects as specified in Section 03300, Cast-In-Place Concrete.
- E. Rubbed Finish
  - 1. Immediately upon stripping forms and before the concrete has changed color, carefully remove all fins. While the wall is still damp, apply a thin coat of medium-consistency neat cement slurry by bristle brushes to provide a bonding coat within all pits, air holes, or blemishes in the parent concrete. Avoid coating large areas with the slurry at one time.
  - 2. Before the slurry has dried or changed color, apply a dry (almost crumbly) grout proportioned by volume and consisting of 1 part cement to 1-1/2 parts of clean masonry sand having a fineness modulus of approximately 2.3 and complying with the gradation requirements of ASTM C33/C33M for such a material. Grout shall be uniformly applied by damp pads of coarse burlap approximately 6-inch square used as a float. Scrub grout into the pits and air holes to provide a dense mortar in all imperfections.
  - 3. Allow the mortar to partially harden for 1 or 2 hours depending on the weather. If the air is hot and dry, keep the wall damp during this period using a fine, fog spray. When the grout has hardened sufficiently so it can be scraped from the surface with the edge of a steel trowel without damaging the grout in the small pits or holes, cut off all that can be removed with a trowel. (Note: Grout allowed to remain on the wall too long will harden and will be difficult to remove.)
  - 4. Allow the surface to dry thoroughly and rub it vigorously with clean dry burlap to completely remove any dried grout. No visible film of grout shall remain after this rubbing. The entire cleaning operation for any area must be completed the day it is started. Do not leave grout on surfaces overnight. Allow sufficient time for grout to dry after it has been cut off with the trowel so it can be wiped off clean with the burlap.
  - 5. On the day after the repair of pits, air holes, and blemishes, the walls shall again be wiped off clean with dry, used pieces of burlap containing old

hardened mortar which will act as a mild abrasive. After this treatment, there shall be no built-up film remaining on the parent surface. If, however, such a film is present, a fine abrasive stone shall be used to remove all such material without breaking through the surface film of the original concrete. Such scrubbing shall be light and sufficient only to remove excess material without changing the texture of the concrete.

6. A thorough wash down with stiff bristle brushes shall follow the final bagging or stoning operation. No extraneous materials shall remain on the surface of the wall. The wall shall be sprayed with a fine fog spray periodically to maintain a continually damp condition for at least 3 days after the application of the repair grout.

#### F. Abrasive Blast Finish

1. Coordinate with Rubbed Finish application. Do not begin until Rubbed Finish operation is complete or before concrete has reached minimum 7-day strength. The Rubbed Finish application may be deleted by the Engineer if the unfinished concrete surface is of superior quality. Apply the abrasive blast finish only where indicated on the Drawings.
2. Prepare a sample area a minimum of 4 feet high by 16 feet wide. Blast Finish as directed by the Engineer on a portion of new wall construction which will not be exposed in the final work. The sample area shall contain a variety of finishes obtained with different nozzles, nozzle pressures, grit materials, and blasting techniques for selection by the Engineer. Final accepted sample shall remain exposed until all Blast Finish operations are complete.
3. The Blast Finish operation shall meet all regulatory agency requirements. The Blast Finish contractor shall be responsible for obtaining all required permits and/or licenses.
4. Perform abrasive blast finishing in as continuous an operation as possible, using the same work crew to maintain continuity of finish on each surface or area of work. Maintain patterns or variances in depths of blast as present on the accepted sample.
5. Use an abrasive grit of proper type and gradation as well as equipment and technique to expose aggregate and surrounding matrix surfaces as follows:
  - a. Medium: Generally expose coarse aggregate 1/4-inch to 3/8-inch reveal.

6. Abrade blast corners and edge of patterns carefully, using back-up boards, to maintain uniform corner or edge line. Determine type of nozzle, nozzle pressure, and blasting techniques required to match the Architect's samples.
7. Upon completing the Blast Finish operation, thoroughly flush finished surfaces with clean clear water to remove residual dust and grit. Allow to air dry until curing of concrete is complete.
8. After the concrete has cured for a minimum of 28 days, apply a clear acrylic sealer as directed by the manufacturer.

### 3.02 FLOORS AND SLABS

#### A. Floated Finish

1. Machine Floating
  - a. Screeed floors and slabs with straightedges to the established grades shown on the Drawings. Immediately after final screeding sprinkle a dry cement/sand shake in the proportion of two sacks of Portland cement to 350 lb of coarse natural concrete sand evenly over the surface at the rate of approximately 500 lb/1,000 square feet of floor. Do not sprinkle neat, dry cement on the surface.
  - b. The application of the cement/sand shake may be eliminated at the discretion of the Engineer if the base slab concrete exhibits adequate fattiness and homogeneity and the need is not indicated. When the concrete has hardened sufficiently to support the weight of a power float without the float's digging into or disrupting the level surface, thoroughly float the shake into the surface with a heavy revolving disc-type power compacting machine capable of providing a 200-lb compaction force distributed over a 24-inch-diameter disc.
  - c. Start floating along walls and around columns and then move systematically across the surface leaving a matte finish.
  - d. The compacting machine shall be the "Kelly Power Float with Compaction Control" as manufactured by Kelley Industries of SSP Construction Equipment Inc., Pomona, CA, or equal. Troweling machines equipped with float (shoe) blades that are slipped over the trowel blades may be used for floating. Floating with a troweling machine equipped with normal trowel blades will not be permitted. The use of any floating or troweling machine which has a water attachment for wetting the concrete surface during finishing will not be permitted.

2. Hand Floating

- a. In lieu of power floating, small areas may be compacted by hand floating. The dry cement/sand shake previously specified shall be used unless specifically eliminated by the Engineer. Scree the floors and slabs with straightedges to the established grades shown on the Drawings. While the concrete is still green but sufficiently hardened to support a finisher and kneeboards with no more than 1/4-inch indentation, wood float to a true, even plane with no coarse aggregate visible. Use sufficient pressure on the wood floats to bring moisture to the surface.

3. Finishing Tolerances

- a. Level floors and slabs to a tolerance of plus or minus 1/8 inch when checked with a 10-foot straightedge placed anywhere on the slab in any direction. Where drains occur, pitch floors to drains such that no low spots are left undrained. Failure to meet either of the above requirements shall be cause for removal, grinding, or other correction as directed by the Engineer.

B. Broom Finish

1. Scree the slabs with straightedges to the established grades indicated on the Drawings. When the concrete has stiffened sufficiently to maintain small surface indentations, draw a stiff bristle broom lightly across the surface in the direction of drainage or, in the case of walks and stairs, perpendicular to the direction of traffic to provide a non-slip surface.

C. Steel Trowel Finish

1. Finish concrete as specified in Article 3.04. Then, hand steel trowel to a perfectly smooth hard even finish free from high or low spots or other defects.

D. Concrete Sealer

1. Prepare and seal surfaces indicated on the room finish schedule to receive a sealer as follows:
  - a. Finish concrete as specified in the preceding paragraphs and in accordance with the Schedule in Article 3.05.

- b. Newly Placed Concrete: Surface must be sound and properly finished. Surface is application ready when it is damp but not wet and can no longer be marred by walking workmen.
- c. Newly Cured Bare Concrete: Level any spots gouged out by trades. Remove all dirt, dust, droppage, oil, grease, asphalt, and foreign matter. Cleanse with caustics and detergents as required. Rinse thoroughly and allow to dry so that the surface is no more than damp and not wet.
- d. Aged Concrete: Restore surface soundness by patching, grouting, filling cracks and holes, etc. Surface must also be free of any dust, dirt, and other foreign matter. Use power tools and/or strippers to remove any incompatible sealers or coatings. Cleanse as required following the procedure indicated under cured concrete.
- e. Methods: Apply sealer to form a continuous, uniform film by spray, soft bristle pushbroom, long nap roller, or lambswool applicator. Ordinary garden-type sprayers, using neoprene hose, are recommended for best results.
- f. Applications: For curing only, apply the first coat evenly and uniformly as soon as possible after final finishing at the rate of 200 to 400 square feet per gallon. Apply the second coat when all trades are completed and the structure is ready for occupancy at the rate of 400 to 600 square feet per gallon.
- g. To meet guarantee and to seal and dustproof, two coats are required. For sealing new concrete, both coats shall be applied full strength. On aged concrete, when renovating, dustproofing, and sealing, the first coat should be thinned 10 to 15% with reducer in accordance with the manufacturer's directions.

### 3.03 CONCRETE RECEIVING CHEMICAL HARDENER

- A. After 28 days minimum concrete cure, apply chemical hardener in three applications to a minimum total coverage of the undiluted chemical of 100 square feet per gallon and in accordance with the manufacturer's recommendations as reviewed.

### 3.04 APPROVAL OF FINISHES

- A. All concrete surfaces, when finished, will be inspected by the Engineer.
- B. Surfaces which in the opinion of the Engineer are unsatisfactory shall be refinished or reworked.

- C. After finishing horizontal surfaces, regardless of the finishing procedure specified, the concrete shall be cured in compliance with Section 03300, Cast-In-Place Concrete, unless otherwise directed by the Engineer.

### 3.05 SCHEDULE OF FINISHES

- A. Concrete shall be finished as specified either to remain as natural concrete or to receive an additional applied finish or material under another Section.
- B. Concrete for the following conditions shall be finished as noted on the Drawings and as further specified in this Section:
1. Concrete to Receive Dampproofing: Rough form finish. See Paragraph 3.01D.
  2. Concrete Not Exposed to View and Not Scheduled to Receive an Additional Applied Finish or Material: Rough form finish. See Paragraph 3.01D.
  3. Exterior Vertical Concrete Above Grade Exposed to View: Rubbed finish. See Paragraph 3.01E.
  4. Interior Vertical Concrete Exposed to View Except in Water Containment Areas: Rubbed finish. See Paragraph 3.01E.
  5. Vertical Concrete in Water Containment Areas. Rubbed finish on exposed surfaces and extending to 2 feet below normal operating water level: Rough form finish on the remainder of submerged areas. See Paragraphs 3.01E and 3.01D.
  6. Interior and Exterior Underside of Concrete Exposed to View: Rubbed finish. See Paragraph 3.01E.
  7. Exterior surfaces exposed to view and indicated to have an abrasive blast finish. See Paragraph 3.01F.
  8. Interior or Exterior Horizontal Concrete not Requiring Floor Hardener or Sealer: Floated finish. See Paragraph 3.02A.
  9. Concrete for Exterior Walks and Interior and Exterior Stairs: Broomed finish perpendicular to direction of traffic. See Paragraph 3.02B.
  10. Concrete Slabs On Which Process Liquids Flow or In Contact with Sludge: Steel trowel finish. See Paragraph 3.02C.
  11. Concrete to Receive Hardener: See Paragraph 3.02D.
  12. Concrete tank bottoms to be covered with grout: See Section 03600, Grout.

END OF SECTION

**SECTION 03600**  
**GROUT**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. The Contractor shall furnish all labor, materials, equipment, and incidentals required and install grout complete as shown on the Drawings and as specified in this Section.

**1.02 RELATED WORK**

- A. Section 03100, Concrete Formwork.
- B. Section 03200, Concrete Reinforcement.
- C. Section 03250, Concrete Joints and Joint Accessories.
- D. Section 03300, Cast-In-Place Concrete.
- E. Section 05500, Metal Fabrications.

**1.03 SUBMITTALS**

- A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:
  1. Commercially manufactured nonshrink cementitious grout. The submittal shall include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, conformity to required ASTM standards, and Material Safety Data Sheet.
  2. Commercially manufactured nonshrink epoxy grout. The submittal shall include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, conformity to required ASTM standards, and Material Safety Data Sheet.
  3. Cement grout. The submittal shall include the type and brand of the cement, the gradation of the fine aggregate, product data on any proposed admixtures, and the proposed mix of the grout.
  4. Concrete grout. The submittal shall include data as required for concrete as delineated in Section 03300, Cast-In-Place Concrete, and for fiber reinforcement as delineated in Section 03200, Concrete Reinforcement. This includes the mix design, constituent quantities per cubic yard, and the water/cement ratio.
- B. Laboratory Test Reports: Submit laboratory test data as required under Section 03300, Cast-In-Place Concrete, for concrete to be used as concrete grout.

- C. Certifications: Certify that commercially manufactured grout products and concrete grout admixtures are suitable for use in contact with potable water after 30 days curing.
- D. Qualifications: Grout manufacturers shall submit documentation that they have at least 10 years experience in the production and use of the proposed grouts which they will supply.

## 1.04 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be in accordance with the currently effective Florida Building Code (FBC). The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American Society for Testing and Materials (ASTM)
  - 1. ASTM C33/C33M—Standard Specification for Concrete Aggregates.
  - 2. ASTM C150/C150M—Standard Specification for Portland Cement.
  - 3. ASTM C531—Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.
  - 4. ASTM C579—Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.
  - 5. ASTM C827/C827M—Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures.
  - 6. ASTM C1107/C1107M—Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
  - 7. ASTM D695—Standard Test Method for Compressive Properties of Rigid Plastics.
- B. US Army Corps of Engineers Standard (CRD)
  - 1. CRD C-621—Corps of Engineers Specification for Non-Shrink Grout.

## 1.05 QUALITY ASSURANCE

- A. Pre-installation Conference
  - 1. Well in advance of grouting, the Contractor shall hold a pre-installation meeting to review the requirements for surface preparation, mixing, placing, and curing procedures for each product proposed for use. Parties

concerned with grouting shall be notified of the meeting at least 10 days before its scheduled date.

B. Services of Manufacturer's Representative

1. A qualified field technician of the nonshrink grout manufacturer, specifically trained in installing the products, shall attend the pre-installation conference and shall be present for the initial installation of each type of nonshrink grout. Additional services shall also be provided as required to correct installation problems.

C. Field Testing

1. All field testing and inspection services required shall be provided by the Owner. The Contractor shall assist in the sampling of materials and shall provide any ladders, platforms, etc., for access to the work. The methods of testing shall comply in detail with the applicable ASTM Standards.
2. The field testing of concrete grout shall be as specified for concrete in Section 03300, Cast-In-Place Concrete.

1.06 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.
- B. Deliver materials to the jobsite in original, unopened packages, clearly labeled with the manufacturer's name, product identification, batch numbers, and printed instructions.
- C. Store materials in full compliance with the manufacturer's recommendations. Total storage time from the date of manufacture to the date of installation shall be limited to 6 months or the manufacturer's recommended storage time, whichever is less.
- D. Material which becomes damp or otherwise unacceptable shall be immediately removed from the site and replaced with acceptable material at no additional expense to the Owner.

- E. Nonshrink-cement-based grouts shall be delivered as preblended, prepackaged mixes requiring only the addition of water.
- F. Nonshrink epoxy grouts shall be delivered as premeasured, prepackaged, three-component systems requiring only blending as directed by the manufacturer.

## 1.08 QUALIFICATIONS

- A. The grout manufacturer shall have a minimum of 10 years experience in the production and use of the type of grout proposed for the work.

## 1.09 DEFINITIONS

- A. Nonshrink Grout: A commercially manufactured product that does not shrink in either the plastic or hardened state, is dimensionally stable in the hardened state, and bonds to a clean base plate.

# PART 2 PRODUCTS

## 2.01 GENERAL

- A. The use of a manufacturer's name and product or catalog number is to establish the standard of quality desired.
- B. To standardize appearance, like materials shall be the products of one manufacturer or supplier.

## 2.02 MATERIALS

### A. Nonshrink Cementitious Grout

- 1. Nonshrink cementitious grouts shall meet or exceed the requirements of ASTM C1107/C1107M, Grades B or C and CRD C-621. Grouts shall be Portland-cement based, contain a pre-proportioned blend of selected aggregates and shrinkage compensating agents, and shall require only the addition of water. Nonshrink cementitious grouts shall not contain expansive cement or metallic particles. The grouts shall exhibit no shrinkage when tested in conformity with ASTM C827/C827M.
  - a. General purpose nonshrink cementitious grout shall conform to the standards stated above and shall be SikaGrout 212 by Sika Corp.; Set Grout by Master Builders, Inc.; Gilco Construction Grout by Gifford Hill & Co.; Euco NS by The Euclid Chemical Co.; NBEC Grout by U.S. Grout Corp.; or equal.

b. Flowable (Precision) nonshrink cementitious grout shall conform to the standards stated above and shall be Masterflow 928 by Master Builders, Inc.; Hi Flow Grout by the Euclid Chemical Co.; SikaGrout 212 by Sika Corp.; Supreme Grout by Gifford Hill & Co.; Five Star Grout by U. S. Grout Corp.; or equal.

B. Nonshrink Epoxy Grout

1. Nonshrink epoxy based grout shall be a pre-proportioned, three-component, 100% solids system consisting of epoxy resin, hardener, and blended aggregate. It shall have a compressive strength of 14,000 psi in 7 days when tested in conformity with ASTM D695 and have a maximum thermal expansion of  $30 \times 10^{-6}$  when tested in conformity with ASTM C531. The grout shall be Ceilcote 648 CP by Master Builders Inc.; Five Star Epoxy Grout by US Grout Corp.; Sikadur 42 Grout Pak by Sika Corp.; High Strength Epoxy Grout by the Euclid Chemical Co.; or equal.

C. Cement Grout

1. Cement grouts shall be a mixture of one part Portland cement conforming to ASTM C150/C150M, Types I, II, or III and 1 to 2 parts sand conforming to ASTM C33/C33M with sufficient water to place the grout. The water content shall be sufficient to impart workability to the grout but not to the degree that it will allow the grout to flow.

D. Concrete Grout

1. Concrete grout shall conform to the requirements of Section 03300, Cast-In-Place Concrete, except as specified in this Section. It shall be proportioned with cement, coarse and fine aggregates, water, water reducer, and an air-entraining agent to produce a mix having an average strength of 2,900 psi at 28 days, or 2,500 psi nominal strength. Coarse aggregate size shall be 3/8 inch maximum. Slump should not exceed 5 inches and should be as low as practical yet still retain sufficient workability.

2. Synthetic reinforcing fibers as specified in Section 03200, Concrete Reinforcement, shall be added to the concrete grout mix at the rate of 1.5 lb of fibers per cubic yard of grout. Fibers shall be added from the manufacturer's premeasured bags and according to the manufacturer's recommendations in a manner which will ensure complete dispersion of the fiber bundles as single monofilaments within the concrete grout.

E. Water

1. Potable water, free from injurious amounts of oil, acid, alkali, organic matter, or other deleterious substances.

PART 3 EXECUTION

3.01 PREPARATION

- A. Grout shall be placed over cured concrete which has attained its full design strength unless otherwise approved by the Engineer.
- B. Concrete surfaces to receive grout shall be clean and sound, free of ice, frost, dirt, grease, oil, curing compounds, laitance and paints, and free of all loose material or foreign matter which may affect the bond or performance of the grout.
- C. Roughen concrete surfaces by chipping, sandblasting, or other mechanical means to ensure bond of the grout to the concrete. Remove loose or broken concrete. Irregular voids or projecting coarse aggregate need not be removed if they are sound, free of laitance, and firmly embedded into the parent concrete.
  1. Air compressors used to clean surfaces in contact with grout shall be the oilless type or equipped with an oil trap in the air line to prevent oil from being blown onto the surface.
- D. Remove all loose rust, oil, or other deleterious substances from metal embedments or bottom of baseplates before installing the grout.
- E. Concrete surfaces shall be washed clean and then kept moist for at least 24 hours before the placing of cementitious or cement grout. Saturation may be achieved by covering the concrete with saturated burlap bags, using a soaker hose, flooding the surface, or other method acceptable to the Engineer. Upon completion of the 24-hour period, visible water shall be removed from the surface before grouting. An adhesive bonding agent should only be used in lieu of surface saturation when approved by the Engineer for each specific location of grout installation.
- F. Epoxy-based grouts do not require the saturation of the concrete substrate. Surfaces in contact with epoxy grout shall be completely dry before grouting.
- G. Construct grout forms or other leak-proof containment as required. Forms shall be lined or coated with release agents recommended by the grout manufacturer.

Forms shall be of adequate strength, securely anchored in place, and shored to resist the forces imposed by the grout and its placement.

1. Forms for epoxy grout shall be designed to allow the formation of a hydraulic head and shall have chamfer strips built into forms.
- H. Level and align the structural or equipment bearing plates in accordance with the structural requirements and the recommendations of the equipment manufacturer.
- I. Equipment shall be supported during alignment and installation of grout by shims, wedges, blocks, or other approved means. The shims, wedges, and blocking devices shall be prevented from bonding to the grout by appropriate bond breaking coatings and removed after grouting unless otherwise approved by the Engineer.

### 3.02 INSTALLATION—GENERAL

- A. The Contractor shall mix, apply, and cure products in strict compliance with the manufacturer's recommendations and this Section.
- B. Have sufficient manpower and equipment available for rapid and continuous mixing and placing. Keep all necessary tools and materials ready and close at hand.
- C. Maintain temperatures of the foundation plate, supporting concrete, and grout between 40 and 90°F during grouting and for at least 24 hours after or as recommended by the grout manufacturer, whichever is longer. Take precautions to minimize differential heating or cooling of baseplates and grout during the curing period.
- D. Take special precautions for hot weather or cold weather grouting as recommended by the manufacturer when ambient temperatures and/or the temperature of the materials in contact with the grout are outside of the 60 and 90°F range.
- E. Install grout in a manner which will preserve the isolation between the elements on either side of the joint where grout is placed in the vicinity of an expansion or contraction joint.
- F. Reflect all existing underlying expansion, contraction, and construction joints through the grout.

### 3.03 INSTALLATION—CEMENT GROUTS AND NONSHRINK CEMENTITIOUS GROUTS

- A. Mix in accordance with the manufacturer's recommendations. Do not add cement, sand, pea gravel, or admixtures without prior approval by the Engineer.
- B. Avoid mixing by hand. Mixing in a mortar mixer (with moving blades) is recommended. Pre-wet the mixer and empty excess water. Add premeasured amount of water for mixing, followed by the grout. Begin with the minimum amount of water recommended by the manufacturer and then add the minimum additional water required to obtain workability. Do not exceed the manufacturer's maximum recommended water content.
- C. Placements greater than 3 inches deep shall include the addition of clean, washed pea gravel to the grout mix when approved by the manufacturer. Comply with the manufacturer's recommendations for the size and amount of aggregate to be added.
- D. Place grout into the designated areas in a manner which will avoid segregation or entrapment of air. Do not vibrate grout to release air or to consolidate the material. Placement should proceed in a manner which will ensure the filling of all spaces and provide full contact between the grout and adjoining surfaces. Provide grout holes as necessary.
- E. Place grout rapidly and continuously to avoid cold joints. Do not place cement grouts in layers. Do not add additional water to the mix (retemper) after initial stiffening.
- F. Just before the grout reaches its final set, cut back the grout to the substrate at a 45° angle from the lower edge of the bearing plate unless otherwise approved by the Engineer. Finish this surface with a wood float (brush) finish.
- G. Begin curing immediately after form removal, cutback, and finishing. Keep grout moist and within its recommended placement temperature range for at least 24 hours after placement or longer if recommended by the manufacturer. Saturate the grout surface by use of wet burlap, soaker hoses, ponding, or other approved means. Provide sunshades as necessary. If drying winds inhibit the ability of a given curing method to keep grout moist, erect wind breaks until wind is no longer a problem or curing is finished.

### 3.04 INSTALLATION—NONSHRINK EPOXY GROUTS

- A. Mix in accordance with the procedures recommended by the manufacturer. Do not vary the ratio of components or add solvent to change the consistency of the

grout mix. Do not overmix. Mix full batches only to maintain proper proportions of resin, hardener, and aggregate.

- B. Monitor ambient weather conditions and contact the grout manufacturer for special placement procedures to be used for temperatures below 60 or above 90°F.
- C. Place grout into the designated areas in a manner which will avoid trapping air. Placement methods shall ensure the filling of all spaces and provide full contact between the grout and adjoining surfaces. Provide grout holes as necessary.
- D. Minimize "shoulder" length (extension of grout horizontally beyond base plate). In no case shall the shoulder length of the grout be greater than the grout thickness.
- E. Finish grout by puddling to cover all aggregate and provide a smooth finish. Break bubbles and smooth the top surface of the grout in conformity with the manufacturer's recommendations.
- F. Epoxy grouts are self curing and do not require the application of water. Maintain the formed grout within its recommended placement temperature range for at least 24 hours after placing, or longer if recommended by the manufacturer.

### 3.05 INSTALLATION—CONCRETE GROUT

- A. Screeed underlying concrete to the grade shown on the Drawings. Provide the surface with a broomed finish, aligned to drain. Protect and keep the surface clean until placement of concrete grout.
- B. Remove the debris and clean the surface by sweeping and vacuuming all dirt and other foreign materials. Wash the tank slab using a strong jet of water. Flushing debris into tank drain lines will not be permitted.
- C. Saturate the concrete surface for at least 24 hours before placing the concrete grout. Saturation may be maintained by ponding, by the use of soaker hoses, or by other methods acceptable to the Engineer. Remove excess water just before placing the concrete grout. Place a cement slurry immediately ahead of the concrete grout so that the slurry is moist when the grout is placed. Work the slurry over the surface with a broom until it is coated with approximately 1/16- to 1/8-inch-thick cement paste.
- D. Place concrete grout to final grade using the scraper mechanism as a guide for surface elevation and to ensure that high and low spots are eliminated. Unless specifically approved by the equipment manufacturer, mechanical scraper mechanisms shall not be used as a finishing machine or screed.

- E. Provide grout contraction joints as indicated on the Drawings.
- F. Finish and cure the concrete grout as specified for cast-in-place concrete.

### 3.06 SCHEDULE

- A. The following list indicates where the particular types of grout are to be used:
  - 1. General purpose nonshrink cementitious grout: Use at all locations where nonshrink grout is called for on the plans except for base plates greater than 3 feet wide by 3 feet long and, except for the setting of anchor rods, anchor bolts or reinforcing steel in concrete.
  - 2. Flowable nonshrink cementitious grout: Use under all base plates greater in area than 3 feet by 3 feet. Use at all locations indicated to receive flowable nonshrink grout by the Drawings. The Contractor, at his/her option and convenience, may also substitute flowable nonshrink grout for general purpose nonshrink cementitious grout.
  - 3. Nonshrink epoxy grout: Use for setting anchor rods, anchor bolts, and reinforcing steel in concrete and for all locations specifically indicated to receive epoxy grout.
  - 4. Cement grout: Cement grout may be used for grouting incidental base plates for structural and miscellaneous steel such as post base plates for platforms, base plates for beams, etc. It shall not be used when nonshrink grout is specifically called for on the Drawings or for grouting primary structural steel members such as columns and girders.
  - 5. Concrete grout: Use for overlaying the base concrete under scraper mechanisms of clarifiers to allow more control in placing the surface grade.

END OF SECTION

**SECTION 03930**  
**MODIFICATIONS AND REPAIR TO CONCRETE**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. The Contractor shall furnish all labor, materials, equipment, and incidentals required and cut, remove, repair, or otherwise modify parts of existing concrete structures or appurtenances as shown on the Drawings and as specified in this Section. Work under this Section shall also include bonding new concrete to existing concrete.

**1.02 RELATED WORK**

- A. Section 02220, Demolition and Modifications.
- B. Section 03100, Concrete Formwork.
- C. Section 03200, Concrete Reinforcement.
- D. Section 03250, Concrete Joints and Joint Accessories.
- E. Section 03300, Cast-In-Place Concrete.
- F. Section 03600, Grout.
- G. Section 05500, Metal Fabrications.

**1.03 SUBMITTALS**

- A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance.
- B. Submit to the Engineer, in accordance with Section 01330, Submittals and Acceptance, a Schedule of Demolition and the detailed methods of demolition to be used at each location.
- C. Submit the manufacturer's technical literature on all product brands proposed for use to the Engineer for review. The submittal shall include the manufacturer's installation and/or application instructions.
- D. When substitutions for acceptable brands of materials specified in this Section are proposed, submit brochures and technical data of the proposed substitutions to the Engineer for approval before delivery to the project.

## 1.04 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be in accordance with the currently effective Florida Building Code (FBC). The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

### A. American Society for Testing and Materials (ASTM)

1. ASTM C881/C881M—Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
2. ASTM C882/C882M—Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Sheer.
3. ASTM D570—Standard Test Method for Water Absorption of Plastics.
4. ASTM D638—Standard Test Method for Tensile Properties of Plastics.
5. ASTM D695—Standard Test Method for Compressive Properties of Rigid Plastics.
6. ASTM D732—Standard Test Method for Shear Strength of Plastics by Punch Tool.
7. ASTM D790—Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
8. ASTM G3—Standard Practice for Conventions Applicable to Electrochemical Measurements in Corrosion Testing.

## 1.05 QUALITY ASSURANCE

- A. No existing structure or concrete shall be shifted, cut, removed, or otherwise altered until the Engineer so authorizes.
- B. When removing materials or portions of existing structures and when making openings in existing structures, all precautions shall be taken and all necessary barriers, shoring and bracing, and other protective devices shall be erected to prevent damage to the structures beyond the limits necessary for the new work, protect personnel, control dust, and prevent damage to the structures or contents by falling or flying debris. Unless otherwise permitted, shown, or specified, line drilling will be required in cutting existing concrete.

## 1.06 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.
- B. Manufacturer Qualifications: The manufacturer of the specified products shall have a minimum of 10 years experience in the manufacture of such products and

- shall have an ongoing program of training, certifying, and technically supporting the Contractor's personnel.
- C. Contractor Qualifications: The Contractor shall complete a program of instruction in the application of the approved manufacturer's material specified in this Section and provide certification from the manufacturer attesting to their training and status as an approved applicator.
  - D. Furnish a notarized certificate stating that the materials meet the requirements of this Section and have the manufacturer's current printed literature on a specified product.

## 1.07 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.
- B. Deliver the specified products in original, unopened containers with the manufacturer's name, labels, product identification, and batch numbers.
- C. Store and condition the specified product as recommended by the manufacturer.

## PART 2 PRODUCTS

### 2.01 MATERIALS

- A. General
  - 1. Materials shall comply with this Section and any state or local regulations.
- B. Epoxy Bonding Agent
  - 1. General:
    - a. The epoxy bonding agent shall be a two-component, solvent-free, asbestos-free moisture-insensitive epoxy-resin material used to bond plastic concrete to hardened concrete complying with the requirements of ASTM C881/C881M, Type II, and the additional requirements specified in this Section.

2. Material

a. Properties of the cured material:

- (1) Compressive Strength (ASTM D695): 8,500 psi minimum at 28 days.
- (2) Tensile Strength (ASTM D638): 4,000 psi minimum at 14 days.
- (3) Flexural Strength (ASTM D790 Modulus of Rupture): 6,300 psi minimum at 14 days.
- (4) Shear Strength (ASTM D732): 5,000 psi minimum at 14 days.
- (5) Water Absorption (ASTM D570 2-hour boil): 1.0% maximum at 14 days.
- (6) Bond Strength (ASTM C882/C882M) Hardened to Plastic: 1,500 psi minimum at 14 days moist cure.
- (7) Effective Shrinkage: Passes Test.
- (8) Color: Gray.

3. Approved manufacturers include Sika Corporation, Lyndhurst, NJ, Sikadur 32, Hi Mod; Master Builder's, Cleveland, OH, Concresive Liquid (LPL); or equal.

C. Epoxy Paste

1. General:

- a. Epoxy Paste shall be a two-component, solvent-free, asbestos-free, moisture-insensitive epoxy-resin material used to bond dissimilar materials to concrete such as setting railing posts, dowels, anchor bolts, and all threads into hardened concrete and shall comply with the requirements of ASTM C881/C881M, Type I, Grade 3 and the additional requirements specified in this Section. It may also be used to patch existing surfaces where the glue line is 1/8 inch or less.

2. Material

a. Properties of the cured material:

- (1) Compressive Properties (ASTM D695): 10,000 psi minimum at 28 days.
- (2) Tensile Strength (ASTM D638): 3,000 psi minimum at 14 days. Elongation at Break 0.3% minimum.

- (3) Flexural Strength (ASTM D790 Modulus of Rupture): 3,700 psi minimum at 14 days.
- (4) Shear Strength (ASTM D732): 2,800 psi minimum at 14 days.
- (5) Water Absorption (ASTM D570): 1.0% maximum at 7 days.
- (6) Bond Strength (ASTM C882/C882M): 2,000 psi at 14 days moist cure.
- (7) Color: Concrete grey.

3. Approved manufacturers include:

- a. Overhead applications: Sika Corporation, Lyndhurst, NJ, Sikadur Hi Mod LV 31; Master Builders, Inc., Cleveland, OH, Concresive 1438; or equal.
- b. Sika Corporation, Lyndhurst, NJ, Sikadur Hi Mod LV 32; Master Builders, Inc., Cleveland, OH, Concresive 1438; or equal.

- D. Non-Shrink Precision Cement Grout, Non-Shrink Cement Grout, Non-Shrink Epoxy Grout and Polymer Modified mortar are included in Section 03600, Grout.
- E. Adhesive-capsule-type anchor system shall be equal to the HIT-HY 200 adhesive Anchoring System by Hilti Fastening Systems, Tulsa, OK. Where the adhesive anchor is under sustained tensile loading (i.e. vertically installed anchors) the anchor system shall be Hilti HIT RE-500 SD by Hilti Fastening Systems, Tulsa, OK. All steel reinforcement shall be anchored using the Hilti HIT RE-500 SD adhesive anchoring system.
- F. Acrylic Latex Bonding Agent
- G. Crack Repair Epoxy Adhesive

1. General:

- a. Crack Repair Epoxy Adhesive shall be a two-component, solvent-free, moisture-insensitive epoxy-resin material suitable for crack grouting by injection or gravity feed. It shall be formulated for the specific size of opening or crack being injected.
- b. All concrete surfaces containing potable water or water to be treated for potable use that are repaired by the epoxy adhesive injection system shall be coated with an acceptable epoxy coating approved by the FDA for use in contact with potable water.

2. Material

a. Properties of the cured material:

- (1) Compressive Properties (ASTM D695): 10,000 psi minimum at 28 days.
- (2) Tensile Strength (ASTM D638): 5,300 psi minimum at 14 days. Elongation at Break 2 to 5%.
- (3) Flexural Strength (ASTM D790 Modulus of Rupture): 12,000 psi minimum at 14 days (gravity); 4,600 psi minimum at 14 days (injection).
- (4) Shear Strength (ASTM D732): 3,700 psi minimum at 14 days.
- (5) Water Absorption (ASTM D570 2-hour boil): 1.5% maximum at 7 days.
- (6) Bond Strength (ASTM C882/C882M): 2,400 psi at 2 days dry; 2,000 psi at 14 days dry plus 12 days moist.
- (7) Effective Shrinkage: Passes Test.

3. Approved manufacturers include:

- a. For standard applications: Sika Corporation, Lyndhurst, NJ, Sikadur Hi Mod; BASF, MasterInject 1500, or equal.
- b. For very thin applications: Sika Corporation, Lyndhurst, NJ, Sikadur Hi Mod LV; Master Builders Inc., Cleveland, OH, Concresive 1468 or equal.

H. Polymer-Modified Portland Cement Mortar (Vertical and Overhead Surfaces)

1. The polymer-modified Portland cement mortar shall be a two-component, polymer-modified, Portland cement fast-setting, non-sag mortar with a migrating corrosion inhibitor.
2. Component A shall be a liquid polymer emulsion of an acrylic copolymer base and additives. It shall have a particle size of less than 0.1 micron.
3. Component A shall contain an organic, migrating corrosion inhibitor, which has been independently proven to reduce corrosion in concrete via ASTM G3 (half-cell potential tests). The corrosion inhibitor shall not be calcium nitrate and shall have a minimum of 7 years of independent field testing to document performance on actual construction projects.
4. Component B shall be a blend of selected Portland cements, specially graded aggregates, admixtures for controlling setting time, water reducers for workability, and accelerators.
5. The ratio of Component A: Component B shall be 1:5:2 by weight.

6. The polymer-modified Portland cement mortar shall be placeable from 1/8- to 1-1/2-inch depth per lift.
7. Aggregate to extend the polymer-modified Portland cement mortar shall be a minus 1/2- or 3/8-inch clean, well-graded, saturated surface dry material having low absorption and high density in conformance with the manufacturer's requirements.
8. Approved manufacturers include Sika Corporation, Lyndhurst, NJ – Sikatop 123 plus.

I. Polymer-Modified Portland Cement Mortar (Horizontal Surfaces)

1. The polymer-modified Portland cement mortar shall be a two-component, polymer-modified, Portland cement fast-setting, non-sag mortar with a migrating corrosion inhibitor.
2. Component A shall be a liquid polymer emulsion of an acrylic copolymer base and additives. It shall have a particle size of less than 0.1 micron.
3. Component A shall contain an organic, migrating corrosion inhibitor, which has been independently proven to reduce corrosion in concrete via ASTM G3 (half-cell potential tests). The corrosion inhibitor shall not be calcium nitrate and shall have a minimum of seven tests. The corrosion inhibitor shall not be calcium nitrate and shall have a minimum of 7 years of independent field testing to document performance on actual construction projects.
4. Component B shall be a blend of selected Portland cements, specially graded aggregates, admixtures for controlling setting time, water reducers for workability, and accelerators.
5. The ratio of Component A: Component B shall be 1:7:2 by weight.
6. The polymer-modified Portland cement mortar shall be placeable from a 1/8-inch to 1-inch depth per lift.
7. Aggregate to extend the polymer-modified Portland cement mortar shall be a minus 1/2- or 3/8-inch clean, well-graded, saturated surface dry material having low absorption and high density in conformance with the manufacturer's requirements.
8. Approved manufacturers include Sika Corporation, Lyndhurst, NJ, Sikatop 122 plus.

## PART 3 EXECUTION

### 3.01 GENERAL

- A. In all cases where concrete is repaired in the vicinity of an expansion joint or contraction joint the repairs shall be made to preserve the isolation between components on either side of the joint.

- B. When drilling holes for dowels/bolts at new or existing concrete, drilling shall stop if rebar is encountered. As approved by the Engineer, the hole location shall be relocated to avoid rebar. Rebar shall not be cut without prior approval by the Engineer. Where possible, rebar locations shall be identified before drilling using "rebar locators" so that drilled hole locations may be adjusted to avoid rebar interference.

### 3.02 CONCRETE REMOVAL

- A. Concrete designated to be removed to specific limits as shown on the Drawings or directed by the Engineer shall be done by line drilling at limits followed by chipping or jack hammering as appropriate in areas where concrete is to be taken out. Remove concrete in such a manner that surrounding concrete or existing reinforcing to be left in place and existing in-place equipment is not damaged. Sawcutting at limits of concrete to be removed shall only be done if indicated on the Drawings or after obtaining written approval from the Engineer.
- B. Where existing reinforcing is exposed due to saw cutting/core drilling and no new material is to be placed on the sawcut surface, a coating or surface treatment of epoxy paste shall be applied to the entire cut surface to a thickness of 1/4 inch.
- C. In all cases where the joint between new concrete or grout and existing concrete will be exposed in the finished work, except as otherwise shown or specified, the edge of concrete removal shall be a 1-inch-deep saw cut on each exposed surface of the existing concrete.
- D. Concrete specified to be left in place which is damaged shall be repaired by approved means to the satisfaction of the Engineer.
- E. The Engineer may from time to time direct the Contractor to make additional repairs to existing concrete. These repairs shall be made as specified or by such other methods as may be appropriate.

### 3.03 CONNECTION SURFACE PREPARATION

- A. Connection surfaces shall be prepared as specified below for concrete areas requiring patching, repairs, or modifications as shown on the Drawings, specified in this Section, or as directed by the Engineer.
- B. Remove all deteriorated materials, dirt, oil, grease, and all other bond-inhibiting materials from the surface by dry mechanical means, i.e. sandblasting, grinding, etc., as approved by the Engineer. Be sure the areas are not less than 1/2 inch deep. Irregular voids or surface stones need not be removed if they are sound, free

of laitance, and firmly embedded into parent concrete, subject to the Engineer's final inspection.

- C. If reinforcing steel is exposed, it must be mechanically cleaned to remove all contaminants, rust, etc., as approved by the Engineer. If half of the diameter of the reinforcing steel is exposed, chip out behind the steel. The distance chipped behind the steel shall be a minimum of 1/2 inch. Reinforcing to be saved shall not be damaged during the demolition operation.
- D. Reinforcing from existing demolished concrete which is shown to be incorporated in new concrete shall be cleaned by mechanical means to remove all loose material and products of corrosion before proceeding with the repair. It shall be cut, bent, or lapped to new reinforcing as shown on the Drawings and provided with 1-inch minimum cover all around.
- E. The following are specific concrete surface preparation "methods" to be used where called for on the Drawings, specified in this Section, or as directed by the Engineer.
  - 1. Method A: After the existing concrete surface at connection has been roughened and cleaned, thoroughly moisten the existing surface with water. Brush on a 1/16-inch layer of cement and water mixed to the consistency of a heavy paste. Immediately after applying the cement paste, place new concrete or grout mixture as detailed on the Drawings.
  - 2. Method B: After the concrete surface has been roughened and cleaned, apply an epoxy bonding agent at connection surface. The field preparation and application of the epoxy bonding agent shall comply strictly with the manufacturer's recommendations. Place new concrete or grout mixture to limits shown on the Drawings within time constraints recommended by the manufacturer to ensure bond.
  - 3. Method C: Drill a hole 1/4 inch larger than the diameter of the dowel. The hole shall be blown clear of loose particles and dust just before installing epoxy. The drilled hole shall first be filled with grout or epoxy paste, then dowels/bolts shall be buttered with paste and inserted by tapping. Unless otherwise shown on the Drawings, deformed bars shall be drilled and set to a depth of 10 bar diameters and smooth bars shall be drilled and set to a depth of 15 bar diameters. If not noted on the Drawings, the Engineer will provide details regarding the size and spacing of dowels.
  - 4. Method D: Combination of Methods B and C.
  - 5. Method E: The capsule anchor system shall be set in existing concrete by drilling holes to the required depth to develop the full tensile and shear strengths of the anchor material being used. The anchor bolts system shall be installed according to the manufacturer's recommendation in holes sized as required. The anchor stud bolt, rebar, or other embedment item

shall be tipped with a double 45° chamfered point, securely fastened into the chuck of all rotary percussion hammer drill and drilled into the capsule-filled hole. The anchor may be installed in horizontal, vertical, and overhead positions.

### 3.04 GROUTING

- A. Grouting shall be as specified in Section 03600, Grout.

### 3.05 CRACK REPAIR

- A. Cracks on horizontal surfaces shall be repaired by gravity feeding crack sealant into cracks according to the manufacturer's recommendations. If cracks are less than 1/16-inch thick they shall be pressure injected.
- B. Cracks on vertical surfaces shall be repaired by pressure injecting crack sealant through valves sealed to the surface with crack repair epoxy adhesive according to the manufacturer's recommendations.

### 3.06 CONCRETE SURFACE REPAIR AND/OR EXPOSED REINFORCING REPAIR

- A. All loose, unsound (delaminated), and deteriorated concrete shall be removed by mechanical means.
- B. Saw cut the perimeter of unsound (delaminated) concrete to form a rectangle with straight edges to a depth of 3/4 inch or to the top of the reinforcing, whichever is shallower. Do not cut reinforcing unless otherwise noted.
- C. Chip concrete substrate to obtain a surface profile with new fractured-aggregate surface.
- D. The depth of repair shall be not less than the performance criteria of the specific product used.
- E. Where reinforcing steel with active corrosion is encountered, the procedure shall be as follows:
  1. Remove all contaminants and rust from exposed reinforcing steel.
  2. When half of the diameter of the rebar is exposed, chip out behind the reinforcing steel, 1 inch minimum.
  3. The distance chipped behind the rebar shall be equal to or exceed the minimum placement depth of the material to be used or as indicated on the Drawings.

4. Bars shown to remain in place which are found to have lost more than 15% class sectional area due to corrosion or which are damaged by the concrete removal process so that their cross-sectional area has been reduced by more than 15% shall be replaced with new bars.
- F. Cracks encountered in the substrate in the area of the patch area shall be treated as approved by the Engineer.
  - G. Substrate may be dry or damp but free of standing water.
  - H. Remove dust, laitance, and any foreign particles.
  - I. Spray apply mixed epoxy resin adhesive on the prepared area to receive the Portland cement mortar or concrete in strict compliance with the manufacturer's recommendations.
  - J. While the adhesive coat is still wet (before it is tack-free to the touch) apply polymer-modified cement. The edges shall be vertical and straight.
  - K. For applications greater than 1 inch in depth, apply polymer-modified cement in lifts. Score the top lifts of each lift to produce a roughened surface before applying the next lift. Allow the lift to reach final set before proceeding with the next lift. Adhesive coat shall be applied between each lift.

### 3.07 INSPECTION

- A. At the completion of all repairs, the Contractor, Engineer, and Installers of the material used on the repairs shall inspect the work.

END OF SECTION

## **DIVISION 5**

### **METALS**

**SECTION 05500**  
**METAL FABRICATIONS**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. Furnish all labor, materials, equipment, and incidentals required and install all miscellaneous metal complete as shown on the Drawings and as specified herein.

**1.02 RELATED WORK**

- A. Section 03250, Concrete Joints and Joint Accessories.
- B. Section 03300, Cast-In-Place Concrete.
- C. Section 03600, Grout.
- D. Section 09900, Painting and Coating.
- E. Sluice gates, slide gates, operators, and appurtenances, including wall thimbles, are included in Division 11.
- F. Pipe hangers and sleeves are included in Division 15.
- G. Equipment anchor bolts are included in the respective Sections of Divisions 11 and 15.

**1.03 SUBMITTALS**

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Shop drawings and product data showing materials of construction and details of installation showing sizes of members, method of assembly, anchorage, and connection to other members.
- B. Samples
  - 1. Samples as requested by the Engineer during the course of construction.
- C. Design Data
  - 1. Calculations sealed by a Professional Engineer registered in Florida or submit load tables and test data demonstrating that the railings and their attachments will resist the loads specified in the 2017 Florida Building Code (FBC) at the post spacing provided.
  - 2. Manufacturer's load and deflection tables for grating.

D. Test Reports

1. Certified copy of mill test reports on each aluminum proposed for use showing the physical properties and chemical analysis.

E. Certificates

1. Certification that the railing system is in compliance with OSHA requirements and the 2017 FBC.
2. Certification that the welders have been qualified under AWS, within the previous 12 months, to perform the welds required under this Section.

## 1.04 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be in accordance with the 2017 FBC. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. Aluminum Association (AA)

1. AA ABH-21—Aluminum Brazing Handbook.
2. AA ASD-1—Aluminum Standards and Data.
3. AA DAF-45—Designation System for Aluminum Finishes.
4. AA SAA-46—Standards for Anodized Architectural Aluminum.

B. American Iron and Steel Institute (AISI)

1. AISI/ANSI/AISC 360—Specification for Structural Steel Buildings.

C. American Society for Testing and Materials (ASTM)

1. ASTM A27/A27M—Standard Specification for Steel Castings, Carbon, for General Application.
2. ASTM A36/A36M—Standard Specification for Carbon Structural Steel.
3. ASTM A47/A47M—Standard Specification for Ferritic Malleable Iron Castings.
4. ASTM A48/A48M—Standard Specification for Gray Iron Castings.
5. ASTM A53/A53M—Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
6. ASTM A108—Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
7. ASTM A123/A123M—Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

8. ASTM A153/A153M—Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
9. ASTM A240/A240M—Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
10. ASTM A276/A276M—Standard Specification for Stainless Steel Bars and Shapes.
11. ASTM A307—Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
12. ASTM A489—Standard Specification for Carbon Steel Eyebolts.
13. ASTM A500/A500M—Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
14. ASTM A501/A501M—Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
15. ASTM 536—Standard Specification for Ductile Iron Castings.
16. ASTM A563—Standard Specification for Carbon and Alloy Steel Nuts.
17. ASTM A653/A653M—Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
18. ASTM A666—Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
19. ASTM A780/A780M—Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
20. ASTM A786/A786M—Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
21. ASTM A992/A992M—Standard Specification for Structural Steel Shapes.
22. ASTM A1008/A1008M—Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
23. ASTM B108/B108M—Standard Specification for Aluminum-Alloy Permanent Mold Castings.
24. ASTM B209—Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
25. ASTM B221—Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
26. ASTM B241/B241M—Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.
27. ASTM B633—Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
28. ASTM B695—Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
29. ASTM C1107/C1107M—Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).

30. ASTM D1187/D1187M—Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
31. ASTM E488/E488M—Standard Test Methods for Strength of Anchors in Concrete Elements.
32. ASTM F436/F436M—Standard Specification for Hardened Steel Washers Inch and Metric Dimensions.
33. ASTM F593—Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
34. ASTM F594—Standard Specification for Stainless Steel Nuts.
35. ASTM F836M—Standard Specification for Style 1 Stainless Steel Metric Nuts (Metric).
36. ASTM F879—Standard Specification for Stainless Steel Socket Button and Flat Countersunk Head Cap Screws.
37. ASTM F1154—Standard Practices for Evaluating the Comfort, Fit, Function, and Durability of Protective Ensembles, Ensemble Elements, and Other Components.
38. ASTM F1554—Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
39. ASTM F3125/F3125M—Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1,040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.

D. American Society of Mechanical Engineers (ASME)

1. ASME B18.2.1—Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series).
2. ASME B18.2.3.8M—Metric Hex Lag Screws.
3. ASME B18.6.1—Wood Screws (Inch Series).
4. ASME B18.6.3—Machine Screws, Tapping Screws, and Metallic Drive Screws (Inch Series).
5. ASME B18.6.7M—Metric Machine Screws.
6. ASME B18.21.1—Washes: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series).
7. ASME B18.21.2M—Lock Washers (Metric Series).
8. ASME B18.22.1—Plain Washers.
9. ASME B18.22M—Metric Plain Washers.

E. American Welding Society (AWS)

1. AWS D1.1/D1.1M—Structural Welding Code – Steel.
2. AWS D1.2/D1.2M—Structural Welding Code – Aluminum.
3. AWS D1.3/D1.3M—Structural Welding Code – Sheet Steel.
4. AWS D1.6/D1.6M—Structural Welding Code – Stainless Steel.

- F. Environmental Protection Agency (EPA)
  - 1. EPA Method 24—Determination of Volatile Matter Content, Water Content, Density, Volume Solids, and Weight Solids of Surface Coatings.
- G. Federal Regulations (FR)
  - 1. 40 CFR 59—National Volatile Organic Compound Emission Standards for Consumer and Commercial Products.
- H. Federal Specifications (FS)
  - 1. FS FF-B-575C—Bolts, Hexagon and Square.
- I. 2017 Florida Building Code (FBC)
- J. National Association of Architectural Metal Manufacturers (NAAMM)
  - 1. NAAMM MBG 531—Metal Bar Grating Manual.
- K. Occupational Safety and Health Administration (OSHA)
- L. Society for Protection Coatings (SSPC)
  - 1. SSPC-PA1—Shop, Field, and Maintenance Painting of Steel.
  - 2. SSPC-SP6/NACE No. 3—Commercial Blast Cleaning.
  - 3. SSPC-SP10/NACE No. 2—Near-White Blast Cleaning.
  - 4. SSPC-Paint 20—Zinc-Rich Primers Type I Inorganic and Type II Organic.
  - 5. SSPC-Paint 29—Zinc Dust Sacrificial Primer, Performance-Based.
  - 6. SSPC-Zone 1A—Interior, Normally Dry.
  - 7. SSPC-Zone 1B—Exterior, Normally Dry.

## 1.05 QUALITY ASSURANCE

- A. The work of this Section shall be completely coordinated with the work of other sections. Verify at the site the dimensions and work of other trades adjoining items of work in this Section before fabrication and installation of items herein specified.
- B. Furnish to the pertinent trades all items included under this Section that are to be built into the work of other Sections.

C. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, Structural Welding Code—Steel.
2. AWS D1.2/D1.2M, Structural Welding Code—Aluminum.
3. AWS D1.3/D1.3M, Structural Welding Code—Sheet Steel.
4. AWS D1.6/D1.6M, Structural Welding Code—Stainless Steel.

## 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver items to be incorporated into the work of other trades in sufficient time to be checked before installation.
- B. Repair items that have become damaged or corroded to the satisfaction of the Engineer before incorporating them into the work.

## 1.07 PROJECT REQUIREMENTS

- A. Thermal Movements: Provide exterior metal fabrications that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  1. Temperature Change (Range): 120°F, ambient; 180°F, material surfaces.

## 1.08 PROJECT CONDITIONS

- A. Field Measurements: The Contractor shall verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication and indicate measurements on shop drawings.
  1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
  2. Provide allowance for trimming and fitting at site.

## PART 2 PRODUCTS

### 2.01 GENERAL

- A. The use of the manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.
- B. Like items of materials shall be the end products of one manufacturer to provide standardization for appearance, maintenance, and manufacturer's service.

### 2.02 MATERIALS

- A. Unless otherwise noted, materials for miscellaneous metals shall conform to the following standards:
  1. Structural Steel:
    - a. W Shapes: ASTM A992/A992M, Grade 50.
    - b. M Shapes: ASTM A36/A36M.
    - c. S, C, and MC Shapes: ASTM A36/A36M.
    - d. L Shapes: ASTM A36/A36M.
    - e. Plates, Rods, and Bars: ASTM A36/A36M.
  2. HSS Rectangular Shapes: ASTM A500/A500M, Grade B, 42 ksi.
  3. HSS Round Shapes: ASTM A500/A500M, Grade B, 35 ksi.
  4. Welded and Seamless Steel Pipe: ASTM A501/A501M or ASTM A53/A53M, Type E or S, Grade B, Schedule 40. Use standard malleable iron fittings, galvanized for exterior work.
  5. Steel Sheets: ASTM A1008/A1008M.
  6. Gray Iron Castings: ASTM A48/A48M, Class 35.
  7. Ductile Iron Castings: ASTM A536, Grade 65-45-12.
  8. Aluminum Extruded Pipe: ASTM B241/B241M, Alloy 6063 T6.
  9. Aluminum Extruded Shapes: ASTM B221, Alloy 6061 T6.
  10. Aluminum Sheet and Plate: ASTM B209, Alloy 6061 T6.

11. Stainless Steel Plates, Sheets, and Structural Shapes:
  - a. Exterior, Submerged, or Industrial Use: ASTM A240/A240M, Type 316 (Type 316L for welded).
  - b. Interior and Architectural Use: ASTM A240/A240M, Type 304.
12. Stainless Steel Bolts, Nuts, and Washers: ASTM A276/A276M, Type 316.
13. Carbon Steel Bolts and Studs: ASTM A307, Grade A, or ASTM F1154, Grade 36 (galvanized unless noted otherwise).
14. High Strength Steel Bolts, Nuts, and Washers: ASTM F3125/F3125M (mechanically galvanized in accordance with ASTM B695, Class 50, where noted):
  - a. Elevated Temperature Exposure: Type I.
  - b. General Application: Type I or Type II.
15. Galvanizing: ASTM A123/A123M, Zn w/0.5% minimum Ni.
16. Galvanizing, Hardware: ASTM A153/A153M, Zn w/0.5% minimum Ni.

## 2.03 ANCHORS, BOLTS, AND FASTENERS

- A. Furnish anchors, bolts, fasteners, etc. as necessary for installation of the work of this Section or as specified for securing the work of other Sections.
- B. Anchor bolt material shall be ASTM F1154, Grade 36, or ASTM A307, Grade A standard headed bolts with heavy hex nuts, Grade A washers, hot-dipped galvanized, unless noted otherwise on drawings.
- C. Unless otherwise noted, bolts for the connection of carbon steel or iron shall be steel bolts; bolts for the connection of galvanized steel or iron shall be galvanized steel or stainless steel bolts; and bolts for the connection of aluminum or stainless steel shall be stainless steel bolts.
- D. Unless otherwise noted, expansion anchors shall be zinc-plated carbon steel wedge-type anchors complete with nuts and washers. Type 316 stainless steel wedge-type anchors shall be used where they will be submerged or exposed to the weather or where stainless steel wedge type anchors are required. When the length or embedment of the bolt is not noted on the Drawings, provide length sufficient to place the wedge and expansion sleeve portion of the bolt at least 1 inch behind the concrete reinforcing steel. Expansion anchors shall be Hilti, Kwick-bolt III; ITW Ramset; Redhead trubolt; or equal.

- E. Unless otherwise noted, adhesive anchors shall be a two-component chemical resin anchoring system. Capsules shall be self-contained, exactly premeasured amounts of polyester or vinyl ester resin, aggregate, and hardener. Stud assemblies shall consist of a stainless steel Type 316 all-thread anchor rod with nut and washer. Provide manufacturer's recommended installation tools for installing anchor components. Install anchors in full compliance with the manufacturer's recommendations. Adhesive anchor system shall be Hilti, HIT-RE 500-SD; Simpson Strong Tie, SET-XP Epoxy-Tie or Acrylic Tie; or approved equal.
- F. Anchors used in masonry construction shall be as indicated in Paragraph 2.03B above where anchors are installed into solid grouted cells. Additional, Hilti, HIY-HY70 M adhesive anchoring system, or approved equal, may also be used in grouted masonry construction. When fastening to hollow concrete block or brick, adhesive anchors shall be a three-part stud, screen, and chemical dispenser anchoring system. Adhesive cartridges shall contain premeasured amounts of resin and hardener, which are mixed and deposited in a screen tube by a dispenser. Stud assemblies shall consist of a stainless steel Type 316 all-thread anchor rod with nut and washer. Anchors shall be Hilti, HIT HY-70 System or approved equal.
- G. Automatic end-welded headed anchor studs shall be flux-ended studs made from cold drawn steel, ASTM A108 Grades C-1010 through C-1020. Headed anchor studs shall be Nelson, H4L Headed Concrete Anchors or equal.
- H. Machine bolts and nuts shall conform to FS FF-B-575C. Bolts and nuts shall be hexagon type. Bolts, nuts, screws, washers, and related appurtenances shall be Type 316 stainless steel.
- I. Connection bolts for wood members shall be ASTM A307, galvanized where specified.
- J. Toggle bolts shall be Hilti, Toggler Bolt, or equal.

## 2.04 METAL GRATING

- A. Grating shall have rectangular, 3/16 inch thick bearing bars spaced 1 3/16-inch on center with cross bars spaced at 4 inches on center. All grating panels shall be

banded with a bar the same size as the bearing bars. All grating shall be slip-resistant.

1. Grating shall not exceed the fabricator's maximum recommended span and meet or exceed the following load and deflection criteria for the maximum span length at the opening being covered by the grating.
    - a. The grating shall produce a deflection of 1/360 of the span or less under a uniform live load of 100 lb/sq ft on the maximum span.
    - b. The grating shall produce a deflection of 1/360 of the span or less under a concentrated live load of 300 lb applied at the mid-point of the maximum span.
  2. Openings 2 inches or greater in diameter/dimension and grating edges shall be banded with a bar of the same depth and thickness as the bearing bars. Cut bearing bars or cross bars shall be welded to the banding bar.
  3. Provide trench grating with symmetrical cross bar arrangement.
  4. Grating clamps, nuts, bolts, washers, and other fastening devices for grating and grating supports shall be Type 316 stainless steel. All grating shall be anchored to the supporting system using saddle clips.
- B. Aluminum grating material shall be aluminum alloy 6063-T6 with a mill finish. Cross bars shall be attached to the bearing bars with interlocked swagged joints. The grating shall be Type BS by IKG Borden, Houston, TX; Type 19 SG-4 by Ohio Gratings, Inc., Canton, OH; Type 19S4 by Seidelhuber Metal Products, San Carlos, CA, or equal.
- C. Metal frames and supports for grating shall be of the same material as the grating unless otherwise shown on the Drawings. Where aluminum supports are used, they shall be fabricated from aluminum alloy 6061-T6.

## 2.05 RAILINGS

- A. Guardrails and railing systems shall comply with the requirements of OSHA and the FBC and shall be custom pre-engineered, mechanically fastened or welded-pipe aluminum railing systems. Mechanically fastened railing system shall be TUFrail as provided by Thomson Fabrication Company or equal.
- B. Rails and posts shall be 6061-T6, 6063-T6, or 6105-T5. Splice and reinforcing sleeves, brackets, end caps, toeboards, etc., shall be aluminum alloy 6061-T6, 6063-T6, or 6105-T5 alloy. Cast fittings shall be aluminum alloy No. 214. Railing system fastening hardware shall be Type 316 stainless steel. After welding,

aluminum shall be anodized. All railing, posts, toeboards, and exposed aluminum shall be anodized with a clear architectural Class I satin finish providing a minimum coating thickness of 0.7 mil and a minimum coating weight of 32 milligrams per square inch in compliance with AA M10C22A41.

- C. Railings shall be two-rail welded railing systems, as shown on the Drawings, fabricated with 1-1/2-in nominal diameter pipe. Posts shall be Schedule 80 pipe, and railing shall be Schedule 40 pipe, minimum. Posts and top rails shall be continuous. The top surface of the top railing at all points, including corners and terminations, shall be smooth and shall not be interrupted by projected fittings or posts. Spacing of posts shall not exceed 5-foot on center and shall be uniformly spaced except as otherwise shown on the Drawings. Posts will be required on each side of structure expansion joints. All railing posts shall be vertical.
- D. Welds shall be circumferential welds ground smooth and even to produce a railing that is neat in appearance and structurally sound. Welding methods shall be in conformity with AWS standards for the materials being joined. All rail to post connections shall be coped and fastened by continuous welds. There shall be no burrs, sharp edges, or protrusions on any weld on any part of the handrail system. After fabrication, the welds and surrounding area shall be cleaned and hand buffed to blend with the adjacent finish. All mechanical fasteners shall be unobtrusively located in countersunk holes with the top flush with the surface of the rail. Bends in the railing shall be as indicated by the Drawings. No distortion of the circular railing shape will be allowed. Bends and terminal sections shall be made without the use of fittings. Corner bends shall be mitered and welded bends.
- E. Railing shall be assembled in sections as long as practical but shall not be greater than 24 feet in length. A field splice shall be used when an assembled section is to be attached to another section. Field splices shall be used in all railing panels that cross over structure expansion joints.
  - 1. Field splices shall use internal splice sleeves located within 8 inches of railing posts. The sleeve shall be welded to the rail on one side and fastened with a set screw to the rail on other side. The field splice shall be detailed to take the differential expansion between the railing system and the supporting structure.
  - 2. When the field splice occurs in a railing panel crossing a structure expansion joint, the sleeve shall be welded to the rail on one side and be free to slide in the rail on other side. The field splice shall be detailed to take the same movement as the structure expansion joint.
  - 3. The bases or supports for railing posts and handrail shall be the types indicated on the Drawings.
  - 4. Where non-removable railing is set in concrete, the posts shall be placed in 2 1/2-inch-diameter formed concrete openings and firmly caulked with

- a nonsulphur compound, hydraulic cement equal to Por-Rok by Minwax Construction Products Division Sterling Drug, Montvale, NJ. Collars shall be placed around the post bases and fastened in place with set screws on the side of the post away from the walkway. Posts shall be placed with the centerline 4 inches from the edge of the concrete except that posts shall be set at the centerline of concrete curbs.
5. Aluminum railing posts, which may collect condensation, shall have a 3/16 inch drain hole drilled immediately above the concrete-encased area, the base flange, or supporting socket on the side away from the walking area. The bottom of the rail post between the drain hole and the bottom of the post shall be filled with an inert material such as a compressed closed-cell neoprene rod.
- F. Toeboards shall be provided on all railing adjacent to a drop-in elevation of 4 feet or more. Toeboards are not required on the inclined portion of stairway railings or where concrete or steel curbs, 4 inches or more in height, are present. Toeboards shall be 4-inch high channels of the same material as the railing. The channels shall have a minimum thickness of 1/8 inch and have flanges of not less than 3/4 inch nor more than 1-1/2 inches in width. Toeboards shall be positioned with a maximum clearance of 1/4 inch from the floor and fastened to railing posts with 1/4-inch stainless steel U-bolts, with J-bolts at corner posts and with clip angles and two 1/4-inch stainless steel expansion bolts at walls. Toeboards shall not be welded to the posts. Connection to post shall allow expansion and contracting movements.
- G. All railings shall be properly protected by paper, or by an approved coating or by both against scratching, splashes or mortar, paint, or other defacements during transportation and erection and until adjacent work by other trades has been completed. After protective materials are removed, the surfaces shall be made clean and free from stains, marks, or defects of any kind.
- H. Aluminum shapes, including mounting brackets, in contact with concrete or a different type of metal shall be separated by a 1/32-inch neoprene gasket or provided with a heavy coating of protective zinc chromate for separation of dissimilar materials.
- I. Safety gates, for railing openings, shall be fabricated of matching pipe and rail material and configuration. The gates shall be self-closing gates with approved stop, latch, and stainless steel closure spring and hinges.
- J. Barrier chains, for railing openings, shall be fabricated of stainless steel chains. Chain shall be 1/4 inch stainless steel links, with 11 links per foot as manufactured by Eastern Chain Works, Inc., NY; Lawrence Metal Products, Inc.; or equal. Chains shall be fastened to the handrail posts at the elevation of each

rail. One end of each chain shall be connected to one post with a 1/4-inch-diameter stainless steel eye bolt and the other end shall be connected to the other post by means of a heavy chromium-plated bronze swivel eye slide harness snap and a similar eye bolt.

## 2.06 METAL BOLLARDS

- A. Steel Pipe Bollards: Fabricate pipe bollards from Schedule 80 steel pipe. Fill bollards with concrete.
  - 1. Where bollards are indicated to receive push-button controls for door operators, provide necessary cutouts for push-button controls and hole for wire.
- B. Fabricate bollards with 3/8-inch-thick steel base plates for bolting to concrete slab. Drill baseplates at all four corners for 3/4-inch anchor bolts.
  - 1. Where bollards are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.
- C. Fabricate sleeves for bollard anchorage from steel pipe or tubing with 1/4-inch-thick steel plate welded to bottom of sleeve. Make sleeves no less than 8 inches deep and 3/4 inch larger than OD of bollard.
- D. Fabricate internal sleeves for removable bollards from Schedule 40 steel pipe or 1/4-inch wall-thickness steel tubing with an OD approximately 1/16 inch less than ID of bollards. Match drill sleeve and bollard for 3/4-inch steel machine bolt.

## 2.07 PATTERNED FLOOR PLATES

- A. Design floor plates to withstand a live load of 250 pounds per square foot for the span indicated, with a maximum deflection of L/240.
  - 1. Steel Floor Plates: Conforming to ASTM A786/A786M, minimum 14-gauge, and with G90 galvanized coating.
  - 2. Aluminum Floor Plate: Conforming to ASTM B209, 6061 T6.

## 2.08 ACCESS HATCHES

- A. Access hatches shall have single or double leaf doors as indicated by the Drawings. The doors shall be 1/4-inch aluminum diamond pattern plate with welded stiffeners, as necessary, to withstand a live load of 300 pounds/square foot with a maximum deflection of 1/150th of the span. Hatches shall have a 1/4 inch aluminum channel frame with a perimeter anchor flange or strap anchors for

concrete embedment around the perimeter. Where the hatch is supported by steel framing members, these members shall be modified as needed to support the hatch chosen. This includes the addition of angles, tube members, etc. Unless otherwise noted on the Drawings, use pivot torsion bars for counterbalance or spring operators for easy operation along with automatic door hold open.

Hardware shall be durable and corrosion resistant with Type 316 stainless steel hardware used throughout. Provide removable lock handle. Finish shall be the factory mill finish for aluminum doors and frames with bituminous coating on the exterior of the frames in contact with concrete. Hatches shall be watertight and have a 1 1/2-inch drainage coupling to the channel frame. Access hatches shall be types as indicated on the Drawings by Bilco Company, New Haven, CT, or equal.

## 2.09 MISCELLANEOUS ALUMINUM

- A. All miscellaneous metal work shall be formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability. Holes shall be drilled or punched. Edges shall be smooth and without burrs. Fabricate supplementary pieces necessary to complete each item though such pieces are not definitely shown or specified.
- B. Connections and accessories shall be of sufficient strength to safely withstand the stresses and strains to which they will be subjected. Exposed joints shall be close-fitting and jointed where least conspicuous. Threaded connections shall have the threads concealed where practical. Welded connections shall have continuous welds or intermittent welds as specified or shown. The face of welds shall be dressed flush and smooth. Welding shall be on the unexposed side as much as possible to prevent pitting or discoloration of the aluminum exposed surface. Grind smooth continuous welds that will be exposed. Provide holes for temporary field connections and for attachment of the work of other trades.
- C. Miscellaneous aluminum items shall include: beams, angles, closure angles, grates, hatches, floor plates, stop plates, stair nosings, and any other miscellaneous aluminum called for on the Drawings and not otherwise specified.
- D. Angle frames for hatches, beams, grates, etc., shall be complete with welded strap anchors attached.
- E. Aluminum diamond plate and floor plate shall have a minimum thickness of 3/8 inch. Frames and supports shall be of aluminum construction. Fastening devices and hardware shall be Type 304 stainless steel. Plates shall have a mill finish.
- F. Stair treads for aluminum stairs shall have abrasive non-slip nosing as approved.

- G. Aluminum nosing at concrete stairs shall be Wooster Products, Inc.; Alumogrit Treads, Type 116; similar by Barry Pattern and Foundry Co.; Andco; or equal. Furnish with wing type anchors and flat head stainless steel machine screws, 12 inches on center. Nosing shall also be used at concrete ladder openings. Nosing shall a single piece for each step extending to within 3 inches at each side of stair or full ladder width. Set nosing flush with stair tread finish at concrete stairs. Furnish treads with heavy duty protective tape cover.
- H. Miscellaneous aluminum items shall have a cleaned and degreased mill finish.

## 2.10 MISCELLANEOUS STEEL

- A. All miscellaneous metal work shall be formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture, and free from defects impairing strength or durability. Holes shall be drilled or punched. Edges shall be smooth and without burrs. Fabricate supplementary pieces necessary to complete each item though such pieces are not definitely shown or specified.
- B. Connections and accessories shall be of sufficient strength to safely withstand the stresses and strains to which they will be subjected. Exposed joints shall be close fitting and jointed where least conspicuous. Threaded connections shall have the threads concealed where practical. Welded connections shall have continuous welds or intermittent welds as specified or shown. The face of welds shall be dressed flush and smooth. Grind smooth continuous welds that will be exposed. Provide holes for temporary field connections and for attachment of the work of other trades.
- C. Miscellaneous steel items shall include beams, angles, lintels, metal stairs, support brackets, base plates for other than structural steel or equipment, closure angles, bridge crane rails, monorail hoist beams, holddown straps and lugs, door frames, splice plates, subframing at roof openings, and any other miscellaneous steel called for on the Drawings and not otherwise specified.
- D. Structural steel angle and channel door frames shall be shop coated with primer. Frames shall be fabricated with not less than three anchors on each jamb.
- E. Steel pipe pieces for sleeves, lifting attachments, and other functions shall be Schedule 40 pipe unless otherwise shown on the Drawings. Wall and floor sleeves of steel pipe shall have welded circumferential steel waterstops at mid-length.
- F. Lintels, relief angles, or other steel supporting masonry or embedded in masonry shall be shop coated with primer.

- G. All steel finish work shall be thoroughly cleaned, by effective means, of all loose mill scale, rust, and foreign matter and shall be given one shop coat of primer compatible with the finish coat after fabrication but before shipment. Paint shall be omitted within 3 inches of proposed field welds. Paint shall be applied to dry surfaces and shall be thoroughly and evenly spread and well worked into joints and other open spaces.
- H. Galvanizing, where required, shall be the hot-dip zinc process after fabrication. Coating shall be not less than 2 ounces/square foot of surface.

## 2.11 MISCELLANEOUS STAINLESS STEEL

- A. All miscellaneous metal work shall be formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture, and free from defects impairing strength or durability. Holes shall be drilled or punched. Edges shall be smooth and without burrs. Fabricate supplementary pieces necessary to complete each item though such pieces are not definitely shown or specified.
- B. Connections and accessories shall be of sufficient strength to safely withstand the stresses and strains to which they will be subjected. Exposed joints shall be close-fitting and jointed where least conspicuous. Threaded connections shall have the threads concealed where practical. Welded connections shall have continuous welds or intermittent welds as specified or shown. The face of welds shall be dressed flush and smooth. Grind smooth continuous welds that will be exposed. Provide holes for temporary field connections and for attachment of the work of other trades.
- C. Miscellaneous stainless steel items shall include: beams, angles, bar racks, and any other miscellaneous stainless steel called for on the Drawings and not otherwise specified.

## PART 3 EXECUTION

### 3.01 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded

because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

- C. Field Welding: Comply with the following requirements:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. All steel surfaces that come into contact with exposed concrete or masonry shall receive a protective coating of an approved heavy bitumastic troweling mastic applied in accordance with the manufacturer's instructions before installation.
- G. Where aluminum contacts a dissimilar metal, apply a heavy brush coat of zinc-chromate primer followed by two coats of aluminum metal and masonry paint to the dissimilar metal.
- H. Where aluminum contacts masonry or concrete, apply a heavy coat of approved alkali-resistant paint to the masonry or concrete.
- I. Where aluminum contacts wood, apply two coats of aluminum metal and masonry paint to the wood.
- J. Between aluminum grating, aluminum stair treads, or aluminum handrail brackets and steel supports, insert 1/4-inch-thick neoprene isolator pads, 85 plus or minus 5 Shore A durometer, sized for full width and length of bracket or support.
- K. Specialty products shall be installed in accordance with the manufacturer's recommendations.

- L. Expansion bolts shall be checked for tightness a minimum of 24 hours after initial installation.
- M. Install adhesive anchors using manufacture's recommended drive units and adapters and in compliance with the manufacturer's recommendations.
- N. All railings shall be erected to line and plumb with tightly fitted joints proving smooth transitions. For mechanically fastened systems, provide gaps between connecting members no greater than 1/8 inch unless at designated expansion joints.

### 3.02 INSTALLING METAL BOLLARDS

- A. Anchor bollards to existing construction with anchor bolts. Provide four 3/4-inch bolts at each bollard, unless otherwise indicated.
  - 1. Embed anchor bolts at least 4 inches in concrete.
- B. Anchor bollards in concrete in formed or core-drilled holes not less than 8 inches deep and 3/4 inch larger than OD of bollard. Fill annular space around bollard solidly with nonshrink, nonmetallic grout mixed and placed to comply with the grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward bollard.
- C. Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches above the bottom of the excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until the concrete has cured.
- D. Anchor internal sleeves for removable bollards in formed or core-drilled holes not less than 8 inches deep and 3/4 inch larger than OD of sleeve. Fill annular space around internal sleeves solidly with nonshrink, nonmetallic grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward internal sleeve.
- E. Anchor internal sleeves for removable bollards in place with concrete footings. Center and align sleeves in holes 3 inches above the bottom of the excavation. Place concrete and vibrate or tamp for consolidation. Support and brace sleeves in position until concrete has cured.
- F. Place removable bollards over internal sleeves and secure with 3/4-inch machine bolts and nuts. After tightening nuts, drill holes in bolts for inserting padlocks. The Owner will furnish padlocks.

G. Fill bollards solidly with concrete, mounding top surface to shed water.

1. Do not fill removable bollards with concrete.

### 3.03 INSTALLING BEARING AND LEVELING PLATES

- A. The Contractor shall clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean the bottom surface of bearing plates.
- B. Set loose leveling and bearing plates on wedges or other adjustable devices. After the bearing members have been positioned and plumbed, tighten the anchor bolts. Do not remove wedges or shims, but if they are protruding cut off flush with the edge of the bearing plate before packing with grout.
  1. Use non-shrink, metallic grout in concealed locations where not exposed to moisture; use non-shrink, nonmetallic grout in exposed locations, unless otherwise indicated.
  2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

### 3.04 ADJUSTING AND CLEANING

The Contractor shall do the following:

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
  1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 9, Finishes.
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION

## **DIVISION 9**

### **FINISHES**

**SECTION 09900**  
**PAINTING AND COATING**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

A. This Section includes materials for and application of painting and coating systems for the following surfaces:

1. Submerged metal.
2. Exposed metal.
3. Buried metal.
4. Submerged concrete and masonry.
5. Exposed concrete and masonry.
6. PVC, CPVC, and FRP.
7. Nonferrous, galvanized, and other miscellaneous metals.

B. Contractor to coordinate with Section 03180, Concrete Coating System, where indicated herein.

**1.02 SUBMITTALS**

A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance.

B. Submit manufacturer's data sheets showing the following information:

1. Percent solids by volume (sbv).
2. Minimum and maximum recommended dry-film thickness per coat for prime, intermediate, and finish coats.
3. Recommended surface preparation.
4. Recommended thinners.
5. Statement verifying that the specified prime coat is recommended by the manufacturer for use with the specified intermediate and finish coats.
6. Application instructions including recommended equipment and temperature limitations.
7. Curing requirements and instructions.

C. Submit color swatches.

- D. Submit certificate identifying the type and gradation of abrasives used for surface preparation.
- E. Submit material safety data sheets for each coating.

## 1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American Architectural Manufacturers Association (AAMA)
  - 1. AAMA 2604—Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).
- B. American Association of State Highway and Transportation Officials (AASHTO)
  - 1. AASHTO T-259—Standard Method of Test for Resistance of Concrete to Chloride Ion Penetration.
- C. American Society for Testing and Materials (ASTM)
  - 1. ASTM A780/A780M—Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
  - 2. ASTM B117—Standard Practice for Operating Salt Spray (Fog) Apparatus.
  - 3. ASTM C67/C67M—Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
  - 4. ASTM C97/C97M—Standard Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone.
  - 5. ASTM C140/C140M—Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
  - 6. ASTM C307—Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings.
  - 7. ASTM C501—Standard Test Method for Relative Resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser.
  - 8. ASTM C518—Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Apparatus.
  - 9. ASTM C579—Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.

10. ASTM C580—Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concrete.
11. ASTM C793—Standard Test Method for Effects of Laboratory Accelerated Weathering on Elastomeric Joint Sealants.
12. ASTM D520—Standard Specification for Zinc Dust Pigment.
13. ASTM D522/D522M—Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings.
14. ASTM D638—Standard Test Method for Tensile Properties of Plastics.
15. ASTM D695—Standard Test Method for Compressive Properties of Rigid Plastics.
16. ASTM D790—Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
17. ASTM D870—Standard Practice for Testing Water Resistance of Coatings Using Water Immersion.
18. ASTM D1002—Standard Test Method for Apparent Shear Strength of Single-Lap-Joint Adhesively Bonded Metal Specimens by Tension Loading (Metal-to-Metal).
19. ASTM D1014—Standard Practice for Conducting Exterior Exposure Tests of Paints and Coatings on Metal Substrates.
20. ASTM D2240—Standard Test Method for Rubber Property—Durometer Hardness.
21. ASTM D2370—Standard Test Method for Tensile Properties of Organic Coatings.
22. ASTM D2697—Standard Test Method for Volume Nonvolatile Matter in Clear or Pigmented Coatings.
23. ASTM D2794—Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
24. ASTM D3273—Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
25. ASTM D3734—Standard Specification for High-Flash Aromatic Naphthas.
26. ASTM D4060—Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.
27. ASTM D4138—Standard Practices for Measurement of Dry Film Thickness of Protective Coating Systems by Destructive, Cross-Sectioning Means.
28. ASTM D4141/D4141M—Standard Practice for Conducting Black Box and Solar Concentrating Exposures of Coatings.
29. ASTM D4258—Standard Practice for Surface Cleaning Concrete for Coating.
30. ASTM D4260—Standard Practice for Liquid and Gelled Acid Etching of Concrete.

31. ASTM D4261—Standard Practice for Surface Cleaning Concrete Masonry Units for Coating.
32. ASTM D4263—Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
33. ASTM D4541—Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
34. ASTM D4585/D4585M—Standard Practice for Testing Water Resistance of Coatings Using Controlled Condensation.
35. ASTM D4587—Standard Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings.
36. ASTM D4787—Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates.
37. ASTM D5590—Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay.
38. ASTM D5894—Standard Practice for Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog-Dry Cabinet and a UV/Condensation Cabinet).
39. ASTM D6386—Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting.
40. ASTM D6695—Standard Practice for Xenon-Arc Exposures of Paint and Related Coatings.
41. ASTM D7091—Standard Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals.
42. ASTM D7234—Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers.
43. ASTM E84—Standard Test Method for Surface Burning Characteristics of Building Materials.
44. ASTM F1869—Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
45. ASTM G210—Standard Practice for Operating the Severe Wastewater Analysis Testing Apparatus.

D. American Water Works Association (AWWA)

1. AWWA C203—Coal-Tar Protective Coatings and Linings for Steel Water Pipelines – Enamel and Tape – Hot Applied.
2. AWWA C209—Cold-Applied Tape Coatings for Steel Water Pipe, Special Sections, Connections, and Fittings.

- E. British Standards Institution (BSI)
  - 1. BS EN 598—Ductile Iron Pipes, Fittings, Accessories, and their Joints for Sewerage Applications – Requirements and Test Methods.
- F. National Association of Corrosion Engineers International (NACE)
  - 1. NACE SP0188—Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.
  - 2. NACE TM0174—Laboratory Methods for the Evaluation of Protective Coatings and Lining Materials on Metallic Substrates in Immersion Service.
- G. NSF International (NSF)
  - 1. NSF 61—Drinking Water System Components – Health Effects.
- H. Society for Protective Coatings (SSPC) and National Association of Corrosion Engineers (NACE)
  - 1. SSPC PA-1—Shop, Field, and Maintenance Painting of Steel.
  - 2. SSPC PA-2—Procedure for Determining Conformance to Dry Coating Thickness Requirements.
  - 3. SSPC SP-1—Solvent Cleaning.
  - 4. SSPC SP-2—Hand Tool Cleaning.
  - 5. SSPC SP-3—Power Tool Cleaning.
  - 6. SSPC SP-5/NACE No. 1—White Metal Blast Cleaning.
  - 7. SSPC SP-6/NACE No. 3—Commercial Blast Cleaning.
  - 8. SSPC SP-7/NACE No. 4—Brush-Off Blast Cleaning.
  - 9. SSPC SP-8—Pickling.
  - 10. SSPC SP-10/NACE No. 2—Near-White Blast Cleaning.
  - 11. SSPC SP-11—Power Tool Cleaning to Bare Metal.
  - 12. SSPC SP-12/NACE No. 5—High- and Ultra-High-Pressure Water Jetting.
  - 13. SSPC SP-13/NACE No. 6—Surface Preparation of Concrete.
    - a. ICRI CSP1-6—Concrete Surface Profile 1 – 6.
  - 14. SSPC SP-14/NACE No. 8—Industrial Blast Cleaning.
  - 15. SSPC SP WJ-1—Waterjet Cleaning of Metals – Clean to Bare Substrate.
  - 16. SSPC SP WJ-2—Waterjet Cleaning of Metals – Very Thorough Cleaning.
  - 17. SSPC SP WJ-3—Waterjet Cleaning of Metals – Thorough Cleaning.
  - 18. SSPC SP WJ-4—Waterjet Cleaning of Metals – Light Cleaning.

I. US Department of Defense (MIL)

1. MIL-C-5541—Chemical Conversion Coatings on Aluminum and Aluminum Alloys.
2. MIL-C-18480B—Coating Compound, Bituminous, Solvent, Coal-Tar Base.
3. MIL-D-3134—Deck Covering Materials.
4. MIL-DTL-24441—General Specification for Paint, Epoxy-Polyamide.
5. MIL-P-21035—Paint High Zinc Dust Content, Galvanizing Repair.

PART 2 MATERIALS

2.01 PAINTING AND COATING SYSTEMS

The following index lists the various painting and coating systems by service and generic type:

| PAINT COATINGS SYSTEM INDEX               |  |  |
|---|--|--|
| No.                                       | Title  | Generic Coating                                    |
| Submerged Metal Coating Systems           |  |  |
| 1.  | Submerged Metal, Severe Wastewater Environments with Elevated H <sub>2</sub> S Levels, Raw Water (Nonpotable), Raw Sewage, or Chemical Waste Immersion | Modified polyamine epoxy                           |
| 2.  | Submerged Metal, Mild to Moderate Wastewater, Raw Water (Nonpotable) or Raw Sewage in Aerobic Environments   | Zinc+MIO blend urethane/Cycloaliphatic amine epoxy |
| 5.  | Submerged Metal Requiring Extremely High Abrasion Resistance, Raw Sewage or Grit Slurries  | Epoxy-ceramic                                      |
| Exterior/UV-Exposed Metal Coating Systems |  |  |
| 11.                                       | Exposed Metal, Non-Immersion, Difficult to Maintain Areas with High UV Exposure  | Zinc-rich urethane/epoxy/fluoropolymer             |
| 12.                                       | Exposed Metal, Non-Immersion Environment   | Epoxy/epoxy/aliphatic acrylic urethane             |
| 13.                                       | Exposed Metal, Mild Environment, Exposed to Atmospheric Weathering and Water Condensation  | Zinc+MIO blend/acrylic/acrylic                     |
| 14.                                       | Exposed Metal, Organic Zinc Primer for Shop Coating and Field Touch-Up   | Zinc-rich urethane                                 |
| Buried Metal Coating Systems              |  |  |
| 21.                                       | Buried Metal   | Epoxy/epoxy/epoxy                                  |
| 22.                                       | Buried Metal   | Corrosion-resisting grease                         |
| 23.                                       | Buried Metal   | Thixotropic coal-tar pitch                         |

| PAINT COATINGS SYSTEM INDEX   |   |  |
|---|---|--|
| No.   | Title   | Generic Coating  |
| 24.   | Buried Metal Piping and Tubing  | Coal-tar, wax, and polyethylene tape wrap or extruded polyethylene |
| <b>Submerged Concrete and Masonry Coating Systems</b>   |   |  |
| 31.   | Anaerobic Severe Wastewater Environments with Elevated H <sub>2</sub> S Levels, Raw Water (Nonpotable), Raw Sewage, or Chemical Waste Immersion | Modified aliphatic amine epoxy mortar/modified polyamine epoxy     |
| 32.   | Exposed Concrete and Masonry, Mild to Moderate Corrosive Environment  | Cycloaliphatic amine epoxy primer, intermediate, and finish        |
| 33.   | Submerged Concrete, Potable Water, Single-Coat System   | Modified polyamine epoxy   |
| 34.   | Submerged Concrete, Potable Water, Three-Coat System  | Polyamide epoxy  |
| <b>Exterior/UV-Exposed Concrete and Masonry Coating Systems</b>                                       |   |  |
| 41.   | New or Bare Concrete and Masonry, Atmospheric Weathering Environment  | Modified waterborne acrylate/modified waterborne acrylate          |
| 42.   | Existing or Coating Concrete and Masonry, Atmospheric Weathering Environment  | Acrylic emulsion/acrylic emulsion                                  |
| 44.   | Clear Sealer on Exterior Concrete and Masonry   | Siloxane/silane with diffused quartz carbide                       |
| 45.   | Exposed Masonry or Concrete, Atmospheric Weathering Environment   | Cementitious waterproofing grout                                   |
| <b>PVC, CPVC, and FRP Coating Systems</b>   |   |  |
| 51.   | PVC, CPVC, and FRP, Ultraviolet Exposure or Color Coding  | Epoxy/aliphatic acrylic polyurethane                               |
| <b>Nonferrous, Galvanized, and Other Miscellaneous Metals Coating Systems</b>                         |   |  |
| 62.   | Galvanized Steel, Stainless Steel, Aluminum, or Copper  | Polyamide epoxy primer and finish                                  |
| <b>Interior Plaster, Wood, Masonry, Stucco, Steel, and Drywall Coating Systems (NOT USED)</b>         |   |  |
| <b>Fusion Epoxy-Coated Steel Surface Coating Systems (NOT USED)</b>                                   |   |  |
| <b>Stains, Sealers, and Lacquers for Shingles and Bare Wooden Surfaces Coating Systems (NOT USED)</b> |   |  |
| <b>High-Temperature/Thermal Coating Systems for Metals (NOT USED)</b>                                 |   |  |
| <b>Resinous Flooring Coating System (NOT USED)</b>  |   |  |

- A. These systems are specified in detail in the following paragraphs. For each system, the required surface preparation, coating materials, and thickness are described.

- B. Only products of one manufacturer may be used throughout any particular coating system.
- C. The following products are listed as a reference standard for this Section. All high-performance coatings shall be a product of Tnemec International or Induron. No other manufacturers will be permitted with prior approval of the Engineer.
- D. To be considered for approval, potential alternate products must:
  - 1. Be submitted by the manufacturer a minimum of 10 days before the project bid date to allow time for review.
  - 2. Be the same generic type and have the same solids by volume (sbv).
  - 3. Maintain the specified total dry film thickness.
  - 4. Meet or exceed the performance criteria of the originally specified coatings in Article 2.02 of this Section.
  - 5. Include a side-by-side comparison of equality including generic coating description, volume solids, ASTM performance test results, etc.
  - 6. Be endorsed by the manufacturer for their intended use on the project.
- E. All dry film thicknesses in the coating systems below are listed in mils.
- F. Submerged Metal Coating Systems
  - 1. System No. 1—Submerged Metal, Severe Wastewater Environments with Elevated H<sub>2</sub>S Levels, Raw Water (Nonpotable), Raw Sewage, or Chemical Waste Immersion:
    - a. Type: Tnemec Series 435 Perma-Glaze Modified Polyamine Epoxy (100% sbv) at 30.0 to 40.0 mils.
    - b. Service Conditions: For use with metal pipes or structures (such as scum troughs, sluice gates, or piping) alternately submerged in raw sewage or raw water (nonpotable) and exposed to a moist saturated hydrogen sulfide (H<sub>2</sub>S) atmosphere, as in raw sewage wet wells.
    - c. Surface Preparation: Average blast profile to be 3.0 mils. Solvent clean in accordance with SSPC SP-1 to remove contaminants from the surface. Abrasive blast in accordance with SSPC SP-5/NACE No. 1.
    - d. Prime Coat: Tnemec Series 435 Perma-Glaze at 15.0 to 20.0 mils.
    - e. Finish Coat: Tnemec Series 435 Perma-Glaze at 15.0 to 20.0 mils.

2. System No. 2—Submerged Metal, Mild to Moderate Wastewater, Raw Water (Nonpotable) or Raw Sewage in Aerobic Environments:
  - a. Type: Tnemec Series 104 Cycloaliphatic Amine Epoxy (82% sbv) with a Series 1 Omnithane Zinc/Micaceous Iron Oxide Blend Modified Aromatic Polyurethane Primer (61% sbv) at a total film thickness of 14.5 to 19.5 mils.
  - b. Service Conditions: For use with metal pipes or structures (such as scum troughs, sluice gates, clarifier mechanisms, or piping) continuously submerged in mild to moderate (aerobic) wastewater conditions, such as clarifiers, chlorine contact basins, aeration basins, settling basins, and other open-top structures.
  - c. Surface Preparation: Solvent clean in accordance with SSPC SP-1 to remove contaminants from the surface; abrasive blast in accordance with SSPC SP-10/NACE No. 2.
  - d. Prime Coat: Tnemec Series 1 Omnithane at 2.5 to 3.5 mils.
  - e. Stripe Coat (Weld Seams and Edges): Tnemec Series 104 Hi-Build Epoxoline at 4.0 to 6.0 mils.
  - f. Intermediate Coat: Tnemec Series 104 Hi-Build Epoxoline at 6.0 to 8.0 mils.
  - g. Finish Coat: Tnemec Series 104 Hi-Build Epoxoline at 6.0 to 8.0 mils.
3. System No. 5—Submerged Metal Requiring Extremely High Abrasion Resistance, Raw Sewage or Grit Slurries:
  - a. Type: Two-component epoxy resin/ceramic having 100% volume solids and having the following characteristics:

|                                      |                                    |
|--------------------------------------|------------------------------------|
| Tensile shear adhesion (ASTM D1002): | 2,500 psi (min)                    |
| Shore D hardness (minimum):          | 85                                 |
| Abrasion resistance (ASTM D4060):    | 0.8 mg (max) loss per 1,000 cycles |
  - b. Service Conditions: For use as a lining for pump volutes, pump impellers, piping, valves, and heat exchanger tubes subject to severe abrasion service.
  - c. Surface Preparation: Solvent clean in accordance with SSPC SP-1 to remove contaminants from the surface. Abrasive blast in accordance with SSPC SP-10/NACE No. 2.
  - d. Coating System: Apply two coats (each a different color) to a minimum thickness of 10 mils per coat. Minimum total coating

thickness shall be 20 mils. Product: THORTEX Cerami-Tech C.R. as applied by Western Industrial Technology, Inc., Fullerton, California, or Paragon Industries, Horsham, Pennsylvania; Belzona 1341; or equal.

## G. Exterior/UV-Exposed Metal Coating Systems

1. System No. 11—Exposed Metal, Non-Immersion, Difficult to Maintain Areas with High UV Exposure:
  - a. Type: Tnemec Series 700 Hydroflon Advanced Thermoset Solution Fluoropolymer finish (60% sbv) with a Series 90-97 Tneme-Zinc Zinc-rich aromatic urethane primer (63% sbv) and a Series 66 Hi-Build Epoxoline Polyamide Epoxy intermediate coat (56% sbv) at a total film thickness of 7.5 to 12.5 mils.
  - b. Service Conditions: For use with metal structures or pipes subjected to UV exposure, which are especially difficult to maintain or are otherwise in need of extremely long maintenance cycles (such as aerial crossings, elevated tanks, and surfaces with custom artwork).
  - c. Surface Preparation: Solvent clean in accordance with SSPC SP-1 to remove contaminants from the surface. Abrasive blast in accordance with SSPC SP-6/NACE No. 3.
  - d. Prime Coat: Tnemec Series 90-97 Tneme-Zinc at 2.5 to 3.5 mils. For a single-component solution, Series 90G-1k97 may be substituted as the primer at the same thickness.
  - e. Stripe Coat (Weld Seams, Edges): Tnemec Series 66 Hi-Build Epoxoline at 2.0 to 5.0 mils.
  - f. Intermediate Coat: Tnemec Series 66 Hi-Build Epoxoline at 3.0 to 6.0 mils.
  - g. Finish Coat: Tnemec Series 700 Hydroflon at 2.0 to 3.0 mils. Series 700 is gloss. For a semi-gloss sheen, Series 701 Hydroflon may be substituted for the finish coat at the same thickness.
2. System No. 12—Exposed Metal, Non-Immersion Environment:
  - a. Type: Tnemec Series 1095 Endura-Shield Aliphatic Acrylic Polyurethane finish (66% sbv) with a Series 66 Hi-Build Epoxoline Polyamide Epoxy (56% sbv) primer and intermediate coat at a total film thickness of 8.5 to 17.0 mils.
  - b. Service Conditions: For use with metal structures or pipes subjected to non-immersion conditions, where high-performance corrosion resistance, high-performance color and gloss retention, or resistance to chemical vapors are desired. This system is not

- suitable for areas of high H<sub>2</sub>S concentrations or other similar extremely corrosive atmospheres.
- c. Surface Preparation: Solvent clean in accordance with SSPC SP-1 to remove contaminants from the surface. Abrasive blast in accordance with SSPC SP-6/NACE No. 3.
  - d. Prime Coat: Tnemec Series 66 Hi-Build Epoxoline at 3.0 to 6.0 mils.
  - e. Intermediate Coat: Tnemec Series 66 Hi-Build Epoxoline at 3.0 to 6.0 mils.
  - f. Finish Coat: Tnemec Series 1095 Endura-Shield at 2.5 to 3.0 mils. Series 1095 is semi-gloss. For a different sheen, apply Series 1094 (gloss) or Series 1096 (eggshell) at the same thickness.
3. System No. 13—Exposed Metal, Mild Environment, Exposed to Atmospheric Weathering and Water Condensation:
- a. Type: Tnemec Series 1029 Enduratone HDP Acrylic Polymer (40% sbv, 100% acrylic resin) with a Series 1 Omnithane Zinc/Micaceous Iron Oxide Blend Modified Aromatic Polyurethane Primer (61% sbv) at a total film thickness of 6.5 to 9.5 mils.
  - b. Service Conditions: For use on interior and exterior metal and piping subject to sunlight, weathering, and water condensation.
  - c. Surface Preparation: Solvent clean in accordance with SSPC SP-1 to remove contaminants from the surface. Abrasive blast to a minimum cleaning in accordance with SSPC SP-6/NACE No. 3. SSPC SP-10/NACE No. 2 is preferred.
  - d. Prime Coat: Tnemec Series 1 Omnithane at 2.5 to 3.5 mils.
  - e. Intermediate Coat: Tnemec Series 1029 Enduratone at 2.0 to 3.0 mils. Series 1029 is low semi-gloss. For a different finish, apply Series 1026 (matte) or Series 1028 (gloss) at the same thickness.
  - f. Finish Coat: Tnemec Series 1029 Enduratone at 2.0 to 3.0 mils. Series 1029 is low semi-gloss. For a different sheen, apply Series 1026 (matte) or Series 1028 (gloss) at the same thickness.
4. System No. 14—Exposed Metal, Organic Zinc Primer for Shop Coating and Field Touch-Up:
- a. Type: Tnemec Series 90-97 Tneme-Zinc aromatic zinc-rich urethane (63% sbv, 83% zinc) primer at a dry film thickness of 2.5 to 3.5 mils.

- b. Service Conditions: For use as a shop-applied primer or field touch-up primer over inorganic zinc prime coatings on exposed metal.
- c. Surface Preparation: Solvent clean in accordance with SSPC SP-1 to remove contaminants from the surface. Abrasive blast in accordance with SSPC SP-10/NACE No. 2.
- d. Coating: Tnemec Series 90-97 at 2.0 to 3.5 mils. For single-component application, apply Series 90G-1K97 at the same thickness instead.

## H. Buried Metal Coating Systems

### 1. System No. 21—Buried Metal:

- a. Type: Tnemec Series N140 Pota-Pox Plus Polyamidoamine Epoxy (67% sbv) primer, intermediate and finish coat with a UV-stable fourth coat for exposed non-immersion areas. Total film thickness without fourth coat is 8.0 to 22.0 mils.
- b. Service Conditions: Buried metal, such as pipe exteriors, valves, flanges, bolts, nuts, structural steel, and fittings.
- c. Surface Preparation: Solvent clean in accordance with SSPC SP-1 to remove contaminants from the surface. Abrasive blast in accordance with SSPC SP-10/NACE No. 2.
- d. Prime Coat: Tnemec Series N140 at 2.0 to 10.0 mils.
- e. Intermediate Coat: Tnemec Series N140 Pota-Pox Plus at 3.0 to 6.0 mils.
- f. Finish Coat: Tnemec Series N140 Pota-Pox Plus at 3.0 to 6.0 mils.
- g. UV-Stable Fourth Coat (UV-exposed, non-immersion areas): Tnemec Series 1095 Endura-Shield at 2.5 to 5.0 mils. Series 1095 is semi-gloss. For a different sheen, apply Series 1094 (gloss) or Series 1096 (eggshell) at the same thickness.

### 2. System No. 22—Buried Metal:

- a. Type: Corrosion-resisting grease.
- b. Service Conditions: Buried metal, such as bolts, bolt threads, tie rods, and nuts.
- c. Surface Preparation: Solvent clean in accordance with SSPC SP-1 to remove contaminants from the surface. Power tool clean in accordance with SSPC SP-3 as a minimum. Abrasive blasting in accordance with SSPC SP-6/NACE No. 3 is preferred.
- d. Coating: NO-OX-ID GG-2 as manufactured by Sanchem, Inc. Apply to a minimum thickness of 1/4 inch.

3. System No. 23—Buried Metal:
  - a. Type: Thixotropic, coal-tar pitch having minimum volume solids of 68% and complying with MIL-C-18480B.
  - b. Service Conditions: Buries metal, such as pipe exteriors, flanges, nuts, bolts, and fittings. This system is not to be used if there are areas aboveground or areas receiving additional coatings.
  - c. Surface Preparation: Solvent clean in accordance with SSPC SP-1 to remove contaminants from the surface. Abrasive blast in accordance with SSPC SP-6/NACE No. 3.
  - d. Multiple Coats: Apply two to three coats of CarboLine Bitumastic 50 or Tnemec Series 46-465, to a total thickness of 30 mils.
4. System No. 24—Buried Metal Piping and Tubing:
  - a. Type: Cold-applied coal-tar tape or hot-applied coal-tar tape.
  - b. Service Conditions: Buried ferrous and nonferrous piping and tubing.
  - c. Coat with one of the following systems:
    - (1) Wrap with cold-applied coal-tar tape conforming to AWWA C209. Minimum thickness of tape shall be 35 mils. Apply tape with manufacturer's prime coat. Tape shall be Tapecoat CT, Protecto-Wrap 200, or equal.
    - (2) Wrap with hot-applied coal-tar tape conforming to AWWA C203, Section 4.6. Minimum thickness of tape shall be 50 mils. Apply tape with manufacturer's recommended prime coat. Tape shall be Tapecoat 20, Protecto-Wrap 110, or equal.
  - d. Use chloride-free primers with the above coatings when applying to stainless steel piping or tubing.
  - e. Coat field joints of buried piping that has a shop-applied coating with primer and tape conforming to AWWA C209. Use Type 1 tape of 35-mil thickness. Products: Protection Engineering Co. Protectowrap 200 GT, Tapecoat CT10/40W, Polyken 930-35, or equal.
  - f. Perform electrical inspection of shop- and field-coating in accordance with Section 5 of AWWA C209.

- g. Install buried pipes with wrapped coatings by extending the wrapping to the first joint after entering a building, penetrating a slab, or 6 inches above finished grade. Wrap joints spirally with a minimum overlap of 50% of the tape width.

## I. Submerged Concrete and Masonry Coating Systems

- 1. System No. 31—Anaerobic Severe Wastewater Environments with Elevated H<sub>2</sub>S Levels, Raw Water (Nonpotable), Raw Sewage, or Chemical Waste Immersion:
  - a. Type: Tnemec Series 435 Perma-Glaze Modified Polyamine Epoxy (100% sbv) finish coat with a Series 434 Perma-Shield H<sub>2</sub>S Modified Aliphatic Amine Epoxy Mortar (100% sbv) base coat at a total film thickness of 143.0 mils.
  - b. Service Conditions: Concrete and masonry exposed to raw sewage or raw water (nonpotable) in anaerobic environments and exposed to a moist saturated hydrogen sulfide (H<sub>2</sub>S) atmosphere, as in raw sewage wet wells, lift stations, headworks, and all other closed-top (anaerobic) wastewater structures, including those with odor control systems.
  - c. Surface Preparation: In accordance with Article 3.04. Clean to an ICRI CSP 5 standard.
  - d. Resurfacing: Apply Tnemec Series 218 to all surfaces to mitigate outgassing and provide a smooth paintable surface. For localized repairs of large bugholes, honeycombs, and other cavities deeper than the recommended maximum thickness, clean sand or pea gravel may be post-added to Series 218. If more than 1/4-inch of repairs is needed, Series 217 may be used.
  - e. Base Coat: Tnemec Series 434 Perma-Shield H<sub>2</sub>S at 1/8-inch or 125.0 mils minimum.
  - f. Finish Coat: Tnemec Series 435 Perma-Glaze at 18.0 to 20.0 mils.
- 2. System No. 32—Exposed Concrete and Masonry, Mild to Moderate Corrosive Environment:
  - a. Type: Tnemec Series 104 HS Epoxy Cycloaliphatic Amine Epoxy (82% sbv) primer, intermediate and finish coat at a total dry film thickness of 18.0 to 24.0 mils.
  - b. Service Conditions: Concrete and masonry exposed to mild to moderate corrosive atmospheres and immersion service, such as chlorine contact basins, chlorine storage areas, or open-top (aerobic) clarifiers, aeration basins, settling basins, etc.

- c. Surface Preparation: In accordance with Article 3.04. Clean to an ICRI CSP 5 standard.
  - d. Resurfacing: Apply Tnemec Series 218 to all surfaces to mitigate outgassing and provide a smooth paintable surface. For localized repairs of large bugholes, honeycombs, and other cavities deeper than the recommended maximum thickness, clean sand or pea gravel may be post-added to Series 218. If more than 1/4-inch of repairs is needed, Series 217 may be used.
  - e. Prime Coat: Tnemec Series 104 at 6.0 to 8.0 mils.
  - f. Intermediate Coat: Tnemec Series 104 at 6.0 to 8.0 mils.
  - g. Finish Coat: Tnemec Series 104 at 6.0 to 8.0 mils.
3. System No. 33—Submerged Concrete, Potable Water, Single-Coat System:
- a. Type: Tnemec Series 22 Epoxoline Modified Polyamine Epoxy (100% sbv) single-coat system at a total dry film thickness of 22.0 to 40.0 mils.
  - b. Services Conditions: Concrete in contact with potable water. Must meet NSF 61. This system is to be used over large surface areas that require minimal detail work.
  - c. Surface Preparation: In accordance with Article 3.04.
  - d. Resurfacing: Apply Tnemec Series 218 to all surfaces to mitigate outgassing and provide a smooth paintable surface. For localized repairs of large bugholes, honeycombs, and other cavities deeper than the recommended maximum thickness, clean sand or pea gravel may be post-added to Series 218. If more than 1/4-inch of repairs is needed, Series 217 may be used.
  - e. Single Coat: Tnemec Series 22 Epoxoline at 22.0 to 40.0 mils.
  - f. Note: To maintain NSF 61 approval, maximum allowable total dry film thickness of Series 22 is 50.0 mils.
4. System No. 34—Submerged Concrete, Potable Water, Three-Coat System:
- a. Type: Tnemec Series 20HS Pota-Pox Polyamide Epoxy (78% sbv) primer, intermediate, and finish coat at a total dry film thickness of 12.0 to 18.0 mils.
  - b. Service Conditions: Concrete in contact with potable water. Must meet NSF 61.
  - c. Surface Preparation: In accordance with Article 3.04.
  - d. Resurfacing: Apply Tnemec Series 218 to all surfaces to mitigate outgassing and provide a smooth paintable surface. For localized repairs of large bugholes, honeycombs, and other cavities deeper

than the recommended maximum thickness, clean sand or pea gravel may be post-added to Series 218. If more than 1/4-inch of repairs is needed, Series 217 may be used.

- e. Prime Coat: Tnemec Series 20HS Pota-Pox at 4.0 to 6.0 mils.
- f. Intermediate Coat: Tnemec Series 20HS Pota-Pox at 4.0 to 6.0 mils.
- g. Finish Coat: Tnemec Series 20HS Pota-Pox at 4.0 to 6.0 mils.
- h. Note: To maintain NSF 61 approval, maximum allowable total dry film thickness of Series 20HS is 18.0 mils.

J. Exterior/UV-Exposed Concrete and Masonry Coating Systems

- 1. System No. 41—New or Bare Concrete and Masonry, Atmospheric Weathering Environment:
  - a. Type: Tnemec Series 156 Enviro-Crete Modified Waterborne Acrylate (50.9% sbv) primer and finish coat with a Series 1254 Epoxoblock WB inorganic hybrid water-based epoxy (100% sbv) block filler at a total dry film thickness of 8.0 to 16.0 mils.
  - b. Service Conditions: Exterior concrete or masonry, exposed to ultraviolet light and weathering, which requires protection from hairline cracking, driving rain, or mold and mildew.
  - c. Surface Preparation: In accordance with Article 3.04.
  - d. Masonry Block Filler: Tnemec Series 1254 Epoxoblock WB at a rate of 100 to 150 square feet for dense substrates or 75 to 100 square feet for porous substrates.
  - e. Prime Coat: Tnemec Series 156 Enviro-Crete at 4.0 to 8.0 mils.
  - f. Finish Coat: Tnemec Series 156 Enviro-Crete at 4.0 to 8.0 mils.
- 2. System No. 42—Existing or Coating Concrete and Masonry, Atmospheric Weathering Environment:
  - a. Type: Tnemec Series 1026 Enduratone Acrylic Emulsion (43% sbv, 100% acrylic resin) primer and finish coat with a Series 156 Enviro-Crete Modified Waterborne Acrylate (50.9% sbv) brush into hairline cracks at a total dry film thickness of 4.0 to 6.0 mils.
  - b. Service Conditions: Exterior concrete or masonry, exposed to ultraviolet light and weathering, which requires excellent permeance (due to existing coatings already in place).
  - c. Surface Preparation: In accordance with Article 3.04.
  - d. Hairline Cracks: Brush Tnemec Series 156 into hairline cracks. Multiple passes may be required for deeper cracks.
  - e. Prime Coat: Tnemec Series 1026 Enviro-Crete at 2.0 to 3.0 mils.

- f. Finish Coat: Tnemec Series 1026 Enviro-Crete at 2.0 to 3.0 mils.
3. System No. 44—Clear Sealer on Exterior Concrete and Masonry:
  - a. Type: Tnemec Series 662 Prime-A-Pell Plus modified siloxane/silane with diffused quartz carbide (45% active content).
  - b. Surface Preparations: In accordance with Article 3.04. Surfaces to be treated must be clean, dry, and free from oil, dirt, grease, efflorescence, or any other coating, which may inhibit penetration and adhesion.
  - c. Test Patch: A test application must be performed to determine exact coverage rate, desired performance, and compatibility.
  - d. Prime Coat: Tnemec Series 662 Prime-A-Pell Plus at 50 to 400 square feet per gallon depending on substrate. Apply a saturating application of the product working from the bottom up. On porous substrates such as concrete masonry units, allow a slight rundown (less than 3 inches). On high-density materials such as precast concrete panels or GFRC, do not allow any rundown. On all substrates allow the product to penetrate the substrate for approximately 5 to 7 minutes before applying finish coat.
  - e. Finish Coat: Tnemec Series 665 Dur-A-Pell 100 at 50 to 400 square feet per gallon depending on substrate. Apply from the bottom up. Do not allow any rundown on the finish coat.
4. System No. 45—Exposed Masonry or Concrete, Atmospheric Weathering Environment:
  - a. Type: Cement-base waterproofing grouting for concrete and masonry.
  - b. Service Conditions: For use in waterproofing concrete, block, brick, stone, and other masonry.
  - c. Surface Preparation: In accordance with Article 3.04. Dampen surface immediately ahead of application with clean water. Follow manufacturer's instructions on mixing and application.
  - d. Coatings: Apply two or more coats of Bonsal Sure-Coat to minimum total thickness of 1/16 inch or evenly distribute a base coat of Thoro Systems Products "Thoroseal" or equal, minimum 2 pounds per square yard. Then apply another coat at 2 pounds per square yard for a total of 4 pounds per square yard. Sherwin Williams SherCrete Waterproof Coat.

**K. PVC, CPVC, and FRP Coating Systems**

1. System No. 51—PVC, CPVC, and FRP, Ultraviolet Exposure or Color Coding:
  - a. Type: Tnemec Series 1095 Endura-Shield Aliphatic Acrylic Polyurethane (66% sbv) finish with a Series 66 Hi-Build Epoxoline Polyamide Epoxy (56% sbv) prime coat at a total dry film thickness of 4.5 to 10.0 mils.
  - b. Service Conditions: Color coding of PVC, CPVC, or FRP exposed to sunlight.
  - c. Surface Preparation: Clean the surface in accordance with SSPC SP-1. Then thoroughly and uniformly scarify and de-gloss the surface.
  - d. Prime Coat: Tnemec Series 66 at 2.0 to 3.0 mils.
  - e. Finish Coat: Tnemec Series 1095 Endura-Shield at 2.5 to 5.0 mils. Series 1095 is semi-gloss. For a different sheen, apply Series 1094 (gloss) or Series 1096 (eggshell) at the same thickness.

**L. Nonferrous, Galvanized, and Other Miscellaneous Metals Coating Systems**

1. System No. 62—Galvanized Steel, Aluminum, or Copper:
  - a. Type: Tnemec Series 66 Hi-Build Epoxoline Polyamide Epoxy (56% sbv) prime and finish coats at a total dry film thickness of 4.0 to 8.0 mils excluding the UV-Stable Third Coat.
  - b. Service Conditions: Coat area of galvanized steel, aluminum, or copper using this system. Consult with coating manufacturer for immersion service requirements.
  - c. Surface Preparation: Clean the surface in accordance with SSPC SP-1. Then, thoroughly and uniformly scarify and de-gloss the surface. Primer must be applied as soon as possible on the same day as surface preparation.
  - d. Prime Coat: Tnemec Series 66 at 2.0 to 4.0 mils.
  - e. Finish Coat: Tnemec Series 66 at 2.0 to 4.0 mils.
  - f. UV-Stable Third Coat (UV-exposed areas): Tnemec Series 1095 Endura-Shield at 2.5 to 5.0 mils. Series 1095 is semi-gloss. For a different sheen, apply Series 1094 (gloss) or Series 1096 (eggshell) at the same thickness.

## 2.02 PERFORMANCE CRITERIA

The following shall serve as a basis of comparison for material substitution requests. Any substitutions which decrease the total film thickness, change the generic type of coating, or fail to meet the performance criteria of the specified materials shall not be approved.

- A. Series 1 Omnitthane – Zinc/Micaceous Iron Oxide Urethane
  - 1. Adhesion: ASTM D4541 (Method B, Type II) – No less than 1,433 psi (9.88 MPa) adhesion, average of three tests.
  - 2. Salt Spray (Fog): ASTM B117 – No blistering, cracking, or delamination of film. No more than .03% rusting on plane and no more than 3/16-inch rust creepage at scribe after 10,000 hours exposure.
- B. Series 20 HS Pota-Pox – Polyamide Epoxy
  - 1. Special Qualification: Certified by NSF International in accordance with NSF 61.
  - 2. Abrasion: ASTM D4060 (CS-17 Wheel, 1,000 gram load) – No more than 68.5 mg loss after 1,000 cycles with 1,000 gram load, average of three tests.
  - 3. Adhesion: ASTM D4541 – No less than 1,909.3 psi (13.16 MPa) adhesion after 10 freeze/thaw cycles, average of three tests.
  - 4. Immersion: ASTM D870 – No blistering, cracking, rusting, or delamination of the film after 1,500 hours continuous immersion in deionized water at 140°F.
  - 5. Salt Spray: ASTM B117 – No blistering, cracking, rusting, or delamination of the film and no creepage at the scribe after 5,000 hours.
  - 6. Cyclic Salt Fog/UV Exposure: ASTM D5894 – No blistering, cracking, rusting, or delamination of the film after 10,000 hours.
- C. Series 22 Epoxoline – Modified Polyamine Epoxy
  - 1. Special Qualification: Certified by NSF International in accordance with NSF 61.
  - 2. Product must be able to be applied in one single-coat application from 16.0 to 40.0 mils dry film thickness.
  - 3. VOC Content: 0.10 pound/gallon (12 grams/liter).
  - 4. Immersion: ASTM 870 – No blistering, cracking, rusting, or delamination of film after 2,000 hours continuous immersion in deionized water at 140°F (60°C), average of three tests.

- D. Series 46H-413 Hi-Build Tneme-Tar – Polyamide Epoxy-Coal Tar
1. Adhesion: ASTM D4541 – Exceeds the cohesive strength of the concrete substrate (400 psi), average of three tests.
  2. Abrasion: ASTM D4060 (CS-17 wheel, 1,000 gram load) – No more than 142 mg loss after 1,000 cycles.
  3. Salt Spray (Fog): ASTM B117 – No blistering, cracking, checking, rusting, or delamination of film. No rust creepage at scribe after 9,000 hours continuous exposure.
- E. Series 66 Hi-Build Epoxoline – Polyamide Epoxy
1. Adhesion: ASTM D4541 – No less than 1,930 psi (13.31 MPa) pull, average of three tests.
  2. Salt Spray: ASTM B117 – No blistering, cracking, checking, or delamination of film. No more than 1/8-inch rust creepage at scribe after 8,000 hours exposure.
- F. Series 90-07 Tneme-Zinc – Aromatic Zinc-Rich Urethane
1. Zinc Pigment: 83% by weight in dried film.
  2. Adhesion: ASTM D4541 (Type II) – No less than 1,442 psi (9.94 MPa) adhesion, average of three tests.
  3. Salt Spray: ASTM B117 – No blistering, cracking, or delamination of film. No more than 1/8-inch creepage at scribe and no more than 1% rusting on plane after 50,000 hours exposure.
- G. Series 94H<sub>2</sub>O Hydro-Zinc – Zinc-Rich Aromatic Urethane
1. Special Qualification: Certified in accordance with NSF 61 for use on interior potable water tanks of 500 gallons or greater.
  2. Zinc Pigment: 83% by weight in dried film.
  3. Adhesion: ASTM D4541 (Type V Self-Aligning Adhesion Tester) – No less than 1,713 psi adhesion, average of three tests.
  4. Salt Spray: ASTM B117 – No blistering, cracking, or delamination of film. No rusting on plane and no more than 1/16-inch rust creepage at scribe after 10,000 hours.
- H. Series 104 HS Epoxy – Cycloaliphatic Amine Epoxy
1. Adhesion: ASTM D4541 – No less than 900 psi (6.21 MPa) pull, average of three tests.
  2. Chemical Immersion: NACE TM0174, Procedure B – No blistering, cracking, or delamination of film after 7 days.

3. Salt Spray (Fog): ASTM B117 – No blistering, cracking, rusting, or delamination of film. No more than 1/32-inch (0.8 mm) rust creepage at scribe after 1,500 hours exposure.

I. Series 115 Uni-Bond DF – Self-Crosslinking Hydrophobic Acrylic

1. Adhesion: ASTM D4541 (Method C – Type V Tester) – No less than 1,472 psi pull (10.15 MPa), average of three tests.
2. Salt Spray: ASTM B117 – No more than 1/64-inch rust creepage at scribe, no more than 3% rusting on plane, and no less than a blister rating of 8 after 500 hours exposure.
3. Humidity: ASTM D4585/D4585M – No blistering, cracking, rusting, or delamination of film after 2,000 hours exposure.

J. Series N140 Pota-Pox Plus – Polyamidoamine Epoxy

1. Adhesion: ASTM D4541 – No less than 1,943 psi (13.40 MPa) pull, average of three tests.
2. Exterior Exposure: ASTM D1014 – No blistering, cracking, checking, rusting, or delamination of film. No rust creepage at scribe after 5 years exposure.
3. Humidity: ASTM D4585/D4585M – No blistering, cracking, or delamination of film after 10,000 hours exposure.
4. Immersion: ASTM D870 – No blistering, cracking, rusting, or delamination of film after 2,000 hours continuous immersion in deionized water at 140°F, average of three tests.
5. Salt Spray (Fog): ASTM B117 (Two Coats Series N140) – No blistering, cracking, or delamination of film. No more than 1% rusting on plane. No more than 1/16-inch rust creepage at scribe after 6,700 hours exposure.
6. Salt Spray (Fog): ASTM B117 (Series 91H<sub>2</sub>O and Two Coats Series N140) – No blistering, cracking, checking, or delamination of film. No more than 1% rusting on plane and no more than 3/16-inch rust creepage at scribe after 20,000 hours exposure.

K. Series 142 Epoxoline – Modified Polyamine Epoxy

1. Suitable for methanol immersion service.
2. Adhesion: ASTM D4541 – No less than 2,042 psi (14.08 MPa) pull, average of three tests.
3. Salt Spray (Fog): ASTM B117 – No blistering, cracking, rusting, or delamination of film and less than 1/32-inch creepage at the scribe after 5,000 hours exposure.
4. Abrasion: ASTM D4060 – No more than 59.3 mg loss after 1,000 cycles, average of two tests.

L. Series 156 Enviro-Crete – Modified Waterborne Acrylate

1. Adhesion: ASTM D7234 – Exceeds the cohesive strength of concrete substrate (400 psi), average of three tests.
2. Salt Spray: ASTM B117 – No blistering, cracking, or delamination of film. No visible damage to coating or substrate after 5,000 hours.
3. QUV Exposure: ASTM D4587 (UVA-340 bulbs, 8 hours UV, 4 hours condensation) – No blistering, cracking, chalking, or delamination of the film. No less than 69% gloss retention, no more than 1.1 units gloss loss, and no more than 3.59 DE (FMC-2) color change (white) after 5,000 hours QUV exposure.
4. Fungal/Mold/Mildew Resistance: ASTM D3273 – No More than slight mold growth after 5 weeks exposure.
5. Tensile Strength, Elongation, Modulus of Elasticity: ASTM D2370 – Elongation no less than 200%, average of five tests. Tensile strength no less than 250 psi (1.7 MPa), average of three tests.
6. Wind Driven Rain Resistance: FED TT-C-555B, Section 4.4.7.3 – No damage to coating or substrate. No visible moisture on the back of lightweight block after 48 hours exposure.

M. Series 239SC Chemblock – Modified Novolac Polyamine Epoxy

1. Chemical Immersion: NACE TM0174, Procedure B – No blistering, cracking, rusting, or delamination of film after 72 hours continuous contact with chemical.
2. Compressive Strength: ASTM C579 – Not less than 11,195 psi (77.19 MPa) compressive strength, average of six tests.
3. Flexural Strength and Modulus of Elasticity: ASTM D790 – Not less than 6,270 psi (43.23 MPa) flexural strength and 323,900 psi (2,233 MPa) flexural modulus of elasticity, average of five tests.
4. Impact: MIL D3134 (modified using 2.5 pound steel ball) – No more than 1/16-inch permanent indentation. No cracking, checking, or delamination of film after 240 in-lb (27 J) direct impact, average of three tests.
5. Tensile Strength, Elongation, Modulus of Elasticity: ASTM D638 – No less than 7,913 psi (54.56 MPa) tensile strength, 222,975 psi (1,537 MPa) tensile modulus of elasticity and 6.14% elongation at break.

N. Series 241 Ultra-Tread MVT – Polyurethane Modified Concrete

1. Can be applied to 10-day old concrete.
2. Withstands moisture vapor transmission up to 20 pounds in accordance with ASTM F1869.
3. Withstands relative humidity up to 99% in accordance with ASTM F2170.

4. Adhesion: ASTM D7234 – Exceeds the cohesive strength of the concrete substrate (approximately 400 psi), average of three tests.
5. Compressive Strength: ASTM C579 – No less than 4,922 psi (33.94 MPa) compressive strength, average of six tests.
6. Flexural Strength and Modulus of Elasticity: ASTM C580 – No less than 2,438 psi (16.81 MPa) flexural strength and 313,614 psi (2,162 MPa) modulus of elasticity (tangent), average of five tests.
7. Tensile Strength: ASTM C307 – No less than 1,015 psi (7.00 MPa) tensile strength, average of six tests.

O. Series 248 Everthane – Aliphatic Moisture Cured Urethane

1. Chemical Resistance: TTM-59 (Covered Spot Test) – No blistering, cracking, checking, or delamination of film. No more than slight softening or very slight swelling and loss of gloss after 24 hours exposure to the following reagents: 30% Sulfuric Acid, 10% Hydrochloric Acid, 50% Phosphoric Acid, 10% Acetic Acid, 50% Sodium Hydroxide, 10% Ammonium Hydroxide, Methyl Ethyl Ketone, Ethyl Alcohol, Hexane, Xylene, Gasoline, Ethylene Glycol, Skydrol, Brake Fluid, Transmission Fluid, Aviation Gas, Jet Fuel (JP4).
2. Abrasion: ASTM D4060 (CS-17 Wheel, 1,000 gram load) – No more than 18 mg loss after 1,000 cycles, average of three tests.

P. Series 282 Tneme-Glaze – Polyamine Novolac Epoxy

1. Chemical Immersion: NACE TM0174, Procedure B – No blistering, cracking, rusting, or delamination of film after 72 hours continuous contact with chemical.
2. Compressive Strength: ASTM C579 – Not less than 11,195 psi (77.19 MPa) compressive strength, average of six tests.
3. Immersion: 140°F Deionized Water Immersion – No blistering, cracking, rusting, or delamination of film after 2,000 hours continuous immersion.
4. Impact: ASTM D2794 – No visible cracking or delamination of film after 59 in/lbs direct impact, average of three tests.
5. Salt Spray (Fog): ASTM B117 – No blistering, cracking, rusting, or delamination of film. No more than 1/16-inch rust creepage at scribe after 3,500 hours exposure.

Q. Series 365 Tank Armor – Novolac Epoxy

1. Suitable for immersion service in 98% sulfuric acid.
2. Adhesion: ASTM D4541, Type II – No less than 1,650 psi (11.38 MPa) adhesion, average of three tests.

3. Hardness: ASTM D2240 (Shore D Durometer) – Not less than 90 Shore Type D hardness, average of five tests.

R. Series 431 Perma-Shield PL – Modified Polyamine Ceramic Epoxy

1. Severe Wastewater Analysis Test: ASTM G210 – Initial impedance of 11.18 log-Z at 0.001 Hz (ohms cm<sup>2</sup>). No blistering, cracking, checking, or delamination. No less than 88.7% EIS retention or not more than 1.26 ohms cm<sup>2</sup> reduction in log-Z electrochemical impedance at 0.001 Hz after 28 days exposure. No less than 2,363 psi (16.30 MPa) adhesion or no loss of adhesion after 28 days in S.W.A.T., average of three tests.
2. Abrasion Resistance: ASTM D4060 (CS-17 Wheel, 1,000 cycles, 1,000 gram load) – No more than 41 mg loss, average of three tests.
3. Abrasion Resistance: BS EN 598: 2007+A1: 2009 (Rocking Abrasion) – No more than 0.14 mm (5.5 mils) thickness of coating loss after 1,000,000 cycles.

S. Series 434 Perma-Shield H<sub>2</sub>S – Modified Aliphatic Amine Epoxy Mortar

1. Severe Wastewater Analysis Test: ASTM G210 – Initial impedance of 10.6 log-Z at 0.01 Hz (ohms cm<sup>2</sup>). No blistering, cracking, or checking. No less than 86.7% retention or not more than 1.4 ohms cm<sup>2</sup> reduction in log-Z electrochemical impedance at 0.01 Hz after 28 days exposure.
2. Abrasion Resistance: ASTM D4060 (CS-17 Wheel, 1,000 gram load) – No more than 88 mg loss after 1,000 cycles, average of three tests.
3. Impact: ASTM D2794 – No visible cracking or delamination after 160 inch-pounds (18.1 J) direct impact.
4. Compressive Strength: ASTM D695 – Not less than 12,331 psi (85.0 MPa) compressive strength, average of five tests.

T. Series 435 Perma-Glaze – Modified Polyamine Epoxy

1. Severe Wastewater Analysis Test: ASTM G210 – Initial impedance of 12.46 log-Z at 0.01 Hz (ohms cm<sup>2</sup>). No blistering, cracking, checking, or delamination. No less than 84.3% retention and no more than 1.95 ohms cm<sup>2</sup> reduction in electrochemical impedance after 28 days exposure. No less than 93% loss of tensile adhesion after 28 days in S.W.A.T. average of three tests.
2. Abrasion Resistance: ASTM D4060 (CS-17 Wheel, 1,000 gram load) – No more than 72 mg loss after 1,000 cycles, average of three tests.

U. Series 436 Perma-Shield FR – Fiber-Reinforced Modified Polyamine Epoxy

1. Severe Wastewater Analysis Test: ASTM G210 – Initial impedance of 10.2 log-Z at 0.01 Hz (ohms cm<sup>2</sup>). No blistering, cracking, or checking. No less than 83.7% retention or not more than 1.6 ohms cm<sup>2</sup> reduction in log-Z electrochemical impedance at 0.01 Hz after 28 days exposure.
2. Abrasion: ASTM D4060 (CS-17 Wheel, 1,000 gram load) – No more than 74.6 mg loss after 1,000 cycles, average of three tests.
3. Impact: ASTM D2794 – No visible cracking or delamination of film after 88 inch-pounds direct impact.
4. Compressive Strength: ASTM D695 – No less than 8,866 psi (6.13 MPa) compressive strength, average of five tests.

V. Series 626 Dur A Pell GS – RTV Silicone Rubber Water and Graffiti Protectant

1. Accelerated Weathering: ASTM C793 – No signs of deterioration except for dirt accumulation after 4,000 hours exposure.
2. Chloride Ion Penetration: AASHTO T-259 – No less than a 1,500% reduction in the chloride ion content when compared to untreated concrete, average of two tests.

W. Series 662 Prime-A-Pell Plus – Modified Siloxane/Silane with Diffused Quartz Carbide

1. QUV Exposure: ASTM D4587 (UVA-340 bulbs, Cycle 4: 8 hours UV/4 hours condensation) – No reduction in water repellent performance after 5,000 hours exposure.
2. Water Absorption: ASTM C67/C67M (Applied to Ohio Sandstone) – No less than a 96% reduction in water absorption as compared to untreated samples following 24 hours of immersion.
3. Water Absorption: ASTM C97/C97M (Applied to Fire Clay Brick) – No less than a 93% reduction in water absorption as compared to untreated samples following 24 hours of immersion.
4. Water Absorption: ASTM C140/C140M (Applied to Cast Mortar Cubes) – No less than a 96% reduction in water absorption as compared to untreated samples following 24 hours of immersion.

X. Series 700 Hydroflon – Advanced Thermoset Solution Fluoropolymer

1. Exterior Exposure: ASTM D1014 (AAMA 2604) (South Florida Marine Exposure) – Exceeds the exterior weathering requirements of AAMA 2604 standard.
2. Exterior Exposure: ASTM D4141/D4141M, Method C (EMMAQUA) – No blistering, cracking, or chalking. No less than 100% gloss retention,

- no more than 1 unit gloss loss and no more than 0.23 DEHunter color change (white) after 1,500 MJ/m<sup>2</sup> (69,109MJ/m<sup>2</sup> total) EMMAQUA exposure.
3. QUV Exposure: ASTM D4587 – No blistering, cracking, or chalking. No less than 61% gloss retention (31.4 units gloss change) and 1.89 DEFMC2 (MacAdam units) color change (white) after 25,000 hours exposure.
  4. Xenon Arc Weathering: ASTM D6695 – No blistering, cracking, or chalking. No less than 87% gloss retention (11.9 units gloss change) and no greater than 0.37 DE00 color change (white) after 8,000 hours Xenon Arc exposure.

Y. Series 971 Aerolon – Fluid-Applied Acrylic Insulation Coating

1. Immersion: ASTM D870 – No blistering, cracking, rusting, or delamination of film after 2,000 hours continuous immersion in deionized water at 140°F (60°C), average of three tests.
2. Thermal Conductivity: ASTM C518 – Thermal conductivity shall not be greater than 0.0356 W/m·°K or 0.2468 BTU-in/ft<sup>2</sup>-hr-°F (R-value at 1 inch equals 4.1).

Z. Series 1026 Enduratone – Acrylic Emulsion

1. VOC Content: 0.38 pounds/gallon (1.4 grams/liter).
2. QUV Exposure: ASTM D4587 (UVA-340 bulbs, 8 hours UV, 4 hours condensation) – No blistering, cracking, chalking, or delamination of film. No less than 49% gloss retention (2.3 units gloss change) and 0.39 DE00 color change after 10,000 hours exposure.

AA. Series 1029 Enduratone – HDP Acrylic Polymer

1. Algal Resistance: ASTM D5590 – No more than traces of fungal growth (less than 10%) after 3 weeks continuous exposure.
2. Fungal/Mold/Mildew Resistance: ASTM D5590 – No more than traces of fungal growth (less than 10%) after 4 weeks continuous exposure.
3. QUV Exposure: ASTM D4587 (UVA-340 bulbs, 8 hours UV, 4 hours condensation) – No blistering, cracking, or delamination of film. No less than 100% gloss retention, no more than 0.45 DE00 color change and no unit gloss loss after 3,000 hours.

BB. Series 1095 Endura-Shield – Aliphatic Acrylic Polyurethane

1. Volatile Organic Compounds (Thinned 5%): 0.77 pounds/gallon (92 grams/liter).

2. QUV Exposure: ASTM D4587 (UVA-340 bulbs, 8 hours UV, 4 hours condensation) – No blistering, cracking, or delamination. No less than 52% gloss retention or 23 units gloss change and 0.59 DECIE2000 color change (white) after 2,000 hours exposure.

## PART 3 EXECUTION

### 3.01 WEATHER CONDITIONS

- A. Do not paint in the rain, wind, snow, mist, or fog or when steel or metal surface temperatures are less than 5°F above the dew point.
- B. Do not apply paint when the relative humidity is above 85% or otherwise outside the manufacturer's recommended level.
- C. Do not paint when temperature of the substrate is outside of the manufacturers listed surface temperature requirement.

### 3.02 SURFACE PREPARATION PROCEDURES

- A. Remove oil and grease from metal surfaces in accordance with SSPC SP-1. Use clean cloths and cleaning solvents and wipe dry with clean cloths. Do not leave a film or greasy residue on the cleaned surfaces before abrasive blasting. Powerwashing with a biodegradable degreaser is also acceptable.
- B. Remove weld spatter and weld slag from metal surfaces and grind smoothly rough welds, beads, peaked corners, and sharp edges including erection lugs in accordance with SSPC SP-2 and SSPC SP-3. Grind 0.020 inch (minimum) off the weld caps on pipe weld seams. Grind outside sharp corners, such as the outside edges of flanges, to a minimum radius of 1/4 inch.
- C. Remove sharp edges, burrs, and weld spatter.
- D. Do not abrasive blast or prepare more surface area in 1 day than can be coated in 1 day; prepare surfaces and apply coatings the same day. For carbon steel, do not touch the surface between the time of abrasive blasting and the time the coating is applied. Prime all areas before rust bloom forms and within the same day.
- E. Surface preparation shall conform to the SSPC and NACE Standards as follows:

|                     |      |
|---------------------|------|
| Solvent Cleaning    | SP-1 |
| Hand Tool Cleaning  | SP-2 |
| Power Tool Cleaning | SP-3 |

|   |                  |
|---|------------------|
| White Metal Blast Cleaning                            | SP-5/NACE No. 1  |
| Commercial Blast Cleaning                             | SP-6/NACE No. 3  |
| Brush-Off Blast Cleaning                              | SP-7/NACE No. 3  |
| Pickling  | SP-8             |
| Near-White Blast Cleaning                             | SP-10/NACE No. 2 |
| Power Tool Cleaning to Bare Metal                     | SP-11            |
| High- and Ultra-High-Pressure Water Jetting           | SP-12/NACE No. 5 |
| Surface Preparation of Concrete                       | SP-13/NACE No. 6 |
| Industrial Blast Cleaning                             | SP-14/NACE No. 8 |
| Waterjet Cleaning of Metals – Clean to Bare Substrate | SP WJ-1          |
| Waterjet Cleaning of Metals – Very Thorough Cleaning  | SP WJ-2          |
| Waterjet Cleaning of Metals – Thorough Cleaning       | SP WJ-3          |
| Waterjet Cleaning of Metals – Light Cleaning          | SP WJ-4          |

- F. Wherever the words “solvent cleaning,” “hand tool cleaning,” “wire brushing,” or “blast cleaning” or similar words are used in these Specifications or in the paint manufacturer’s specifications, they shall be understood to refer to the applicable SSPC, surface preparation specifications listed above.
- G. *Brush-off blasting* of concrete and masonry surfaces is defined as opening subsurface holes and voids and etching the surface for a coating to bond.
- H. For carbon steel surfaces, after abrasive blast cleaning, the height of the surface profile shall be angular and from 2.0 to 3.0 mils unless specified otherwise. Verify the surface profile by measuring with an impresser tape acceptable to the Owner’s Representative. Perform a minimum of one test per 100 square feet of surface area. Testing shall be witnessed by the Owner’s Representative. The impresser tape used in the test shall be permanently marked with the date, time, and locations where the test was made. Test results shall be promptly presented to the Owner’s Representative.
- I. Do not apply any part of a coating system before the Owner’s Representative has reviewed the surface preparation. If coating has been applied without this review, if directed by the Owner’s Representative, remove the applied coating by abrasive blasting and reapply the coat in accordance with this Specification.

### 3.03 ABRASIVE BLAST CLEANING

- A. Use dry abrasive blast cleaning for metal surfaces. Do not use abrasives in automatic equipment that have become contaminated. When shop or field blast cleaning with handheld nozzles, do not recycle or reuse blast particles.
- B. After abrasive blast cleaning and before coating is applied, dry clean surfaces to be coated by dusting, sweeping, and vacuuming to remove residue from blasting.
- C. Apply the specified primer or touch-up coating within an 8-hour working day. Do not apply coating over damp or moist surfaces. Reclean any blast-cleaned surface not coated within the 8-hour period before applying primer or touch-up coating. If enough time has elapsed that a bare surface no longer meets the surface cleanliness requirement, that surface must be re-blasted until the surface cleanliness requirement is met.
- D. Keep the area of the work in a clean condition and do not permit blasting particles to accumulate and constitute a nuisance or hazard.
- E. During abrasive blast cleaning, prevent damage to adjacent coatings. Schedule blast cleaning and coating so that dust, dirt, blast particles, old coatings, rust, mill scale, etc., will not damage or fall upon wet or newly coated surfaces.

### 3.04 PREPARATION OF CONCRETE AND MASONRY SURFACES TO BE COATED

- A. Surface preparation of concrete and masonry surfaces shall be in accordance with SSPC SP-13/NACE No. 6 and the following.
- B. Do not apply coating until concrete has cured at least 28 days at 75°F. Finish concrete surfaces in accordance with Section 03360, Concrete Finishes. Do not use curing compound on surfaces that are to be coated.
- C. Concrete and masonry surfaces on which coatings are to be applied shall be of even color, gray or gray-white. The surface shall have no pits, pockets, holes, or sharp changes of surface elevation. Scrubbing with a stiff-bristle fiber brush shall produce no dusting or dislodging of cement or sand. Sprinkling water on the surface shall produce no water beads or standing droplets. Concrete and masonry shall be free of laitance and slick surfaces.
- D. Detergent clean the concrete or masonry surface with Trisodium Phosphate in accordance with ASTM D4258. Then abrade or blast surfaces to the required surface profile. Floor slabs may be acid etched as specified in ASTM D4260 in lieu of sandblasting. After sandblasting, wash surfaces with water to remove dust

and salts in accordance with ASTM D4258 or ASTM D4261. Use ICRI standards for concrete and masonry surface preparation.

- E. All concrete which has been subjected to low-pH or acidic conditions must be confirmed to have a pH of 9 or greater prior to application of coatings. If the desired surface profile has been achieved without a minimum pH of 9, that surface shall be considered contaminated and in need of further abrasion or blasting.
- F. Before coating concrete, plaster, and masonry that is below-grade, on-grade, or new, determine the presence of capillary moisture in accordance with ASTM D4263, except as modified below. Tape a 4-foot-by-4-foot sheet of polyethylene plastic to the concrete surface to be coated. Allow the plastic sheet to remain in place at least 24 hours. After the specified time has elapsed, remove the plastic sheet and visually examine both the underside of the plastic sheet and the concrete surface beneath it. There shall be no indication of moisture on either surface. If moisture is indicated, allow additional curing time for the concrete and then retest. Provide one test sheet for every 500 square feet of concrete surface to be coated. For walls, provide one test sheet for each 10 feet (or fraction thereof) of vertical rise in all elevations starting within 12 inches of the floor or base slab.
- G. Acceptance criteria for concrete surfaces shall be in accordance with SSPC SP-13, Table 1, "Severe Service" or this Section, whichever is more stringent.
- H. Do not apply coatings to concrete when the concrete is outgassing. Apply coatings only when the concrete surface temperature is stable or declining, not rising. Apply concrete coatings when the temperature is falling to reduce the potential of outgassing.

### 3.05 COATING STAINLESS STEEL, NONFERROUS, AND COPPER

- A. Solvent clean in accordance with SSPC SP-1. Solvents and cleaning solutions shall contain less than 200 mg/l of halogens. Then abrasive blast to give a surface profile of 2.0 to 3.0 mils. Refer to the coatings for the correct surface profile. Use coatings that are low in chloride content.
- B. Do not apply inorganic zinc primers to stainless steel if such primers are specified in the painting system required. Apply only the intermediate and finish coats in such cases.
- C. All surfaces must be primed as soon as possible on the same day following surface preparation.

### 3.06 PROCEDURES FOR ITEMS HAVING SHOP-APPLIED PRIME COATS

- A. After applying primer to surfaces, allow coating to cure for a minimum of 2 hours before handling to minimize damage.
- B. When loading for shipment to the project site, use spacers and other protective devices to separate items to prevent damaging the shop-primed surfaces during transit and unloading. If wood spacers are used, remove wood splinters and particles from the shop-primed surfaces after separation. Use padded chains or ribbon binders to secure the loaded items and minimize damage to the shop-primed surfaces.
- C. Cover shop-primed items 100% with protective coverings or tarpaulins to prevent deposition of road salts, fuel residue, and other contaminants in transit.
- D. Handle shop-primed items with care during unloading, installation, and erection operations to minimize damage. Do not place or store shop-primed items on the ground or on top of other work unless the ground or work is covered with a protective covering or tarpaulin. Place shop-primed items above the ground upon platforms, skids, or other supports.

### 3.07 FIELD TOUCH-UP OF SHOP-APPLIED PRIME COATS

- A. Remove oil and grease surface contaminants on metal surfaces in accordance with SSPC SP-1. Use clean rags wetted with a degreasing solution, rinse with clean water, and wipe dry.
- B. Remove dust, dirt, salts, moisture, chalking primers, or other surface contaminants that will affect the adhesion or durability of the coating system. Use a high-pressure water blaster or scrub surfaces with a broom or brush wetted with a solution of Trisodium Phosphate, detergent, and water. Rinse scrubbed surfaces with clean water.
- C. Before applying intermediate or finish coats to inorganic zinc primers, remove any soluble zinc salts that have formed by scrubbing with a stiff bristle brush.
- D. Remove loose or peeling primer and other surface contaminants not easily removed by the previous cleaning methods in accordance with SSPC SP-7/NACE No. 4. Take care that the remaining primers are not damaged by the blast cleaning operation. The remaining primers shall be firmly bonded to the steel surfaces with blast-cleaned edges feathered.
- E. Remove rust, scaling, or primer damaged by welding or during shipment, storage, and erection in accordance with SSPC SP-10/NACE No. 2. Take care that the

remaining primers are not damaged by the blast cleaning operation. Areas smaller than 1 square inch may be prepared in accordance with SSPC SP-11. The remaining primers shall be firmly bonded to the steel surfaces with cleaned edges feathered.

- F. Use repair procedures on damaged primer that protect adjacent primer. Blast cleaning may require the use of lower air pressure, smaller nozzles and abrasive particle sizes, short blast nozzle distance from surface, shielding, and/or masking.
- G. After abrasive blast cleaning of damaged and defective areas, remove dust, blast particles, and other debris by dusting, sweeping, and vacuuming; then apply the specified touch-up coating.
- H. Surfaces that are shop primed with inorganic zinc primers shall receive a field touch-up of organic zinc primer as specified in System No. 18 to cover scratches or abraded areas.
- I. Other surfaces that are shop primed shall receive a field touch-up of the same primer used in the original prime coat.

### 3.08 PAINTING SYSTEMS

- A. All materials of a specified painting system, including primer, intermediate, and finish coats, shall be produced by the same manufacturer. Thinners, cleaners, driers, and other additives shall be as recommended by the paint manufacturer for the particular coating system.
- B. Deliver paints to the jobsite in the original, unopened containers.

### 3.09 PAINT STORAGE AND MIXING

- A. Store and mix materials only in areas designated for that purpose by the Owner's Representative. The area shall be well ventilated, with precautionary measures taken to prevent fire hazards. Post "No Smoking" signs. Storage and mixing areas shall be clean and free of rags, waste, and scrapings. Tightly close containers after each use.
- B. Store paint in accordance with the manufacturer's latest written recommendations, or at an ambient temperature from 50°F to 100°F, whichever is more stringent.
- C. Prepare multiple-component coatings using all of the contents of the container for each component as packaged by the paint manufacturer. Do not use partial batches. Do not use multiple-component coatings that have been mixed beyond their pot life. Provide small quantity kits for touch-up painting and for painting

other small areas. Mix only the components specified and furnished by the paint manufacturer. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.

### 3.10 PROCEDURES FOR THE APPLICATION OF COATINGS

- A. Conform to the requirements of SSPC PA-1. Follow the recommendations of the coating manufacturer, including the selection of spray equipment, brushes, rollers, cleaners, thinners, mixing, drying time, temperature and humidity of application, and safety precautions.
- B. Stir, strain, and keep coating materials at a uniform consistency during application. Power mix components. For multiple component materials, premix each component before combining. Apply each coating evenly, free of brush marks, sags, runs, and other evidence of poor workmanship. Use a different shade or tint on succeeding coating applications to indicate coverage where possible. Finished surfaces shall be free from defects or blemishes.
- C. Do not use thinners unless recommended by the coating manufacturer. If thinning is allowed, do not exceed the maximum allowable amount of thinner per gallon of coating material. Stir coating materials at all times when adding thinner. Do not flood the coating material surface with thinner before mixing. Do not reduce coating materials more than is absolutely necessary to obtain the proper application characteristics and to obtain the specified dry-film thicknesses.
- D. Remove dust, blast particles, and other debris from blast cleaned surfaces by dusting, sweeping, and vacuuming. Allow ventilator fans to clean airborne dust to provide good visibility in working area before applying coating. Remove dust from coated surfaces by dusting, sweeping, and vacuuming before applying succeeding coats.
- E. Apply coating systems to the specified minimum dry-film thicknesses as determined in accordance with SSPC PA-2.
- F. Apply primer immediately after blast cleaning and before any surface rusting occurs, or any dust, dirt, or any foreign matter has accumulated. Before applying coating, re-clean surfaces that have surface colored or become moist by blast cleaning.
- G. Apply a brush coat of the specified primer on welds, sharp edges, nuts, bolts, and irregular surfaces before applying the prime coat. Apply the brush coat before and in conjunction with the spray coat application. Apply the spray coat over the brush coat.

- H. Before applying subsequent coats, allow the primer and intermediate coats to dry for the minimum curing time recommended by the manufacturer. In no case shall the time between coats exceed the manufacturer's recommendation.
- I. Each coat shall cover the surface of the preceding coat completely and there shall be a visually perceptible difference in applied shade or tint of colors.
- J. Applied coating systems shall be cured at 75°F or higher for 48 hours. If temperature is lower than 75°F, curing time shall be in accordance with printed recommendations of the manufacturer, unless otherwise allowed by the Owner's Representative.
- K. Assembled parts shall be disassembled sufficiently before painting or coating to ensure complete coverage by the required coating.

### 3.11 SURFACES NOT TO BE COATED

- A. Do not paint the surfaces listed below unless otherwise noted in the drawings or in other Specification sections. Protect the following surfaces during the painting of adjacent areas:
  - 1. Concrete walkways.
  - 2. Mortar-coated pipe and fittings.
  - 3. Stainless steel.
  - 4. Metal letters.
  - 5. Glass.
  - 6. Roofing.
  - 7. Fencing.
  - 8. Copper tubing, red brass piping, and PVC piping except where such piping occurs in rooms where the walls are painted, or required for color coding.
  - 9. Electrical fixtures except for factory coatings.
  - 10. Nameplates.
  - 11. Grease fittings.
  - 12. Brass and copper.
  - 13. Buried pipe, unless specifically required in the piping specifications.
  - 14. Fiberglass items, unless specifically required in the FRP specifications.
  - 15. Aluminum handrail, stairs, and grating.
  - 16. Insulated pipe.

### 3.12 PROTECTION OF SURFACES NOT TO BE PAINTED

- A. Remove, mask, or otherwise protect hardware, lighting fixtures, switch plates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on

machinery, and other surfaces not intended to be painted. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process. Mask openings in motors to prevent paint and other materials from entering the motors.

### 3.13 SURFACES TO BE COATED

- A. The exact coating to be applied in any location is not designated by the descriptive phrases in the coating system titles such as “corrosive environment,” “buried metal,” or “submerged metal.” Coat surfaces with the specific coating systems as described below:
1. Coat mechanical equipment, such as pumps and mixers as described below and in the various mechanical equipment specifications. The color of the finish coat shall match the color of the connecting piping.
  2. Coat aboveground and exposed piping or piping in vaults and structures as described in the various piping specifications and as shown in the Piping Schedule in the drawings. The color of the finish coat shall be as shown in the Piping Schedule in the Contract Drawings.
  3. Coat submerged steel as specified in System No. 1, 2, or 21 as applicable.
  4. Coat valves same as the adjacent piping. Aboveground valves, or valves in vaults and structures, shall match the color of the connecting piping.
  5. Coat Sludge Holding Tank Interior in accordance with Section 03180, Concrete Coating System.
  6. Coat Sludge Holding Tank exterior as specified in System No. 41.
  7. Coat concrete and masonry surfaces where shown in the drawings. Apply System No. 41, 42, 44, or 45 on exposed exterior concrete, System No. 31, 32, 33, or 34 on exposed interior concrete surfaces, and System No. 31, 32, 33, or 34 on submerged concrete surfaces unless otherwise shown in the drawings.
  8. Coat aluminum surfaces in contact with concrete as specified in System No. 61.
  9. Coat buried flanges, nuts and bolts, valves, flexible pipe couplings, exposed rebar in thrust blocks, and valve boxes as specified in System No. 21, 22, 23, or 24. Coat buried bolt threads, tie bolt threads, and nuts as specified in System No. 24.
  10. Coat aboveground structural steel or structural steel located in vaults and structures as described in the various structural specifications.
  11. Coat exposed indoor galvanized electrical conduit as specified in System No. 62. Color of finish coat shall be OSHA Safety Orange unless specified elsewhere.

### 3.14 DRY-FILM THICKNESS TESTING

- A. Measure coating thickness specified for carbon steel surfaces with a magnetic-type dry-film thickness gauge in accordance with SSPC PA-2. Measure coating thickness specified for stainless steel, aluminum, and copper surfaces with an eddy-current type thickness gauge in accordance with ASTM D7091. Provide certification that the gauge has been calibrated by a certified laboratory within the past 6 months. Provide dry-film thickness gauge as manufactured by Mikrotest or Elcometer.
- B. Test the finish coat of metal surfaces (except zinc primer and galvanizing) for holidays and discontinuities with an electrical holiday detector. Provide measuring equipment. Provide certification that the gauge has been calibrated by a certified laboratory within the past 6 months. Provide detector as manufactured by Tinker and Rasor, K-D Bird Dog, or similar. Test using voltages recommended by the coating manufacturer.
- C. If the Owner's representative suspects low film thickness, the coating thickness for concrete or masonry surfaces may be measured in accordance with ASTM D4138 (tooke gauge). Use of a "tooke" gauge is classified as a destructive test. Before performing any destructive tests on a newly applied coating system, the Owner and Contractor shall determine which of them is responsible for the cost of repairing the damaged coatings.
- D. For severe environments, test the finish coat of concrete and masonry surfaces in accordance with NACE SP0188 or ASTM D4787. Patch coatings at the points of thickness measurement or holiday detection.
- E. Check each coat for the correct dry-film thickness. Do not measure within 8 hours after application of the coating.
- F. For metal surfaces, make five separate spot measurements (average of three readings) spaced evenly over each 100 square feet of area (or fraction thereof) to be measured. Make three readings for each spot measurement of either the substrate or the paint. Move the probe or detector a distance of 1 to 3 inches for each new gauge reading. Discard any unusually high or low reading that cannot be repeated consistently. Take the average (mean) of the three readings as the spot measurement. The average of five spot measurements for each such 100 square-foot area shall not be less than the specified thickness. No single spot measurement in any 100 square-foot area shall be less than 80% nor more than 120% of the specified thickness. One of three readings which are averaged to produce each spot measurement may underrun by a greater amount as defined by SSPC PA-2.

G. Perform tests in the presence of the Owner's Representative.

### 3.15 REPAIR OF IMPROPERLY COATED SURFACES

A. If the item has an improper finish color or insufficient film thickness, clean and topcoat the surface with the specified paint material to obtain the specified color and coverage. Sandblast or power-sand visible areas of chipped, peeled, or abraded paint, feathering the edges. Then prime and finish the coat in accordance with the Specifications. The work shall be free of runs, bridges, shiners, laps, or other imperfections.

### 3.16 CLEANING

- A. During the work, remove discarded materials, rubbish, cans, and rags at the end of each day's work.
- B. Thoroughly clean brushes and other application equipment at the end of each period of use and when changing to another paint or color.
- C. Upon completion of painting work, remove masking tape, tarps, and other protective materials, using care not to damage finished surfaces.

END OF SECTION

**DIVISION 11**

**EQUIPMENT**

**SECTION 11000**  
**GENERAL EQUIPMENT REQUIREMENTS**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. This Section specifies general work requirements regarding the products and execution services that are specified in the Division 11 Sections incorporated in the Contract Documents. The requirements specified shall apply to all of the Division 11 Sections, unless noted otherwise.

**1.02 RELATED WORK**

- A. Other sections in the Contract Documents contain work that is related to the general work requirements specified in this Section. This related work includes but is not limited to the following sections:
1. Division III, General Conditions.
  2. Section 01330, Submittals and Acceptance.
  3. Section 01650, Delivery, Storage, and Handling.
  4. Section 01755, Equipment Testing and Startup.
  5. Section 01820, Training.
  6. Section 09900, Painting and Coating.
  7. Division 11, Equipment.
  8. Division 13, Special Construction.
  9. Section 15125, Piping Appurtenances.
  10. Division 16, Electrical.

**1.03 SUBMITTALS**

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. The submittal contents for equipment, instrumentation, controls, and appurtenances specified in the Division 11 Sections shall contain the general information listed below. Additional submittal requirements are contained in the Division 11 Sections.
1. A list and description of all deviations from the Contract Documents.
  2. A list of equipment and components on each drawing with each product identified by legend reference. Include product name, manufacturer, and model number.

3. Completely dimensioned plan, elevations and cross-sections of system equipment and sub-assemblies.
4. Shop and erection drawings showing details, anchor bolt locations, and field connections.
5. Manufacturer's equipment installation instructions.
6. Descriptive literature, technical bulletins, and catalog data sheets for all equipment and purchased sub-components.
7. Installation, operation, maintenance, and start-up procedures.
8. Total equipment weight (while operating).
9. Drive mechanism torque rating and bearing life rating.
10. Motor data and catalog information.
11. Submit complete electrical drawings, schematics, and interconnecting wiring diagrams and schedules for the equipment control system, instrumentation, and control panel(s) showing numbered wiring terminals in the control panel conforming to NEMA ICS-1-101. Identify field device terminals, wire number, wire sizes, control and power wire types, and interfaced elements.
12. Control panel construction and panel layout drawings.
13. Complete technical literature for all factory-applied paint systems. Clearly indicate the components to be coated and the corresponding paint system.
14. Manufacturers' descriptive literature, product specifications, and published details.

## 1.04 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies: The Contractor shall comply with construction requirements of State, County, and other local political subdivision specifications as may exceed the requirements of the codes, standards, and approving bodies referenced in this Section.
1. NFPA Standards: The Contractor shall comply with requirements of the National Fire Protection Association (NFPA) Standards referenced in the various Specifications Sections and as directly appropriate to the work and workmanship.
  2. Electrical Requirements: The Contractor shall comply with requirements for both the Underwriters' Laboratories, Inc. (UL) Listings, Labels, and Approvals and the National Electrical Manufacturers' Associations (NEMA) Stamps or Seals as applicable to electrical equipment or apparatus forming parts of the Mechanical Equipment.
- B. Certificates and Permits: Upon completion of work and before final payment, the Contractor shall furnish to the Engineer formal certification of final inspections from authorities having jurisdiction over the work in this project and secure required permits, if any, from such authorities. Additionally, the Contractor shall

prepare any detailed diagrams and drawings that are required by those authorities having jurisdiction over the work of this project at no additional cost to the Owner.

- C. Source Quality Control: Products used throughout these Specifications and as indicated on the Drawings shall be from companies having established reputations in the manufacture of the particular materials, equipment, or apparatus specified. Such products may be of their own make or products of others for which they assume full responsibility when used in finished products which are not manufactured completely by them and with replacement parts available.
- D. Products: The equipment specified in the Division 11 Sections was based on the latest models that were available from the specified equipment manufacturers at the time the Contract Documents were developed. If any equipment models specified in the Division 11 Sections have been discontinued or will be discontinued within 1 year after the bid date, the Contractor shall furnish and install the latest and most recent equipment model at no additional cost to the Owner.
- E. For each category of materials and equipment (Products) specified in the Division 11 Sections, the Contractor shall provide Products of the same manufacturer and type.
- F. Equipment Selection: The Contractor may furnish equipment of higher electrical characteristics, physical dimensions, capacities, and ratings provided such proposed equipment is approved by the Engineer in writing. Upon receiving the Engineer's approval to provide such equipment, the Contractor shall furnish the connecting mechanical and electrical services including but not limited to circuit breakers, conduit, increased control panel enclosure size, motors, bases, and any other electrical equipment needed to accommodate the higher electrical characteristics at no additional cost to the Owner.
- G. If minimum energy ratings or efficiencies of equipment are specified in Division 11, Equipment, the Contractor shall furnish and install equipment that meets or exceeds the specified design and commissioning requirements (no exceptions) as determined by the Engineer.
- H. All the equipment specified in the Contract Documents shall be standard units of proven ability as manufactured by a competent organization that is fully experienced, reputable and qualified in the manufacture of the equipment to be furnished. The equipment shall be designed, constructed, and installed in accordance with the best practice and methods and shall operate satisfactorily when installed.

## 1.05 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

## 1.06 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

## 1.07 QUALIFICATIONS

- A. The manufacturer of each piece of equipment described in the Division 11 Sections shall meet the following requirements, unless noted otherwise:
  1. Have a record of operation, manufacturing and servicing the items specified in the Division 11 Sections for a minimum of 10 years before the Bid Date.
  2. Have a minimum of five installations of equipment similar to that specified in this Section at municipal wastewater treatment facilities in Florida before the bid date.
  3. Have been in business for at least the 10 consecutive years before the Bid Date.
- B. If the equipment manufacturer that the Contractor proposes to furnish and install the equipment described in the Division 11 Sections does not meet these qualifications and is not specified in the Contract Documents, the Engineer reserves the right to reject the equipment from this manufacturer for use on this project. Any costs incurred by the Contractor as a result of providing equipment from a manufacturer that does not meet the qualifications described in this Section shall not be incurred by the Owner.
- C. The Contractor shall furnish documentation that the manufacturer meets these qualifications as part of the submittals specified in Section 01330, Submittals and Acceptance.

## 1.08 MAINTENANCE

- A. Spare Parts
  1. The Contractor shall furnish the spare parts specified in the Division 11 Sections. The Contractor shall also submit a list of recommended spare parts, special tools, and lubricants for each equipment item. The list shall

include contact information for local sources for supply of all parts and professional service.

## 1.09 OPERATION AND MAINTENANCE (O&M) MANUALS

- A. O&M Manuals shall be in accordance with General Conditions, Supplementary Conditions, and Section 01830, Operations and Maintenance Manuals.

## 1.10 PATENTS AND LICENSES (NOT USED)

## PART 2 PRODUCTS

### 2.01 MOTORS

- A. All motors identified in Division 11 Sections shall be furnished and installed under Division 11, Equipment, and in accordance with Division 16, Electrical.

### 2.02 CONTROLS

#### A. General

1. All control panels specified in the Division 11 Sections shall be furnished and installed under Division 11, Equipment, and in accordance with Divisions 13, Special Construction, and 16, Electrical.
2. The Contractor shall furnish and install controls designed to operate on 120-volt, single-phase, 60 Hertz electric service unless otherwise specified. The Contractor shall furnish and install 120-volt step-down voltage transformers as specified in Division 16, Electrical, in each control panel as required.
3. The Contractor shall furnish and install elapsed time meters in each control panel for each piece of motor-driven equipment being controlled by that control panel. All elapsed-time meters shall be furnished and installed in accordance with Division 16, Electrical.
4. All control panels shall be furnished with a main circuit breaker to enable/disable electric service to the panelboard.
5. All control panels that will annunciate a local and/or remote alarm shall be furnished with an ALARM ACKNOWLEDGE reset pushbutton switch (momentary contact) wired to each alarm contact.

6. All indicating lamps in each control panel shall be furnished in accordance with the color-coded scheme:
  - a. ON indicating lamps: Red.
  - b. OFF indicating lamps: Green.
  - c. Alarm indicating lamps: Amber.
  - d. POWER ON indicating lamp: White.
7. Provide a heater inside of each control panel enclosure to prevent condensation. Heater size shall be in accordance with the equipment manufacturer's recommendations.
8. The face of each control panel shall be installed so it is facing north whenever possible or provided with a sunshield when not possible.

## 2.03 FLOAT SWITCHES

- A. Float switches shall be of the suspended type with polypropylene or PVC body. Units shall have an integral electrical cable with two #19 AWG stranded conductors. Switches shall be pilot duty, normally open or normally closed, as required for application. Switches shall be suitable for use with intrinsically safe circuits. Each switch shall be supported from an AISI Type 316 stainless steel cable support bracket with individual stainless steel Kellems grip strain relief supports. Each switch shall be provided with sufficient cable length to extend from the float switch to the final termination point at the pump control panel with an additional 18 inches of looped cable. The float switch cables shall be bundled to an AISI Type 316 stainless steel cable with heavy-duty nylon strap wire ties. The upper end of the stainless steel cable shall be attached to the cable support bracket and the lower end attached to a 5-pound (minimum) cable weight. The cable weight shall be firmly attached to the cable and shall be constructed of noncorrosive metal and/or materials. Float switches and cables shall be intrinsically safe when used in classified locations.

## 2.04 EQUIPMENT ANCHORING SYSTEMS

- A. All anchoring systems including, but not limited to, expansion anchors, adhesive anchors, anchor bolts, cinch anchors, and screws that are required to install the equipment and appurtenances specified in the Division 11 Sections shall be AISI Type 316 stainless steel unless noted otherwise. The Contractor shall furnish and install all equipment anchoring systems in accordance with Section 05500, Metal Fabrications.

## 2.05 EQUIPMENT NAMEPLATES

- A. The Contractor shall provide engraved laminated phenolic nameplates with white legend and black field that provides the following information for each piece of equipment described in the Division 11 Sections.
  - 1. Equipment Description (i.e., Mixer, Dewatering Feed Pump, Truck Off-Loading and Recirculation Pump, etc.).
  - 2. Equipment Identification Label No. as shown on the Contract Drawings.
- B. Letter height on each nameplate shall not be less than 3/4-inch. Nameplates shall be factory drilled for fasteners. Secure nameplates to equipment or nearby wall using AISI Type 304 stainless steel fasteners. The locations of each nameplate shall be coordinated with the Owner and approved by the Owner before their installation.
- C. The Contractor shall obtain the Engineer's approval for the nameplate information for each equipment item described in the Division 11 Sections before ordering these nameplates from the manufacturer.

## 2.06 PRESSURE GAUGE ASSEMBLIES - PUMPING UNITS

- A. General: The Contractor shall provide a pressure gauge assembly as specified in Section 15125, Piping Appurtenances, on the suction and discharge piping of the pumping units specified in the Division 11 Sections. The intent of the Drawings is not to show the locations of every pumping unit pressure gauge. Rather, the Contractor shall mount each pressure gauge as close to the pump suction and discharge connections as possible, but so as not to impede the operation and maintenance of the pressure gauge assembly, pumping unit, and valves installed on the pumping unit suction and discharge piping. Coordinate the location of all pressure gauge assemblies with the Owner before installation.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. General: The Contractor shall install the equipment in accordance with the manufacturer's instructions and recommendations and approved submittals at the locations shown on the Drawings. If the equipment locations shown on the Drawings are in conflict with the manufacturer's recommendations or will interfere with the installation or operation of any other item indicated in the Contract Documents, the Contractor shall immediately notify the Owner and Engineer before they relocate this equipment and provide the necessary appurtenances to install the equipment in accordance with the manufacturer's

recommendations at no additional cost to the Owner. The Contractor shall not install any equipment at locations not in accordance with the Contract Documents or approved submittals.

- B. The Contractor shall install equipment, slabs, and walls level and plumb, parallel, and perpendicular to other building and components in exposed interior spaces, unless otherwise shown on the Drawings.
- C. The Contractor shall apply an anti-seize compound to threaded fasteners of equipment components that require removal, replacement, or adjustment as part of any maintenance or inspection procedure.
- D. The Contractor shall furnish and install the required oil and grease for initial operation in accordance with the manufacturer's recommendations.
- E. Provide means of oil lubrication for bearings and other metallic parts in sliding contact. Use alemite industrial-type fittings except where otherwise specified. The Contractor shall also perform the following work:
  - 1. Locate lubrication points on equipment readily accessible without the necessity of removing covers, plates, housings, or guards, or without creating safety hazards at installed equipment elevations.
  - 2. The Contractor shall exhaust pressure-lubricated units to the atmosphere to prevent excessive greasing.
  - 3. The Contractor shall extend grease fittings to locations that are readily accessible to the Owner. The Contractor shall coordinate the location of these grease fittings with the Owner before their installation.
- F. The Contractor shall furnish and apply touch-up paint to any equipment's factory painting finish that is chipped or damaged during installation. All factory-finish touch-up paint shall be mutually compatible with the factory finish on the equipment and shall be furnished by the manufacturer of the equipment to be touched up in the field.
- G. If equipment mounting heights are not shown on the Drawings, the Contractor shall install that piece of equipment to provide the maximum amount of headroom (defined as the distance from the bottom of the structure to the top of finished floor or grade), as possible. In such an instance, the Contractor shall obtain the Engineer's approval for this mounting location before installing that piece of equipment in the field.
- H. The Contractor shall furnish and install all mechanical equipment to facilitate service, maintenance, and repair or replacement of the equipment components.

The Contractor shall connect equipment for ease of disconnecting, with minimum interference to other installations.

### 3.02 FIELD TESTING

- A. General: The Contractor shall provide services of a factory-authorized service representative to perform, approve, and certify the field testing specified in this Section. Field testing shall generally consist of performing the pre-startup and startup tests as specified in the Division 11 Sections and the final mechanical performance test specified in this Section. The Contract Documents may require the Contractor to perform factory testing on equipment items before the Engineer approves their use for this project. The Contractor shall refer to the Division 11 Sections regarding equipment shop testing requirements.
- B. The Contractor shall adhere to the following requirements regarding the field testing to be provided for this project:
  1. The service representative shall be employed by the manufacturer of the equipment specified at the time field testing is being performed. The service representative shall be authorized by the factory to perform the field testing specified in Division 11, Equipment. Upon request by the Engineer, the Contractor shall submit a letter from a company officer of the equipment manufacturer stating that the service representative performing the field testing is authorized by the manufacturer.
  2. Before scheduling each field test with the equipment manufacturer, the Contractor shall coordinate with the Owner and Engineer to obtain a list of dates that both parties would be available to attend the testing. The Contractor shall notify the Owner and Engineer of the field testing dates no less than 14 calendar days before the date of the field test.
  3. If directed by the Engineer, the Contractor shall perform a second pre-startup and/or startup test, in accordance with the procedures specified in the Division 11 Sections, at no additional cost to the Owner if the original pre-startup and/or startup test did not pass because of any work that was deemed by the Engineer to be non-compliant with the Contract Documents and/or manufacturer's recommendations.
  4. The Contractor shall only perform startup testing after the Contractor has reached Substantial Completion for the project as defined in the Agreement and General Conditions.
  5. The Contractor shall furnish, install, and remove any temporary piping, valves, appurtenances, and equipment necessary to perform the pre-startup and startup testing to the Engineer's satisfaction.
  6. All field testing shall be performed Monday through Friday at the project site, unless otherwise approved by the Owner.

7. The duration that the manufacturer's representative is required to be onsite to perform the pre-startup and startup training is specified in the Table 11000-1, Equipment Testing and Training Requirements.

C. Operating Costs

1. Costs for Pre-startup and Startup Testing: The Contractor shall include in the Contract Price the following operating costs for satisfactorily completing the Initial Mechanical Performance Tests on equipment being tested:
    - a. Lubricating grease.
    - b. Lubricating oils.
    - c. Such other materials or utilities not specifically identified in this Section but required to conduct the pre-startup and startup testing.
    - d. Portable diesel power generation sets and diesel fuel as needed for lighting, portable tools, and furnishing electrical to any temporary pumping units used to transfer reclaimed water to each treatment or storage structure for startup testing. The Owner will provide reclaimed water for testing at their discretion.
  2. Costs for Final Mechanical Performance Tests: The Owner will pay for the operating costs for the Final Mechanical Performance Test, except for the Contractor's personnel needed to perform and supervise this testing as specified in this Section. These operating costs shall be limited to incidentals such as power, water, and other items fully installed by this time. The City of Clearwater can provide plant effluent reuse water if applicable and approved.
- D. The intent of the field testing for each equipment item specified in the Division 11 Sections is provided in this Section. If the individual equipment field testing procedures specified in the Division 11 Sections are not sufficient to obtain a Manufacturer's Certification or to demonstrate compliance with the Contract Documents, the Contractor shall perform these additional field test procedures at no additional cost to the Owner.
1. Pre-startup Testing: Upon the Contractor's completion of the installation and adjustment of the equipment; the Contractor, with his own forces and with the manufacturer's representative(s), shall demonstrate to the Engineer's satisfaction that the equipment has been furnished and installed

in accordance with the Contract Documents and the manufacturer's recommendations.

- a. The Contractor shall repair any equipment items that do not pass the pre-startup test, as identified by the Engineer and/or manufacturer's representative, to the satisfaction of the Engineer before performing the startup testing for that equipment.
  - b. The Contractor shall coordinate with the Construction Administrator provided by the Owner or Engineer to ensure that all requirements of the Contractor's pre-startup testing are fulfilled and have satisfactorily passed the pre-startup testing before the startup testing may commence.
2. Startup Testing: Upon successful completion of the pre-startup testing, the Contractor shall demonstrate that the mechanical performance and controls of each equipment item, when operated in accordance with the design intent indicated by the Contract Documents, are satisfactory to the Owner and Engineer.
    - a. Startup testing shall be performed with each equipment item and associated treatment structure simulated under similar operating conditions as the final mechanical performance testing specified in this Section. For equipment that will operate while being submerged as shown on the Drawings, the Contractor shall fill the respective treatment structure to its maximum water surface with reclaimed water for wastewater systems and perform startup testing while that equipment is submerged. The Contractor shall not use wastewater to fill any treatment structures for startup testing.
    - b. After the startup testing procedures specified in the Division 11 Sections have been completed to the satisfaction of the Engineer, the Contractor shall operate that equipment for one successful continuous 72-hour period without assistance from the Owner as a condition of startup testing. If the equipment needs to be taken out of service for repair during this 72-hour period because it is not operating in accordance with the intent of the Contract Documents, this operating period shall cease. A new operating period will not begin until the equipment has been operating in accordance with the Contract Documents and manufacturer's recommendations for at least 72 consecutive hours. The Contractor shall furnish any additional supervision or provisions necessary to verify that each equipment item was successfully operated during this 72-hour operating period.

- c. Upon completion of the startup test, the Contractor shall dewater each treatment and storage structure in accordance with local and State regulations and in a manner that is satisfactory to the Owner and Engineer.
- 3. Final Mechanical Performance Testing: The Contractor shall perform final mechanical performance testing of the equipment specified in the Division 11 Sections once the following conditions have been satisfied:
  - a. The Contractor has successfully completed the pre-startup and startup testing requirements specified in the Division 11 Sections.
  - b. The Contractor has performed the training services specified in this Section.
  - c. The Contractor has procured all of the required permits for each building and treatment structure within the project site.
  - d. The Engineer has received and approved all of the manufacturer's certifications of compliance, warranties, and operation and maintenance manuals for all required items as specified in the Contract Documents.
  - e. The intent of the final mechanical performance test is for the entire facility to be operated by the Owner for a continuous 30-day period while the facility is receiving and treating raw sewage or raw water. During this 30-day testing period the Contractor shall furnish personnel who shall be on site as needed and available at all times 24 hours per day during the final mechanical performance test. Personnel shall be competent in the troubleshooting and repair of the equipment and related electrical and mechanical systems specified in the Contract Documents. The Contractor's electricians and mechanical technicians shall be on-site as needed (minimum 8 hours/week) and available 24 hours per day to assist with this testing. If the final mechanical performance testing needs to be stopped and suspended due to equipment not operating in accordance with the design intent of the Contract Documents as determined by the Engineer, the following conditions shall apply:
    - (1) The Contractor shall repair and troubleshoot these items immediately at no additional cost to the Owner.
    - (2) The 30-day period for the final mechanical performance testing will start over (i.e., be reset to zero hours).

- f. Upon restarting the final mechanical performance testing, the Contractor shall furnish the appropriate personnel defined above on-site as needed and available (minimum 8 hours/week) for 24 hours per day during the 30-day period at no additional cost to the Owner even though the total duration of the final mechanical performance testing (including restarts), may exceed 30 days.
- g. The final mechanical performance test shall end when the Engineer determines that all of the equipment and related systems are operating in accordance with the design intent of the Contract Documents and all deficiencies that hinder the normal day-to-day operation of the facility have been corrected to the satisfaction of the Engineer. The Engineer shall notify the Contractor in writing when the final mechanical performance testing has been successfully completed.

### 3.03 TRAINING SERVICES

- A. Upon completion of the pre-startup and startup testing and before the final mechanical performance testing, the manufacturer of the equipment specified in the Divisions 11, Equipment, 13, Special Construction, 15, Mechanical, and 16, Electrical, shall provide an authorized representative to train the Owner's personnel in the operation and maintenance of the equipment. Training shall be provided in accordance with Section 01820, Training, and as specified in each section. The representative shall provide additional onsite startup and troubleshooting services during this training upon request by the Engineer or Owner while performing these training services. The duration of the training services for each equipment item are specified in the Table 11000-1, Equipment Testing and Training.
- B. The Contractor shall provide 30 days' notice of intention to perform testing before conducting two separate training sessions for all items discussed in this document: one for the morning staff (7:00 A.M.) and one for the afternoon staff (2:00 P.M.). The Owner shall receive a copy of the training materials with the notice of intent. The Training shall take place only after Owner approval of testing material.

### 3.04 MANUFACTURER'S CERTIFICATIONS OF COMPLIANCE

- A. Upon successful completion of the pre-startup testing, startup testing, and training services specified in this Section, as required in Table 11000-1, Equipment Testing and Training Requirements, the Contractor shall obtain the equipment manufacturer's certification that the equipment specified in the respective Division 11 Sections has been installed, adjusted, and tested in accordance with the manufacturer's recommendations. The Contractor shall furnish the Engineer

with Manufacturer's Certificates of Compliance and Equipment Manufacturer's Certificate of Installation Testing and Instruction for each specified equipment item before performing the final mechanical performance testing specified in this Section.

**Table 11000-1      Equipment Testing and Training Requirements**

(Hours below stipulate the duration the manufacturer's representative is required be on site to perform the required pre-startup and starting testing, final mechanical performance testing, and training services specified in the listed sections. See Note 1.)

| Section | Equipment Name           | Pre-Startup Testing <sup>(3)</sup> | Startup Testing <sup>(3)</sup> | Final Mechanical Performance Testing <sup>(4)</sup> | Training <sup>(4)(5)</sup> |
|---------|--------------------------|------------------------------------|--------------------------------|---|----------------------------|
| 11228   | Mixer                    | 4 hours                            | 4 hours                        | 4 hours   | 8 hours                    |
| 11356   | Progressing Cavity Pumps | 8 hours                            | 8 hours                        | 8 hours   | 16 hours                   |
| 13232   | Aluminum Flat Covers     | 2 hours                            | 2 hours                        | 2 hours   | 4 hours                    |

Notes:

1. If difficulties occur in operating the equipment due to the manufacturer's fabrication or the Contractor's installation, additional service shall be provided at no change in Contract Price or Time.
2. All times listed above exclude travel time to and from the project site.
3. The Pre-Startup and Startup testing may be combined within a single trip if the manufacturer's representative determines that the equipment is properly installed by the Contractor in accordance with the Contract Documents and the manufacturer's recommendations. However, these services shall not be combined with the Final Mechanical Performance Testing and Training; a separate trip(s) shall be conducted to accomplish these services.
4. The Final Mechanical Performance Testing and Training may be combined within a single trip but shall not be combined with the Pre-Startup and Startup testing. Training shall be conducted in accordance with Section 01820, Training.
5. The Contractor shall conduct two separate training sessions for all items discussed in this document: one for the morning staff (7:00 A.M.) and one for the afternoon staff (2:00 P.M.). The reflected training hours are the total combined between both of these sessions.
6. Table 1100-1 is to define the startup and testing times allotted for each individual major piece of equipment. The 30 Day Final Mechanical Performance Testing reference in this Section is a comprehensive test of the entire facility with live loads, as specified within this Section.

## MANUFACTURER'S CERTIFICATE OF COMPLIANCE

OWNER \_\_\_\_\_

EQPT SERIAL NO: \_\_\_\_\_

EQPT TAG NO: \_\_\_\_\_

EQPT/SYSTEM: \_\_\_\_\_

PROJECT NO: \_\_\_\_\_

SPEC. SECTION: \_\_\_\_\_

I hereby certify that the above-referenced equipment/system has been:

(Check Applicable)

- Installed in accordance with Manufacturer's recommendations.
- Inspected, checked, and adjusted.
- Serviced with proper initial lubricants.
- Electrical and mechanical connection meet quality and safety standards.
- All applicable safety equipment has been properly installed.
- System has been performance tested, and meets or exceeds specified performance requirements (when complete system of one manufacturer).

Comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

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

Date: \_\_\_\_\_, 20\_\_\_\_

Manufacturer: \_\_\_\_\_

By Manufacturer's Authorized Representative: \_\_\_\_\_  
(Authorized Signature)

**EQUIPMENT MANUFACTURER'S CERTIFICATE OF  
INSTALLATION TESTING AND INSTRUCTION**

OWNER \_\_\_\_\_

PROJECT \_\_\_\_\_

CONTRACT NO. \_\_\_\_\_

Jones Edmunds No. \_\_\_\_\_

EQUIPMENT SPECIFICATION SECTION \_\_\_\_\_

EQUIPMENT DESCRIPTION \_\_\_\_\_

I \_\_\_\_\_, Authorized representative of  
(Print Name)

\_\_\_\_\_ (Print Manufacturer's Name)

hereby CERTIFY that \_\_\_\_\_  
(Print equipment name and model with serial No.)

Installed for the subject project has have been installed in a satisfactory manner, has have been satisfactorily tested, is/are ready for operation, and that Owner assigned operating personnel have been suitably instructed in the operation, lubrication, and care of the units on Date:

\_\_\_\_\_ Time: \_\_\_\_\_.

CERTIFIED BY: \_\_\_\_\_ DATE: \_\_\_\_\_  
(Signature of Manufacturer's Representative)

**OWNER'S ACKNOWLEDGEMENT OF MANUFACTURER'S INSTRUCTION**

I/We the undersigned, authorized representatives of the \_\_\_\_\_  
and/or Plant Operating Personnel have received classroom and hands on instruction on the  
operation, lubrication, and maintenance of the subject equipment and am are prepared to assume  
normal operational responsibility for the equipment:

\_\_\_\_\_ DATE: \_\_\_\_\_

\_\_\_\_\_ DATE: \_\_\_\_\_

\_\_\_\_\_ DATE: \_\_\_\_\_

**END OF SECTION**

## SECTION 11228

### MIXERS

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

- A. The Contractor shall furnish all labor, materials, equipment, and incidents required and unload, install, place in operation, and field test mixer, motors, gearboxes, local control panel and isolator in the Sludge Holding Tank. The mixer unit shall be specifically designed to provide sufficient mixing to the Sludge Holding Tank. The mixing will be determined sufficient if it is in accordance with the Field Testing Article of this Section.
- B. These Specifications are intended to generally describe what is required but do not cover all details, which will vary with the requirements of the equipment application. The Specifications are, however, intended to cover furnishing, shop testing, delivery, unloading, on-site storage, complete installation, and field testing of all materials, equipment, and appurtenances for the complete mixing system as specified in this Section, whether specifically mentioned in these Specifications or not.

##### 1.02 RELATED WORK

Other Specifications in the Contract Documents contain work related to the general work requirements specified in this Section. This related work includes but is not limited to the following sections:

- A. Section 01330, Submittal and Acceptance.
- B. Section 01650, Delivery, Storage, and Handling.
- C. Section 01755, Equipment Testing and Startup.
- D. Section 01780, Warranties and Bonds.
- E. Section 01785, Record Documents.
- F. Section 01815, Maintenance of Plant Operation and Sequence of Construction.
- G. Section 01820, Training.
- H. Section 01830, Operations and Maintenance Manuals.
- I. Division 3, Concrete Work.
- J. Section 09900, Painting and Coating.
- K. Division 16, Electrical.

## 1.03 SUBMITTALS

- A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance.
- B. The Contractor shall submit to the Engineer copies of all materials required to establish compliance with this Section. Submittals shall include at least the following:
  1. Descriptive literature, bulletins, catalog cuts, and drawings for the equipment including minimum submergence requirements.
  2. Materials of construction, specifications, grade, or type.
  3. Coating information.
  4. Identify each mixer by tag number to which the catalog data and detail sheets pertain.
  5. Certified shop and installation drawings showing all details of construction, dimensions, and anchor bolt requirements.
  6. Shaft size and material.
  7. Mixer body size, type, and material.
  8. Complete bill of materials for the equipment.
  9. Description of surface preparation and shop prime painting, including certification that the paint to be used to shop prime the equipment is compatible with the finish coat paint to be applied to the equipment.
  10. The weight of each component: motor, gearbox, shafting, and impeller.
  11. The total weight of the complete assembled mixer.
  12. Dynamic torque and moment.
  13. Complete motor data including size, make, type, and characteristics of the electric motor along with wiring diagram.
  14. A list of manufacturer's recommended spare parts to be supplied
  15. Design calculation demonstrating that specified performance requirements are met.
  16. Control panel drawing and wiring diagrams.
- C. Test Reports to be Submitted:
  1. Description of test procedures and equipment.
  2. Copies of all test results, as specified in Parts 2 and 3 of this Section.
- D. Complete operation and maintenance instructions shall be furnished for all equipment specified in this Section in accordance with Division 1, General Requirements.
- E. The Contractor shall submit the manufacturer's Certificate of Installation, Testing, and Instruction as specified in Division 1, General Requirements.

## 1.04 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American Iron and Steel Institute (AISI)
- B. American Bearing Manufacturers Association (ABMA)
- C. American Gear Manufacturers Associations, Inc. (AGMA), where applicable or equivalent DIN-ISO standards.
  - 1. AGMA 6013—Standard for Industrial Enclosed Gear Drives.
- D. American Society for Testing and Materials (ASTM)
- E. American Welding Society (AWS)
- F. Anti-friction Bearing Manufacturer's Association (AFBMA)
- G. International Organization for Standardization (ISO), where applicable
- H. National Electrical Code (NEC)
- I. National Electrical Manufacturers Association (NEMA)
- J. Occupational Safety and Health Administration (OSHA)
- K. The Society of Protective Coatings (SSPC)
- L. Underwriter's Laboratory (UL)

## 1.05 QUALITY ASSURANCE

- A. The Contractor shall provide quality assurance measures for the items specified in this Section in accordance with this Section and Section 11000, General Equipment Requirements.

## 1.06 WARRANTIES

- A. Warranties shall be in accordance with Section 01780, Warranties and Bonds, and as specified herein.
- B. Warranty Period: All equipment supplied under this Section shall be warranted by the manufacturer for at least 3 years, 6 months, following initial shipments from its factory or 3 years following start-up and testing, whichever occurs first.
- C. The equipment shall be warranted to be free from defects in workmanship, design, and materials. If any part of the equipment fails during the warranty period, the failed component shall be replaced and the unit(s) restored to service at no expense to the Owner.
- D. The manufacturer's warranty period shall run concurrently with the Contractor's warranty period. No exception to this provision shall be allowed.

## 1.07 DELIVERY, STORAGE AND HANDLING

- A. The Contractor shall adhere to the requirements specified in the Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.
- B. All equipment and parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation.
- C. The equipment shall be delivered on site as fully assembled as transportation allows. Factory-assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.
- D. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.
- E. Each box or package shall be properly marked to show its net weight in addition to its contents.
- F. Finished surfaces of all exposed openings shall be protected by wooden blanks, strongly built and securely bolted thereto.
- G. Finished iron or steel surfaces shall be painted in accordance with Section 09900, Painting and Coating.

- H. Care shall be taken to avoid supporting or lifting the mixers in a manner that will place excessive stress on parts or shafts that are not designed to support the weight of the unit. The mixer assembly shall be lifted by eyebolts provided in the top of motor drive or by slings.

## 1.08 QUALIFICATIONS

- A. The Contractor shall assume full responsibility for the satisfactory installation and operation of the entire mixer, gearbox, and motor as specified.
- B. All the equipment specified under this Section shall be furnished by a single manufacturer and shall be standard units of proven ability as manufactured by a competent organization that is fully experienced, reputable, and qualified in the manufacture of the equipment to be furnished. The equipment shall be designed, constructed, and installed in accordance with the best practice and shall operate satisfactory when installed.
- C. All equipment furnished under this Section shall be new and unused and shall be the standard products of manufacturers with a successful record of manufacturing and servicing the similar equipment for a minimum of 5 years.
- D. The manufacturer shall be fully responsible for the design, arrangement, and operation of all connected rotating components of the assembled mixer unit to ensure that neither harmful nor damaging vibration occurs during operation. The design shall include all supporting frames and fabrication steel base plate for mounting the unit to the existing structure.
- E. Any additional equipment necessary for the proper operation of the proposed installation not specifically mentioned in these Specifications or shown on the Drawings shall be furnished and installed.

## 1.09 TESTING REQUIREMENTS

- A. Testing shall be performed as specified in Part 2 and Part 3 of these Specifications.

## 1.10 MAINTENANCE

- A. Spare Parts
  - 1. The Contractor shall furnish the following spare parts in clearly identified containers, labeled for easy identification without opening the packaging and suitably protected for long-term storage in humid environment.

2. For the mixer, provide:
  - a. One service kit with lip seals, O-rings, and shim sets.
  - b. One spare motor.
  - c. One spare gearbox.
  - d. Additional spare parts shall be provided in accordance with the recommendations of equipment manufacturers.

B. Special Tools

1. One shaft clamp for each shaft size.
2. The Contractor shall furnish one set of all special tools required for normal operation and maintenance of the equipment

C. Tools shall be furnished in a suitable steel case, clearly and indelibly marked on the exterior to indicate the equipment for which the tools are intended.

## 1.11 SYSTEM DESCRIPTION

- A. The Contractor shall provide a mixer at the Marshall Street Water Reclamation Facility (MSWRF). The mixer should be installed in the Sludge Holding Tank as shown on the Contract Drawings.
- B. The mixer shall be adequately designed to mix sludge completely within the Sludge Holding Tank with geometry, volume, and side-water depth shown in the Contract Drawing and as specified herein. Variation in the blended sludge shall be less than 10% over the range of the side-water depth. The mixer shall consist of a complete assembly of drive unit, gear box, shaft, seals, impeller, base plate, and all other necessary components and accessories. The mixer shall be specifically designed and furnished to meet the requirements specified herein these Project Specifications and as shown in the Contract Documents.
- C. All equipment specified and to be furnished and installed in this Section is intended to be standard for mixing based on this application.
- D. The mixer unit required under this Section shall be complete, including the motor, speed reducer, shaft, impeller, and base plate with proper alignment of the unit. All parts shall be so designed and proportioned as to have lateral strength, stability, and stiffness and to be especially adapted for the operational conditions and the properties of the sludge to be mixed.
- E. Equipment furnished under this Section shall be designed for a municipal wastewater treatment plant environment in which the equipment is exposed to the atmosphere. The equipment shall be designed for specific use with wastewater

treatment plant sludge. The environment will contain humid atmospheric conditions in West-Central Florida, and the equipment shall be designed for continuous operation; 24 hours per day, 365 days per year.

## 1.12 OPERATION AND MAINTENANCE (O&M) MANUALS

- A. The manufacturer shall provide O&M Manuals for the specific equipment with appropriate model numbers and motor data specific for this project. O&M Manuals shall be in accordance Section III – General Conditions, and Section 01830, Operations and Maintenance Manuals.

## PART 2 PRODUCTS

### 2.01 PERFORMANCE AND DESIGN REQUIREMENTS

- A. The mixing equipment is used to mix the contents of the Sludge Holding Tank as shown on the Contract Drawings.
- B. The mixer shall operate independently and shall be controlled from the as shown in the Contract Documents and specified in these Project Specifications. The mixer shall be constant speed designed to operate continuously.
- C. Marshall Street Water Reclamation Facility

#### 1. Sludge Holding Tank Volume

|  |                               |
|--|-------------------------------|
| Number of Sludge Holding Tanks         | 1                             |
| Tank Dimensions                        | 40 ft diameter x 15 ft height |
| Side Water Depth                       | 13.5 ft                       |
| Sludge % TS                            | 2-4%                          |
| Tank Finished Floor (Elevation)        | 7.00 ft                       |
| Minimum Operating Level (Elevation)    | 8.00 ft                       |
| Maximum Operating Level (Elevation)    | 20.50 ft                      |
| Normal Sludge Level (Elevation varies) | 16.00 ft                      |
| Tank Volume-Full                       | 127,000 gallons               |
| Tank Volume – Normal Operation         | 9,400 to 85,000 gallons       |

#### 2. Performance Criteria

| Sludge Holding Tank Mixer Design |              |
|----------------------------------|--------------|
| Rotational Speed                 | <45 rpm      |
| Average Bottom Velocity          | ≥3.0 ft/s    |
| Motor                            | 40 hp        |
| Voltage/Ph/Hz                    | 460/3/60     |
| Nominal Motor Speed              | 1,800 rpm    |
| Service Factor                   | <2           |
| Bearing Life                     | ≥100,000 L10 |

D. The mixer manufacturer and model shall be the following:

1. Invent Environmental Technologies, Inc., Model HCM/2500-44-40.0hp.

## 2.02 MATERIALS AND EQUIPMENT

A. Invent Environmental Technologies

1. Mixer Design and Construction:

- a. The mixer assembly shall consist of a dry installed heavy-duty speed reducer with hollow stainless steel shaft, electric motor, base plate, and hyperbolic mixing body.
- b. The mixer shall be capable of handling biological-activated sludge with a solids concentration from 2 to 4%, with a Sludge Volume Index (SVI) of 80 mL/g or greater and shall be designed to prevent settlement in the tank and to re-suspend biological material on the tank bottom. The mixer shall be capable of mixing the mixed liquor without introduction of air.
- c. The mixer shall be designed as a vertical shaft mixer, with a dry installed motor. During operation the mixer shall not generate any upward forces on the bridge construction.
- d. The mixer shall have a steady stationary flow pointed downward parallel to the mixer shaft, the highest speeds and turbulent fluctuations shall be produced in the bottom area. No separation vortex shall appear on the water surface.
- e. The mixer shall be equipped with a bottom guide to allow the mixer to operate at tank empty to full operating condition.

2. Gear Drive:

- a. The drives for the mixer shall be SEW Eurodrive (or approved equal), parallel shaft helical geared motor and have a high-quality corrosion protection coating, robust weather protective hood and filled with synthetic oil.
- b. The gear shall be rated for a long bearing service life and for adverse operating conditions. The driving shaft shall be mounted in a hollow shaft and secured by means of a nut. The torque shall be transmitted by a feather key connection. The hollow shaft shall be capped.

- c. The gearbox shall be built as a parallel helical gear shaft with the following requirements:
    - (1) A calculated lifetime L10 of the bearings of approximately 100,000 hours.
    - (2) High quality protection against corrosion.
    - (3) Covered hollow shaft.
    - (4) Service factor of greater 1.5.
  - d. The gearbox housing shall be cast iron covered with a high-quality Standard 0S3 coating having a thickness of at least 6 mils. The gear box shall be connected to the mounting base using a flange connection with stainless steel nuts and bolts.
3. Motor:
- a. The motor shall be a three-phase squirrel cage motor with helical gear having the following specifications:
    - (1) The motor shall be SEW or approved equal.
    - (2) Squirrel cage induction for operation on 460 volt, three-phase, 60 Hz current. Synchronous speed shall not exceed 1,800 rpm. The motor shall be of the totally enclosed, fan-cooled type suitable for outdoor operation having NEMA Class F insulation and Class B temperature rise at full load, a service factor of 1.5, rated for 40°C ambient temperature.
    - (3) The motor shall have a weather protection hood and be suitable for operation in a moisture-laden atmosphere. The conduit boxes shall be gasketed with neoprene or equivalent material, so as to prevent moisture from entering the stator through the conduit box. Condensation drains shall be suitable positioned in the lower external surface, so that nay accumulation of moisture can drain from the complete motor housing.
    - (4) Increased protection of the winding against humidity and acid.
    - (5) Inner corrosion protection of motor.
    - (6) High-quality protective varnishing against corrosion.
    - (7) Protection type IP66.
    - (8) ISO-Class F.
    - (9) Provide 120VAC motor space heaters and motor bi-metallic thermostats.

4. Mounting Base: The mounting base of the mixer shall consist of a gear base plate mounted on rubber buffers connected permanently to the bridge by AISI Type 316 stainless steel bolted connection. The gear plate shall be designed as a distortion-proof steel structure with an impact-proof powder-coated surface. The plate shall be able to be leveled using threaded bolts which adjust in height. The rubber buffers/isolator shall absorb starting-up jolts, prevent any transfer of vibrations to the bridge and constitute the galvanic separation of the mixer from its surroundings. The mounting base shall be supplied with a fastening set with AISI Type 316 stainless steel anchor bolts for connecting to the bridge as shown in the Contract Drawings.
5. Shaft: The drive shaft of the mixer shall be made from AISI Type 316 and resistant to most chemicals and wastewater. The top end of the shaft shall be a steel tappet for the connection to the gear hollow shaft. At the lower end there shall be a flange. The mixer body shall include a flanged screwed connection. The manufacturer shall field verify shaft length with the Contractor during shop drawing submittal.
6. Hyperboloid Mixer Body: The hyperboloid mixer body shall be a streamlined stress-free body without any mounted or fitted parts. The transport ribs which accelerate the flow shall be integrated in the mixer body and be made of top quality, fiberglass reinforced plastic. The mixer body shall be coated with a gel coat and polished surface.
7. Bolts and Hardware: All base plates, assembly bolts, nuts, washers, fasteners shall be AISI Type 316 stainless steel as specified.
8. Anti-Rotation Baffles: The Mixer manufacturer shall include three anti-rotation baffles constructed of Type 304 stainless steel. Each will be 40 inches x 144 inches and constructed of 11-gauge plate and 3x3 angle frame minimum of 1/4-inch-thick. Each will have three main supports anchored to the wall. The baffle design will be PE-stamped by a Florida-registered Professional Engineer.

## 2.03 SHOP PAINTING

- A. Before exposure to weather and shop painting, all surfaces shall be thoroughly cleaned, dry, and free from all mill scale, rust, grease, dirt, and other foreign matter.
- B. The mixer, base plate, and gear box shall be prepared and shop-primed in accordance with Division 9. Primer shall be compatible with the manufacturer's coating and shall be included in the equipment submittal to the Engineer.

- C. All nameplates shall be properly protected during painting.
- D. Gears and other similar surfaces not to be painted shall be given a heavy shop coat of grease or other suitable rust-resistant coating. This coating shall be maintained as necessary to prevent corrosion during storage and erection and shall be satisfactory to the Engineer up to the time of the final acceptance test.

## 2.04 SHOP TESTING

- A. The Engineer shall have the right to inspect, test, or witness tests of all materials or equipment to be furnished under this Section before shipment from the point of manufacture.
- B. The Engineer shall be notified in writing before initial shipment in ample time so that arrangement can be made for an inspection.
- C. The mixer shall be factory/shop tested in accordance with the manufacturer's procedures to ensure that the quality of materials used in the manufacture of the mixer and workmanship conforms to the specified requirements. The testing procedures and results shall be included in the equipment submittal to the Engineer.

## 2.05 CONTROL PANELS

- A. A NEMA 4X, 316 stainless control panel shall be provided for the mixer. The panels shall be deadfront construction with inner door, a three-point door latch, and a UL 508a label as an assembly with a SCCR rating of 14 kA minimum.
- B. The panel shall include a main circuit breaker and branch breaker for controls and receptacle. The panel shall include a solid-state soft-type starter rated for 50°C, manufactured by either Square-D or Allen-Bradley. All internal wiring shall be copper, rated at 600V and identified at each end.
- C. The panel will include an inner door with the following NEMA 4X rated devices:
  1. Lockable Safety Disconnect Switch.
  2. Hand-off-Auto.
  3. Elapse Time Meter.
  4. Running Indicator.
  5. Stop Indicator.
  6. Mixer Trouble Indicator.
  7. Alarm Reset.

- D. The panel shall include dry contacts for use by the remote SCADA system as follows:
  - 1. Mixer Run.
  - 2. Mixer Fail.
  - 3. Mixer in Hand.
  - 4. Mixer in Auto.
  - 5. Reset Position.
- E. The panel shall include an internal 480-volt surge protection rated a minimum of 50kA/mode.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Installation of the mixer, motor, shaft, associated equipment and accessories, and supports shall be in strict accordance with the manufacturer's instructions and recommendations in the locations shown on the Contract Drawings. The required grade lubricant for initial operation shall be furnished in accordance with the manufacturer's recommendations. Mounting, leveling, any required calibration, and anchor bolting shall be installed in accordance with the manufacturer's recommendations.
- B. The Contractor shall submit a certificate from the manufacturer stating that the installation of the equipment is satisfactory; that the equipment is ready for operation; and that the operating personnel have been suitably instructed in the operation, lubrication, and care of each unit.
- C. The Contractor shall make all adjustments to each unit as directed by the equipment manufacturer before placing the unit in operation.

### 3.02 FIELD PAINTING

- A. Field painting is specified in Division 9, Finishes. The primer and paint used in the shop shall be products of the same manufacturer as the field paint to ensure compatibility.
- B. All nameplates shall be properly protected during painting.

### 3.03 FIELD TESTING

- A. Before testing, the mixer shall be checked by the manufacturer's technical representative for lubrication, alignment, and rotation. The manufacturer's

technical representative shall notify the Contractor and the Engineer of anything in the installation that affects the manufacturer's guarantee. The Contractor shall make the adjustment based on manufacturer's recommendation. The manufacturer's representative shall provide certification that each mixer is rotating in the right direction and is ready for testing.

- B. The test runs of the mixer shall be undertaken with water in the tank filled to the peak water elevations shown on the Drawings. The test runs on the mixer shall determine acceptable running noise, speed, and rotational direction.
- C. In the event of improper installation, the Contractor shall correct the Work and re-test the mixer at no additional cost to the Owner. The manufacturer will provide certification that the improper installation has been corrected.
- D. The Contractor shall perform testing on blended sludge concentration after the installation is complete and the plant is in operation. The Contractor shall furnish all labor, materials, laboratory testing, and equipment required for the test. The cost of the testing shall be included in the Contract Price. The blended sludge test shall be conducted as follows in the tank when it is full and without additional sludge flowing into the tank:
  - 1. Sludge concentration test shall be conducted at blended sludge concentrations of 2 to 4% in the tank. The SVI shall be greater than 80 mL/g.
  - 2. The test shall be conducted in the tank, and the tests shall demonstrate that a uniform concentration of the blended Sludge is achieved. Uniformity shall be defined as plus or minus 10% of the arithmetic average of blended sludge total suspended solids concentration for all samples taken.
  - 3. Nine samples shall be taken in the tank. The sample location shall be selected by the Engineer and shall be spaced horizontally based on the location of the access hatches on the tank cover and equally spaced vertically within the tank. The maximum depth at which any sample shall be taken shall be a minimum of 6 inches above the floor level. In addition, samples shall be taken a minimum of 12 inches from the tank wall. Samples shall be tested at an independent laboratory approved by the Engineer. The tests will be conducted without flow into the tank. The cost for the laboratory shall be borne by the Contractor.
  - 4. If requested by the Engineer, the Contractor shall collect additional samples to be tested by the Owner's laboratory for verification.
  - 5. If the average of the samples fails to meet the specified requirements, the Contractor and the manufacturer shall make all necessary modifications to correct the problem and re-test at no additional cost to the Owner. If necessary, the Contractor shall replace the non-performing mixer at no additional cost to the Owner.

### **3.04 TRAINING SERVICES**

- A. The manufacturer technical representative shall be on site to perform training services in accordance with Section 01820, Training, and Table 11000-1, Equipment Testing and Training Requirements, in Section 11000, General Equipment Requirements.

### **3.05 CERTIFICATION**

- A. The Contractor shall provide a written certification from the manufacturer certifying that the equipment has been properly installed according to the Contract Drawings, Project Specifications, and manufacturer's instructions and that the equipment is operating normally.

### **3.06 MANUFACTURER'S SERVICES**

- A. The equipment manufacturer shall furnish the services of a competent and experienced factory representative who has complete knowledge of proper installation, operation, and maintenance of the equipment for not less than what is specified in Table 11000-1, Equipment Testing and Training Requirements, in Section 11000, General Equipment Requirements, to inspect the installed equipment, perform an initial test run and startup testing, conduct final performance testing, and provide operation and maintenance instructions to the plant personnel. The number of trips is determined by the construction schedule and as necessary to meet the requirements of these Project Specifications.
- B. If there are difficulties in operating the equipment due to manufacturer's design or fabrication, additional service shall be provided at no cost to the Owner.

**END OF SECTION**

**SECTION 11356**  
**PROGRESSING CAVITY PUMPS**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. The Contractor shall furnish all labor, materials, and incidentals required to provide the self-priming, positive displacement progressing cavity pumping units and appurtenances specified in this Section and shown on the Drawings. Each pumping unit shall be specifically designed to convey digested sludge from the Sludge Holding Tank. All equipment shall be installed, adjusted, tested, and placed in operation in strict accordance with this Section and the manufacturer's recommendations.
- B. All equipment shall be installed, adjusted, tested, and placed in operation in strict accordance with this Section and the manufacturer's recommendations.
- C. Each pumping unit shall be designed and constructed to operate satisfactorily with minimum noise, vibration, and cavitation, and reasonable long service life when operated continuously or intermittently for digested sludge.
- D. Each unit shall be furnished with motor of adequate size to start each progressing cavity pump that has not been in service for 90 days.
- E. Only one pump manufacturer shall be selected for the two pump stations.

**1.02 SUBMITTALS**

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Certified shop and erection drawings showing all important details of construction, dimensions, and anchor bolt locations.
- B. Descriptive literature, bulletins, and/or catalogs of the equipment.
- C. Complete master wiring diagrams and elementary or control schematics drawings, including coordination with other electrical control devices such as the pump control system, shall be furnished for approval before proceeding with manufacturing. Drawings should show such details that are necessary to facilitate interconnections with other equipment. Standard pre-printed sheets or drawings simply marked to indicate applicability to this Contract will not be acceptable.

Refer to the Electrical and Instrumentation Drawings for the control wiring diagrams for the pump motors.

- D. A complete bill of materials of all equipment.
- E. A list of the manufacturer's recommended spare parts to be supplied in addition to those specified in this Section, with the manufacturer's current price for each recommended space part item. Include gaskets, packing, etc. on the list. List bearings by the bearing manufacturer's name and corresponding numbers.
- F. Complete motor and variable-frequency drive data.
- G. Test reports to be submitted: Tests shall be conducted at a minimum of five points along the pump performance curve on the actual pumping units to be furnished. All equipment tested by the pump manufacturer shall certify to its compliance with the project requirements. Curves and other information shall be submitted on 8-1/2-inch-by-11-inch sheets at as large a scale as is practical. Curves shall be plotted from zero flow at shut-off head to pump capacity at minimum specified head:
  - 1. Certified factory test results of each pumping unit in accordance with the standards of the Hydraulic Institute.
  - 2. Factory-tested, certified, and guaranteed pump performance curves showing the specified requirements for head/capacity, brake horsepower, pump efficiency, speed of rotation, and NPSHR for each pumping unit. Characteristics of pumps furnished may have a tolerance of 1% percent below or 5% above the head and capacity of the specified requirements.
- H. The Contractor shall submit the Manufacturer's Certificate of Installation, Testing, and Instruction as specified in Division 1, General Requirements.
- I. If it is not possible to comply with certain requirements of this Specification, include in submittals a complete description of all requirements not complied with.
- J. The Contractor shall submit a signed letter from an authorized representative of the pump manufacturer certifying that each pumping unit will not clog or bind on the solids typically found in the application specified in this Section.
- K. If the Contractor deviates from the piping layout as shown on the Contract Drawings, the Contractor shall submit scaled piping drawings showing locations and dimensions to and from fittings, valves, tanks, equipment, structures, and related appurtenances. Provide scaled drawings to a minimum scale of 1 inch equals 10 feet. Provide details to minimum scale of 1/8 inch equals 1 foot.

Elevations shall correspond to referenced vertical elevation datum shown or provided for this project.

- L. Provide wiring and control panel drawings related to the alarming systems.

## 1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American Iron and Steel Institute (AISI)
- B. American Society for Testing and Materials (ASTM)
- C. American Society of Mechanical Engineers (ASME)
  - 1. ASME B16.1—Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250.
  - 2. ASME B16.5—Pipe Flanges and Flanged Fittings NPS 1/2 through NPS 24 Metric/Inch Standard.
- D. American Gear Manufacturers' Association (AGMA)
- E. American Welding Society (AWS)
- F. Anti-Friction Bearing Manufacturers Association (AFBMA)
- G. National Electrical Manufacturer's Association (NEMA)
  - 1. NEMA MG 1—Motors and Generators Standards.
  - 2. NEMA MG 1-12.58.1—Standardized Method for Testing.

## 1.04 QUALITY ASSURANCE

- A. The Contractor shall provide quality assurance measures for the equipment specified in this Section in accordance with Section 11000, General Equipment Requirements.
- B. The pumps shall be shipped to the jobsite complete with the motor, local wiring, control, equipment base, and anchor bolts and other appurtenances as specified pre-installed. Spare parts shall be shipped loose and ready for installation at the location shown on the Drawings.

- C. Modifications to the manufacturer's standard design may be required to meet these Specifications. Equipment not complying with the mechanical, electrical, and material integrity established by these Specifications will not be acceptable as determined by the Engineer.
- D. All of the equipment, accessories, and controls specified in this Section shall be furnished by a single manufacturer and shall be standard units of proven ability as manufactured by a competent organization that is fully experienced, reputable, and qualified in the manufacture of the equipment to be furnished.

## 1.05 QUALIFICATIONS

- A. The manufacturer(s) of the equipment specified in this Section shall meet the qualifications specified in Section 11000, General Equipment Requirements. Additionally, the pump manufacturer shall meet the following qualifications that supersede the requirements specified in Section 11000, General Equipment Requirements:
  1. The manufacturer shall have a minimum of five installations in Florida that are similar to the pumping equipment specified in this Section. The Engineer shall reserve the right to determine if previous installations by the manufacturer are similar to the pumping equipment specified in this Section.
  2. The Contractor shall submit a list of no fewer than 10 reference installations of pumps in identical service applications to those specified in this Section. At least five of the reference installations provided shall be of the exact model pump specified in this Section. References shall be pumps that have been in continuous service for at least 3 years from the Bid Date.

## 1.06 MAINTENANCE

- A. The Contractor shall furnish the following spare parts for each of the four pumps in clearly identified containers, labeled for easy identification without opening the packaging and suitably protected for long-term storage in a humid environment.
  1. One stator assembly with TSE sensor sleeves.
  2. One set of universal joint assemblies.
  3. One of each set of mechanical seals, if applicable.
  4. One rotor.
- B. The Contractor shall furnish the following spare parts for each of the two pump models in clearly identified containers, labeled for easy identification without

opening the packaging, and suitably protected for long-term storage in a humid environment.

1. One motor.

## 1.07 SYSTEM DESCRIPTION

- A. The pumping equipment specified in this Section shall be designed to pump digested sludge from two stations to their respective locations as shown on the Drawings.
  1. Truck Off-Loading and Recirculation Pump
    - a. Shall be used to pump sludge from the Truck Off-Loading Station to the Sludge Holding Tank.
    - b. Shall be used to recirculate sludge within the Sludge Holding Tank (pumping from the bottom of the tank and discharging to the top of the tank).
  2. Dewatering Feed Pumps
    - a. Shall be used to pump sludge from the Sludge Holding Tank to the Dewatering Building.
    - b. Shall be capable of pumping sludge directly from the Anaerobic Digester to the Dewatering Building.
- B. Equipment furnished under this Section shall be designed for a municipal wastewater treatment plant environment in which the equipment is exposed to the atmosphere. The equipment shall be designed for humid atmospheric conditions in West-Central Florida.

## PART 2 PRODUCTS

### 2.01 PERFORMANCE AND DESIGN REQUIREMENTS

- A. Equipment Identification Labels:
  1. Truck Off-Loading and Recirculation Pump: 400-P-1.
  2. Dewatering Feed Pumps: 100-P-1, 100-P-2, and 100-P-3.

B. Service Conditions:

1. Liquid Pumped: Digested Sludge:
  - a. Percent Solid: 2 to 4%.
  - b. Design Specific Gravity: 1.00 to 1.02.
  - c. Apparent Viscosity: 300 to 1,000 CP.
  - d. Solid Size: 1/4 inch.
  - e. pH: 5 – 9.
  - f. Design Pumping Temperature: 68°F to 84°F.
2. Minimum Available Suction Head: 6.5 feet.
3. Minimum Available NPSH: 25.61 feet (absolute).

C. General Design Requirements:

| Unit Designation                                | Truck Off-Loading and Recirculation Pumping Station | Dewatering Feed Pumping Station |
|---|---|---------------------------------|
| Number of Units                                 | 1   | 3                               |
| Total Head at Primary Design Condition (feet)   | 29  | 90                              |
| Capacity at Primary Design Condition (gpm)      | 500   | 150                             |
| Total Head at Secondary Design Condition (feet) | –   | 55                              |
| Capacity at Secondary Design Condition (gpm)    | –   | 50                              |
| Discharge Diameter                              | 8-inch  | 8-inch                          |
| Maximum RPM at Design Point                     | 280   | 280                             |
| Drive   | VFD   | VFD                             |

D. Pump Mounting:

1. Base Mount (on a common fabricated-steel base-plate).

E. Acceptable Manufacturers:

1. Moyno, Inc. EZ Strip Model.
2. Engineer-approved equal.

## 2.02 EQUIPMENT

A. The pumping equipment specified in this Section shall in general consist of the following components:

1. Pump Case.
2. Rotor.
3. Stator.
4. Drive Train:
  - a. Universal Joint.
  - b. Drive Shafts.
  - c. Bearings, if applicable.
5. Motor.
6. Accessories.

B. Pump Casing:

1. The pump body shall be thick-walled ASTM A48 cast iron. All cast parts will be smooth and free of sandholes, blowholes, and other defects.

C. Rotor and Stator:

1. Each pump shall employ a single-helix convoluted rotor operating in a double-helix convoluted stator.
2. The convolutions shall be configured to form a cavity between the rotor and stator progressing from the pump inlet to pump discharge outlet with the operation of the rotor. The fit between the rotor and stator at the point of contact shall compress the stator material sufficiently to form sufficient sealing to prevent leakage of sludge.
3. The rotor shall be provided with the following plating systems:
  - a. Chrome Plating: a minimum of 0.010-inch thickness with a minimum Rockwell hardness of 57-60 Rc.

- b. Rotor shall be manufactured in one piece from alloy steel conforming to ASTM A322, grade 4140/4145.
- 4. The stator material shall be a single piece medium-high acrylonitrile Buna-N rubber with a minimum Durometer hardness (Shore A) of 70 to 76.
- 5. The stator shall use 720° clamp rings to fasten to the normal horizontal flange and suction housing and shall have sealed ends. The stator seals shall be designed to prevent the material from being pumped from contacting the stator bonding and tube.

D. Drive Train

- 1. Rotor shall be driven by means of a heavy-duty drive train. Rotor shall be joined to the drive shaft by means of connecting the rod with sealed pin-type universal joints at each end. Pin-type universal joints shall be factory lubricated with oil and completely sealed from abrasive fluid being pumped.
- 2. Shaft shall be sealed using a single internal, bi-directional mechanical seal. Seal materials shall be solid silicon carbide faces with 316 stainless steel metal parts and Viton elastomers. The stuffing box housing shall be drilled and tapped for water flush connection.
- 3. Drive shaft shall be of solid drive shaft design to avoid clogging and/or trapping solids. Universal joint head shall be removable from the drive shaft to allow access to mechanical seal without disturbing drive end of pump.

E. Motor:

- 1. The motors shall meet the following:

| Unit Designation     | Truck Off-Loading and Recirculation Pumping Station | Dewatering Feed Pumping Station |
|----------------------|---|---------------------------------|
| Max Motor Power (HP) | 25  | 15                              |
| Voltage              | 230/460   | 230/460                         |
| Phase                | 3   | 3                               |
| Hertz                | 60  | 60                              |

- 2. All motors shall have NEMA Premium Efficiency in accordance with NEMA MG 1-12.58.1 and guaranteed minimum full load efficiency

labeled on the motor shall be equal or exceed the values in NEMA MG 1 Table 12-12.

3. Each motor shall be provided with two motor winding thermostats. Thermostats shall be connected in series and embedded in adjoining phases as required by Underwriters Laboratories for motors of 1 HP or larger. Thermostats shall be automatic reset, normally closed contact rated at 3 amperes at 115 VAC.
4. A standard in-line gearmotor shall drive the pump with a NEMA C face connection between the motor and the gearbox. The gearbox shall employ helical reduction gearing with a service factor of 2.0 and AGMA Service Classification II. Gears shall run in an oil bath and the reducer housing shall be equipped with oil fill, drain and level indication. Gears shall be full filet, radius forged, and carburized. Gearbox housing shall be single-piece iron casting with internal reinforcement.
5. Each pump motor shall be designed to withstand up to 15 separate pump starts per hour.
6. Acceptable manufacturer:
  - a. Baldor.
  - b. US Motors.
  - c. WEG.
  - d. Engineer-approved equal.

#### F. Accessories

1. Each pump shall be equipped with the following accessories:
  - a. Run-Dry Protection: The stator shall be fitted with a sensor sleeve and thermistor sensor.
  - b. Over-Pressure Protection: Each pump unit shall be supplied with a single-point pressure switch. The pressure ranges for the switch shall be selected specifically for each specified service.

### 2.03 PAINTING

- A. Equipment shall be provided with the manufacturer's recommended shop and field coating systems for severe-duty services rated for outdoor exposure in Florida.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. The Contractor shall install the equipment specified in this Section in accordance with Section 11000, General Equipment Requirements, and in accordance with the manufacturer's recommendations.
- B. Install the equipment in the locations as shown on the Drawings and in accordance with the manufacturer's published instructions and recommendations and the approved shop drawings. Installation shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the manufacturer's recommendations.
- C. The Contractor shall be responsible for providing all anchor bolts and fasteners. These components shall be AISI Type 316 stainless steel.
- D. Adjust pump assemblies so that the motors are properly aligned, plumb, and level with the pumps and all interconnecting shafts and couplings.
- E. Provide non-shrink grout for pump installation in accordance with Section 03600, Grout.
- F. All strain from the attached piping shall be eliminated from the pumps, and any evidence of pump or motor misalignment, noisy operation, or other signs of improper setting shall be corrected by the Contractor using the means specified in this Section at no additional cost to the Owner. Care during storage, installation, and lubrication shall be in strict accordance with the manufacturer's recommendations.

### 3.02 FIELD TESTING

- A. The Contractor shall provide the services of a factory-authorized service representative to perform, approve, and certify the pre-startup testing and startup testing specified in this Section. The service representative shall be certified and employed by the manufacturer of the equipment specified in this Section. All field testing shall be provided in accordance with Section 11000, General Equipment Requirements.
  - 1. The factory-authorized service representative shall be onsite to perform the field-testing services specified for one 8-hour day, excluding travel time.

2. Pre-Startup Testing: The factory-authorized service representative shall perform the pre-startup testing specified in this Section in accordance with Section 11000, General Equipment Requirements.
3. Startup Testing: The factory-authorized service representative shall perform the startup testing specified in this Section in accordance with Section 11000, General Equipment Requirements.
4. Final Mechanical Performance Testing: The Contractor shall perform final mechanical performance testing for this equipment in accordance with Section 11000, General Equipment Requirements.

### 3.03 TRAINING SERVICES

- A. The manufacturer's technical representative shall be on site to perform training services in accordance with Section 01820, Training, and Table 11000-1, Equipment Testing and Training Requirements.
- B. An authorized representative of the pump manufacturer shall instruct representatives of the Owner in startup, operation, and maintenance procedures. The Contractor shall procure the services of the pump manufacturer's representative for on the project site training service in accordance with Table 11000-1 in Section 11000, General Equipment Requirements. The manufacturer's services specified represent an absolute minimum acceptable level of service and are not intended to limit the responsibilities of the Contractor to comply with all requirements of the Contract Documents. The Contractor shall procure, at no additional cost to the Owner, all services required to comply with these requirements, including additional or extended trips to the job site by the manufacturer's representative.

### 3.04 MANUFACTURER'S CERTIFICATION OF COMPLIANCE

- A. The Contractor shall furnish a Manufacturer's Certification of Compliance for the equipment specified in this Section in accordance with Section 11000, General Equipment Requirements.

END OF SECTION

**DIVISION 13**

**SPECIAL CONSTRUCTION**

**SECTION 13232**  
**ALUMINUM FLAT COVERS**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. The Contractor shall furnish all labor, materials, and equipment to provide a complete, installed system of fixed and removable, custom fit, flat aluminum covers over the Sludge Holding Tank. The Sludge Holding Tank Cover System includes cover panels, structural supports, and attaching hardware. The cover shall be fully engineered, substantially airtight, aluminum cover structure comprised of panels and beams.
- B. All equipment shall be installed, adjusted, and tested in strict accordance with this Section and the manufacturer's recommendations.
- C. The manufacturer shall field-verify all dimensions before fabrication of components.

**1.02 RELATED WORK**

- A. Section 01330, Submittals and Acceptance.
- B. Section 01650, Delivery, Storage, and Handling.
- C. Section 01780, Warranties and Bonds.
- D. Section 01785, Record Documents.
- E. Section 01830, Operations and Maintenance Manuals.
- F. Section 11000, General Equipment Requirements.

**1.03 SUBMITTALS**

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Shop Drawings: Submit for approval the following:
  - 1. Manufacturer's literature, illustrations, specifications, and engineering data.
  - 2. Dimensioned drawings showing layout, final installation, fabrication methods, assembly, accessories, and installation details.
  - 3. Setting drawings, templates, and directions for the installation of anchor bolts and other anchorages.

4. Deviations from Drawings and Specifications.
  5. Proof of qualifications (see paragraph 1.07A).
- B. Computations and Certifications:
1. Complete structural calculations showing the governing stresses in all members and connections and detailed shop drawings. Preliminary drawings shall be stamped by the cover Manufacturer's Professional Engineer. Final Drawings and calculations shall bear the stamp of Professional Engineer registered in the State of Florida.
  2. A letter of certification signed and sealed by a Professional Engineer registered in Florida confirming that the aluminum cover is in full compliance with the Contract Drawings and Project Specifications including any testing provisions included therein.

## 1.04 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. Aluminum Association
- B. American Welding Society (AWS)
  1. AWS D1.2/D1.2M—Structural Welding Code – Aluminum.
- C. Florida Building Code
- D. National Environmental Balancing Bureau (NEBB)
  1. Procedural Standards for Testing, Adjusting and Balancing of Environment System.
- E. Uniform Building Code (UBC)

## 1.05 QUALITY ASSURANCE

- A. Fabrication and Workmanship
  1. Workmanship: The quality of workmanship shall be equal to the best general practice in modern structural fabrication shops. Workmanship,

- fabrication, and shop connections shall be in accordance with the latest edition of AWS D1.2/D1.2M.
2. Preparation for Welding: All components to be welded shall be free of dirt, grease, and other contaminants and shall fit up properly for sound welding. Surfaces to be welded may not be cut with oxygen. Sawing, shearing, or machining may be used.
  3. Welding Procedures: All welding shall be with an inert gas shield arc process. Machine settings shall be developed with test welds of the same material, alloy, and geometry as the work pieces, and samples will be tested destructively.
- B. The Contractor shall provide quality assurance measures for the items specified in this Section in accordance with this Section and Section 11000, General Equipment Requirements.
- C. All of the equipment, accessories, and other appurtenances specified in this Section shall be furnished by a single manufacturer and shall be standard units of proven ability as manufactured by a competent organization that is fully experienced, reputable, and qualified in the manufacture of the equipment to be furnished.

## 1.06 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section and in strict accordance with the manufacturer's instructions and recommendations.

## 1.07 QUALIFICATIONS

- A. Manufacturer's Qualifications: Manufacturer shall be a company specialized in providing engineered aluminum covers for wastewater treatment tanks/troughs for at least 10 years with a minimum of five successful and similar installations in Florida. These installations shall be similar in square footage and design to this project. When requested by the Engineer, submit written evidence to show experience qualifications and adequacy of plant capability and facilities for performance of contract requirements.
- B. Erector: Regularly engaged for at least 10 years in the erection of aluminum covers for wastewater treatment tanks.
- C. Welders: Qualified and licensed within the past 2 years in accordance with AWS.

## 1.08 OPERATION AND MAINTENANCE (O&M) MANUALS

- A. O&M Manuals shall be in accordance with General Conditions, Supplementary Conditions, and Section 01830, Operations and Maintenance Manuals.

## PART 2 PRODUCTS

### 2.01 DESIGN CRITERIA

- A. Except as otherwise specified or shown, all design, materials, joints, connections, and workmanship shall conform to the Uniform Building Code (UBC), the Florida Building Code, and the Aluminum Association.
- B. Design flat cover to withstand the cover dead load plus equipment dead load plus the following live load conditions:
  1. The structure is in a hurricane-prone region. Wind loading shall be in accordance with the applicable Florida Building Code:
    - a. Base wind speed shall be 155 mph.
    - b. Importance factor shall be in accordance with Industrial Standards.
  2. Span: The clear span length of the cover shall be as noted on the Contract Drawings.
  3. Radius: The radius of the cover shall be as noted on the Contract Drawings.
  4. The flat cover shall be a clear span structure, designed to be supported from the tank walkway and concrete tank walls. The cover shall span to the designed bridge structure and the bridge structure shall be designed to support the service level loads of the cover, as provided by the cover manufacturer.
  5. The flat cover shall not have any support beams below the decking that exceed the 1-foot-6-inch freeboard (from the top of the tank wall to the liquid level) inside the tankage placing any cover support beams in direct contact with the liquid inside the tank.
  6. The flat cover shall provide a means to remove four panel sections as shown on the Contract Drawings for ease of maintenance and removal of the mixers and impellers. The overall clear and unobstructed opening after panel and beam removal shall accommodate the direct dead lift of a 10-foot-6-inch-diameter impeller on the mixer shaft without tilting or

turning the angle of the shaft or impeller. The cover system surrounding this opening shall maintain the design stress, concentrated live load, distributed design live load, and deflection requirements of this specification when these panels and beams are removed for mixer maintenance.

7. The removable panel sections shall be labeled to clearly indicate how to remove and reinstall the sections during maintenance and removal of the mixer and impellers.
8. Concentrated Live Load: The structural components shall be designed to support a 400-pound load on a 6-inch-x-6-inch area located anywhere on the surface of the structure without permanently deforming the tested area.
9. Distributed Design Live Load and Deflection: All structural components shall be designed to support the dead weight of the structure, plus a live load of 50 pounds per square foot of surface. The maximum deflection of any component under this load shall not exceed L/240 of the span of that component. In no event shall the dead load deflection exceed the rise of any component to avoid surface ponding.
10. Design Stresses: All allowable design stresses in structural aluminum shall be in accordance with the *Specifications for Aluminum Structures* for building-type structures by the Aluminum Association.
11. Skid Resistance: The cover shall possess an integral non-skid surface, and no exposed area of cover system wider than 1 inch shall be without ribs/non-skid surface. The aluminum-decking surface of the structure shall be Hallsten's Deck Slat or Engineer-approved equal, which is ribbed to provide an aggressively non-skid surface. The edges of adjacent deck slats shall double interlock so that the slats shall act together. The decking surface shall be manufactured from alloy 6061-T6. The manufacturer of the non-skid surface shall demonstrate in writing satisfactory performance for a minimum of 10 years in the wastewater industry for the intended purpose. This surface shall not be achieved by the use of paint, adhesive tapes, sand blasting, or any other means other than an extruded process.
12. Chemical Resistance: Panels shall be fabricated entirely of 6061-T6 corrosion-resistant aluminum extrusions. Every panel to beam connection shall be chemical resistant and will not weaken or corrode and will interlock. A mechanical and replaceable Santoprene seal shall isolate the cover perimeter from the concrete wall. No foam tape or caulk shall be allowed.

13. Configuration: The surface-mount aluminum cover shall land on the surface of the existing concrete as shown on the Contract Drawings and on ledger angle where applicable. The cover shall be composed of panels and beams. All panels shall interlock with the adjoining beam and panels without the use of threaded fasteners. Uplift of each panel will be resisted with the use of an integral latch system. The weight of an individual panel shall not exceed 150 pounds. Each removable panel shall be easy to remove without disruption of adjacent panels, and the lifting force required shall not exceed the dead weight of the panel.

## 2.02 DETAILS OF CONSTRUCTION

- A. Manufacturer: Provide flat cover as designed and fabricated by one of the following:
1. Hallsten.
  2. Or Engineer-approved equal in accordance with Article 2.03 of this Section.
- B. Flat Coved Dimensions: The flat cover shall conform to the dimensions shown on the Contract Drawings.
- C. General:
1. The flat cover shall be a clear span structure, designed to be self-supporting from its periphery on concrete tank walls.
  2. The edges of each panel shall be interconnected as to prevent slippage or disengagement under design conditions.
  3. Provide gasket material such that all connections to the concrete structure are substantially airtight. Provide gasket material such that all connections between adjacent aluminum cover panels are substantially airtight. Gasket material shall be as specified below.
  4. Provide the flat cover with access hatches, as shown on the Contract Drawings.
  5. Provide openings for odor control ductwork and air piping inlet for the tank cover in accordance with the details of the Contract Drawing and at locations shown on the Contract Drawings.
  6. No welding or thermal cutting of aluminum structural members, supports, or connections will be permitted in the field.

D. Materials:

1. Aluminum: All aluminum used in the fabrication of the cover shall be alloy 6061-T6. All plate shall be alloy 6061-T6. Material shall be new and of top quality.
2. Welding Electrodes: Welding shall be with electrodes of an alloy, which shall produce welds with strength and corrosion-resistant characteristics compatible to the base metal.
3. Fasteners: All fasteners between aluminum components shall be stainless steel or structural plastic. Aluminum shall be isolated from dissimilar materials by means of a stainless steel spacer or an elastomeric isolator. Beams and panels shall be fastened to concrete using stainless steel drill in place anchor bolts.
4. Steel Accessories: No carbon steel components shall be used.
5. Seals: A mechanical and replaceable Santoprene seal shall isolate the cover perimeter from dissimilar materials such as concrete and steel. No foam tape or caulk shall be allowed for isolation of cover system.
6. Access Hatch Panels: Access to any location under the cover shall be gained through integral gear hinged access hatches. The Access Hatch Panels shall have the identical properties as the rest of the aluminum cover including loads, deflection, and slip resistance specifications. The access-hinged panels shall be the full panel width. The length of the access panel shall be clearly indicated on the submittal drawings and in accordance with the Contract Drawings. Hinged panel components including hinges, decking, and lifting handles shall be extruded 6061-T6. While in the closed position, the hatches will be completely flush and therefore pose no tripping hazard. In the open position, the panel shall lie flat on the cover and will not need a hold-open device.
7. Pipe penetration kits shall be provided as shown on the Drawings for all locations where liquid piping penetrates the plane of the cover.
8. Duct penetration kits shall be provided as shown on the Drawings for the location on the tank where the odor control ducting intersects with the cover.
9. A small 18-inch square hatch will be provided on the tank cover to facilitate the Contractor-provided float switch and transducer for liquid level sensing.
10. A penetration kit shall be provided on the tank cover to accommodate the level transducer for liquid level sensing.
11. Handles: Handles shall be an integral flush-mounted aluminum and incorporated into the non-skid deck slat.
12. Anchor Bolts: Furnish anchor bolts and nuts of Series 316 stainless steel, of ample size and strength for the purpose intended, sized by the equipment manufacturer.

## 2.03 ENGINEER'S PRE-APPROVAL OF ALTERNATE COVERS

- A. The manufacturer of an alternate cover system shall submit a pre-approval submittal package to the Engineer at least 14 days before the Bid Date. Only approved alternates listed by addendum will be acceptable. The following information and supporting documentation shall be provided to the Engineer.
  - B. Shop Drawings: Submit for approval the following:
    - 1. Manufacturer's literature, illustrations, specifications, and engineering data.
    - 2. Complete detailed drawings showing the proposed cover system, fabrication methods, assembly, accessories, and installation details.
    - 3. Setting drawings, templates, and directions for the installation of anchor bolts and other anchorages.
    - 4. Deviations from Drawings and Specifications.
    - 5. Proof of qualifications (see paragraph 1.07A).
  - C. Computations:
    - 1. Complete structural calculations showing the governing stresses in all members and connections and detailed shop drawings. Preliminary drawings shall be stamped by a Florida-registered Professional Engineer.
    - 2. Manufacturer's standard guarantee.
    - 3. A letter of certification signed and sealed by a Florida-registered Professional Engineer confirming that the aluminum cover is in full compliance with the Drawings and Specifications including any testing provisions included therein.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. All preparation to the existing concrete tank for installation of the cover shall be in strict accordance with the manufacturer's recommendations so as not to damage the existing concrete tank and to allow for proper installation of the cover.
- B. The flat cover shall be erected in strict accordance with the manufacturer's instructions by the manufacturer skilled and experienced in the erection of aluminum structures and covers.

- C. The manufacturer shall field-verify all dimensions before fabrication of components.
- D. Ensure an initial substantially airtight/watertight installation of the structure by establishing and adhering to a uniform method of applying the prescribed torque to the strut cover bolt fasteners.
- E. Properly align cover, ensuring that it is plumb and level. Field re-fabrication of structural components of panels will not be accepted. Forcing of the structure to make it fit during construction is expressly forbidden and not acceptable.
- F. The cover manufacturer shall install the aluminum cover with certified crews from the factory who regularly install tank covers. Installation shall not be subcontracted nor handled by the Contractor. Installation by the manufacturer shall ensure installation of the cover according to the required windload standards according to Florida Building Code. The manufacturer shall certify the installation in writing after the installation is completed, and the certification shall be signed and sealed by a Florida-registered Professional Engineer.

### 3.02 TESTING

- A. The manufacturer's technical representative shall be on site to perform training services in accordance with Section 01820, Training, and Table 11000-1, Equipment Testing and Training Requirements.
- B. Loads: After installation, the cover structure shall be tested for conformance with the deflection limits. A load of 400 pounds shall be placed as directed by the Engineer, and the maximum deflection created by the load shall be measured.
- C. Prequalified Shop Testing:
  - 1. The manufacturer shall perform a prequalified shop air tightness test and certification for the cover components proposed. This test shall be performed in accordance with the *Procedural Standards for Testing, Adjusting and Balancing of Environment System* as published by the National Environmental Balancing Bureau (NEBB) on cover components of no less than 80 square feet. Said test shall be conducted and witnessed by a NEBB-certified technician.
  - 2. A report of the test shall be prepared by the certified technician and shall be sealed with the NEBB seal. The report shall include a description and illustration of the test components and test apparatus and a report of the results.

3. The cover shall maintain an air intrusion leakage rate not to exceed 0.2 cfm per square foot at an applied negative pressure of 0.2 inch of water column for 5 minutes.

END OF SECTION

**SECTION 13316**  
**SOFTWARE CONTROL BLOCK DESCRIPTIONS**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section provides functional descriptions of the computer software requirements for the Process and Instrumentation and Control System (PICS) as indicated in specifications and on the drawings. These descriptions are intended to provide an overview of the operating concept of the plant process equipment rather than describing in detail every operating feature, I/O point, or required set-point.
- B. The Supplier shall provide all PLC and Human Machine Interface (HMI) programming, and graphic configuration as required for completely functional system in accordance with the contract documents.
  - 1. Programming: The PICS Supplier shall configure and program all hardware and network and communications devices required for an operating system plus any testing software required for the factory test. The PICS Supplier is responsible for programming the Plant SCADA System and Plant Control Work Station (PCWS) and all other plant systems PLCs.
  - 2. Control Hierarchy: Several levels and modes of operational control will exist for the system. Operators will have the ability to monitor and control equipment via local manual controls at the equipment, or via the local PLC Operator Interface Terminal (OIT) and through the SCADA computers. The selection of these operational modes will be made available through the use of hardwired and/or software selector switches.
    - a. Manual Control (Local): Hardwired local switches Local-Off-Remote (LOR) (or as shown on plans and noted in detailed loop descriptions) provide selection of Local Manual control, or Remote Manual control (via PLCOIT or via SCADA) control of the equipment. All equipment equipped with Local Manual LOCAL/OFF/REMOTE (LOR) switches in LOCAL will override all Remote PLC and SCADA control. This mode is intended primarily for maintenance functions and is not intended for normal process control operation. When the local switch is in REMOTE, the device is under computer (PLC and/or SCADA) control.

- b. Computer Control: When the equipment LOR switch is placed in the REMOTE position, equipment will be controlled by the PLC in either the REMOTE AUTO or REMOTE MANUAL mode (via a software switch on the PLCOIT or SCADA screen).
  - c. REMOTE MANUAL: The Operator can remotely control equipment through software Start/Stop commands and where applicable, speed control using software switching on the PLC OIT or via SCADA screen. The Start/Stop Command shall be wired as one discrete output and programmed as maintained RUN command.
  - d. REMOTE AUTO: Control is accomplished via PLC or SCADA automatic control logic strategy.
  - e. While in the REMOTE AUTO mode, SCADA and PLCOIT MANUAL commands are not executed by the PLC control logic.
- C. Programming of control logic and configuration of the EXISTING CONTROL SYSTEM with new process graphical screens – HMI software is part of the Work and shall be the responsibility of the PICS Supplier.
- D. Control System: The Instrumentation and Control System shall apply to all systems described in this Section. Attached PLC I/O tabulations are for reference. The PICS Supplier and CONTRACTOR shall confirm in the field the existing physical PLC wiring before adding or removing wiring.

## PART 2 PRODUCTS

### 2.01 GENERAL

- A. The descriptions are applicable to the software specified in Section 13401, Process Instrumentation and Controls (PICS).

## PART 3 EXECUTION

### 3.01 PLC PROGRAMMING FUNCTIONAL REQUIREMENTS

- A. The following paragraphs describe general configuration tasks that are required for the system PLC(s). These tasks shall be programmed in the applicable PLC. Each PLC may have multiple instances of each of these tasks or may have no instances of some or all of these tasks. The input/output lists (located in these documents as specified in Section 13401, Process Instrumentation and Controls [PICS]) and detailed equipment control descriptions (included herein) should be referenced to determine the requirements for each PLC.

- B. PLC or HMI requirements detailed here will not be repeated in the individual control loop descriptions but are required.
- C. The following paragraphs cover functional requirements of the software, which are generic and may or may not be related to any specific control loop. The requirements apply to both the local OITs and SCADA computers. Control functionality will be identical for all sites.
- D. Abbreviations: The following abbreviations are used in the control descriptions:

|     |     |                      |
|-----|-----|----------------------|
| 1.  | AM  | Auto-Manual          |
| 2.  | HOA | Hand-Off-Auto        |
| 3.  | LR  | Local-Remote         |
| 4.  | LOR | Local-Off-Remote     |
| 5.  | RS  | Run-Stop             |
| 6.  | OC  | Open-Close           |
| 7.  | OSC | Open-Stop-Close      |
| 8.  | OO  | On-Off               |
| 9.  | PV  | Process Variable     |
| 10. | SP  | Set Point (variable) |

- E. Available Process Values: All generated process alarm, equipment status, and process variable values associated with a particular PLC shall be available at its OIT and also on SCADA HMI including remote displays (PCWS). Refer to HMI specification for additional requirements.
- F. Flow Totalized Values: Flow values shall be integrated, totalized, and stored in the PLC registers so the values displayed on the OIT and SCADA computers will be identical.
  - 1. For each flow meter whose analog “flow” signal is monitored by a PLC or for any calculated flow signal utilized for process control and monitoring, internal flow totalization shall be accumulated by the respective PLC. The flow totalization routine shall utilize floating point variables to accomplish the flow integration.
  - 2. Two flow totals shall be accumulated and accessible from the PLC. The current 24-hour period total, the previous 24-hour period total shall be calculated and stored. The 24-hour total shall reset at midnight.
  - 3. The flow total values shall be displayed on the OIT.
- G. System Failure: Failure of a PLC shall result in safe shutdown of associated process equipment. Interposing relays shall be provided where required to assure that equipment will revert to its fail-safe condition. Failure of any PLC or its communication shall be alarmed.

- H. Rack/Module Configuration: The rack and module definitions for each PLC, as well as the PLC communications configuration shall be completely configured to allow proper addressing of all field connected I/O points. This shall include configuration of any remote input/output (RIO) racks.
- I. PLC Database Definition: The PLC database will include both field I/O points and internally generated points required for programming. All field I/O points and internal programming points shall be fully defined according to database naming conventions approved by ENGINEER and OWNER. As a minimum, each database point shall be provided with a tag name, engineering unit, alarm parameters, and description. Internally generated points (calculations) and set-point variables shall be provided as required whether specified in the control descriptions or not. All process and timer set points shall be Operator adjustable from the OIT.
- J. Analog Scaling: Each analog input and output will be appropriately scaled in engineering units for use in internal PLC programming and monitoring by the OIT and remote SCADA computers.
- K. Equipment Runtimes: For each equipment item whose "run" status is monitored by a PLC, an internal equipment runtime shall be accumulated by the respective PLC. The runtime procedure will monitor the status of the equipment "run" contact and, when the equipment is running, increment a software timer that maintains equipment runtime to within a one-minute resolution. The timer shall stop incrementing, but not reset, when the "run" contact indicates that the equipment is not running. The timer value shall increment an hour counter that maintains a floating-point value representing the equipment run time in hours and tenths of hours. The counter value shall be available for display on the OIT and SCADA computer. A manual reset of the runtime value shall be available at the OIT for personnel at the supervisor level and above.
- L. Equipment Starts: For each equipment item whose "run" status is monitored by a PLC, an internal equipment number of 'Starts' shall be accumulated by the respective PLC. The runtime procedure will monitor the status of the equipment "run" contact and, when the equipment is running, increment a software counter that maintains equipment 'starts'. The counter value shall be available for display on the OIT and SCADA computer. A manual reset of the value shall be available at the HMI for personnel at the supervisor level and above.
- M. Change-of-State Alarms: While equipment is controllable from the PLC (IN REMOTE), discrete output commands shall be compared to their respective process feedback status signal (where available) to verify proper execution. If the feedback status does not match the most recent output command (after an

adjustable time delay), an alarm message shall be displayed on the HMI computer and transmitted to SCADA. The alarm shall remain energized until the proper discrete condition is sensed and until the operator resets the alarm.

N. Equipment Availability: In general, equipment with PLC control has been provided with a local HOA, HOR, LR, or LOR selector switch that transfers control to the PLC. The PLC shall monitor the position of this local selector switch to determine if the equipment is available for PLC control. If more than one ‘switch’ or availability condition exists, the ‘switches’ shall be series hard-wired such that a single signal shall indicate that the equipment is available for PLC control. If the equipment is not available, the PLC program shall not attempt to implement remote manual or automatic status changes for the equipment. The PLC program may, however, need to implement special routines if equipment unavailability affects a sequence (as described in the detailed equipment descriptions).

1. Upon:

- a. Transmitter Failure: Analog signal less than 2 mA or greater than 22 mA.
- b. Pump/Motor Failure: The PLC shall automatically remove its Call-to-Run and if applicable, set its analog set-point value to a minimum value.
- c. An alarm shall be generated on any failure.

O. Maintained/Momentary Outputs: The need for maintained or momentary control outputs shall be determined from the input/output listing and the electrical schematics. In general, equipment with only one PLC control output point indicated in the I/O list shall be programmed for a maintained control output. Equipment with two (or more) control outputs shall be programmed for momentary outputs as required. Provisions shall be made, in either case, to remove the active state (start, open, forward, initiate, etc.) control output when an equipment failure is sensed or when the equipment transitions from available to unavailable (local switch change).

P. Power Failure: A utility power failure is detected by the PLC UPS running from battery power.

1. Upon detection of utility power failure:

- a. A power failure alarm is generated.

2. All PLC controlled equipment is turned off until main power has been restored for 30 seconds.
  3. Upon power restoration for 30 seconds:
    - a. A power restored alarm is generated.
    - b. Devices will remain in their current configuration. Note that an equipment REMOTE AUTO / REMOTE MANUAL mode may be altered during the power outage if designated in the detailed control strategy.
    - c. All devices will require Operator intervention (via OIT or SCADA) to restart the equipment when not in REMOTE AUTO mode.
    - d. All devices over 20 HP shall be stagger-started according to control strategy details.
    - e. Control strategy details shall provide additional (if required) actions to occur upon power restoration.
- Q. Manual/Auto Bumpless Transfer: Unless otherwise indicated in the equipment control descriptions, equipment changes from automatic to manual control shall be bumpless. Equipment running or stopped in automatic mode shall remain running or stopped when manual mode is selected.
- R. PLC Peer to Peer Ethernet Communications: Each PLC shall monitor peer-peer PLC communications required for process control of an equipment system distributed among multiple RTUs/PLCs. Communications failures shall be detected, alarmed, and acted upon in accordance with detailed strategy requirements.
- S. PLC Low Battery: An alarm shall be generated on PLC low memory low battery detection.
- T. PLC Generated Alarms: Alarms from each PLC shall be logged into the OIT alarm log table and displayed as described below. This requirement will not be restated in the individual control loop descriptions.
- U. Instrument Calibration: Provide the ability to place all field instruments in a CALIBRATE mode at the SCADA system or OIT. The PLC will hold last value of the field instrument to allow the plant to operate.
- V. PLC Out of Service mode: An alarm shall be generated on SCADA system when the PLC is taken out of service.

### 3.02 OIT FUNCTIONAL REQUIREMENTS

- A. The following paragraphs describe general configuration tasks that are required for the OIT and related software.
  - 1. Database: The system database, including field I/O and internal points shall be established according to the database point naming conventions approved by OWNER. Database generation for field I/O shall include all required coordination with PLC level addresses. All calculated totals, averages, daily totals, etc. calculated by the PLC in Section 3.01 of this Section shall be displayed on the OIT.
  - 2. Alarms: Complete system alarming shall be configured. This shall include configuration of graphical alarm displays, and configuration of audible alarms as available. All process or system alarms shall appear on a dedicated alarm summary screen.
    - a. For LOW or LOW-LOW analog or discrete alarms which do not apply if the associated equipment is not operating, provisions shall be made to prevent generation of these alarms. This shall include alarms such as low amperage alarms for pumps that are not running. This may also include low flows or pressures when associated pumps are not operating (this will only apply if periodic operation of the equipment is considered normal).
    - b. All alarms/events shall be time stamped when displayed or printed. Unacknowledged alarms shall not automatically clear from the alarm summary if they return to normal before being acknowledged.
- B. Manual Entry of Data: The OIT shall allow manual entry data of all ENGINEER and OWNER designated set-points, and process control variables. These variables shall be password protected as indicated in the control descriptions.

### 3.03 EQUIPMENT CONTROL AND CONTROL MODE OVERVIEW

- A. The following paragraphs explain the general format and control modes that are used in the detailed equipment descriptions. These paragraphs apply to the attached, project specific, equipment control descriptions included herein.
- B. Descriptions for control are included in the detailed equipment control descriptions. They are provided primarily for overview information and guidance to show intent for the PICS Supplier. The PICS Supplier are responsible for all

detailed programming requirements for safe and proper operation of the equipment provided by them under all conditions.

1. PICS Supplier and ultimately the CONTRACTOR shall be responsible for all coordination issues between their systems to insure they work together in a seamless operation.

### 3.04 DETAILED EQUIPMENT CONTROL DESCRIPTIONS

- A. The following paragraphs describe functional requirements for various software control blocks in the control system. These descriptions are intended to provide an overview of the operational concept for the facilities, rather than describing in detail every operating feature, requirement, or interlock. The programmer is to provide a functioning system, including failure recovery, whether completely or explicitly stated in the control descriptions.
- B. Introduction: The purpose of the control strategy is to provide a detailed description of the control, monitoring and alarm functional requirements associated with each process loop for the plant control system (PCS) to operate all the processes associated for the operation of the facility.
- C. The process loop number is determined by the ISA tag name. The Control Strategy Description Table in Paragraph 3.04G of this Section provides a cross-reference between the process loop and the associated control strategy.
- D. Each control strategy is divided into sections:
  1. Overview: This Section provides a basic performance description as an introductory guide.
  2. Monitoring and Control: This Section provides required equipment operation status, current process variable measurements, totaling process variable measurements, and active equipment control mode status that are to be monitored ('Monitor' does not include alarms):
    - a. Equipment operation status includes OPEN or CLOSED position; ON or OFF; and LOW, HIGH or OFF. (OFF is also referred to 'READY' in the electrical schematics wiring diagrams.)
    - b. Current process variable measurements include level, pressure,
    - c. Totaling process variable measurements include daily, monthly, and annual total measurements; as well as, equipment (pumps) cumulative runtimes for daily, weekly, monthly and yearly runtimes.

- d. Active equipment control mode status includes REMOTE selected in the field; MANUAL or AUTO selected from the control system interface; PID controller's set point and output; operator entered parameters for control algorithms (such as dosage, timers, etc.); current sequence steps.
- e. Local (Manual) Display/Control: For equipment and valves that have Local Control Stations (LCS), Local Control Panels (LCP) or Motor Control Panels (MCPs), the Local/Off/Remote (L/O/R) hand switches dictates where the equipment or valves are controlled. In LOCAL Mode, the control is from the LCS, LCP or MCP via Open/Close pushbuttons or Start/Stop pushbuttons and also speed potentiometers.

3. Remote Control:

- a. Manual: In this mode the LCS or LCP must be in REMOTE Mode REMOTE MANUAL Mode – control is forwarded to the OIT. Equipment and valves do not operate automatically but must be “pulsed” open/close (for valves and slide gates) or equipment started/stopped manually. Typical POP-UP graphic templates shall be utilized for all valves, slide gates, pumps, equipment, etc.
- b. Auto: Same as Remote Manual Control except: In REMOTE AUTO Mode – control of equipment and valves are controlled automatically from the PLC as defined below:
  - (1) Control: This Section provides required modes of equipment operation, mathematical algorithms, proportional-integral-derivative (PID) controller, and sequencing steps. This Section assumes the equipment is placed in AUTO or REMOTE (from the field). If the equipment is not in REMOTE then the described controls are disabled and the equipment is not available for the OIT. The OIT shall alert the operator defining the problem area or piece of equipment Not-In-Auto Mode or that is not functioning properly.

4. Transfer: This Section provides the functional requirements of transferring from one control mode to another control mode. For example, bumpless transfer is the ability to seamlessly go from one mode to another mode without interrupting the equipment operation.

- a. Active equipment control mode status includes AUTO or REMOTE selected in the field; MANUAL or AUTO selected from

the control system interface; PID controller's set point and output; operator entered parameters for control algorithms (such as dosage, timers, etc.); current sequence steps.

5. Interlock: This Section provides required control interaction between two or more devices and override functions to protect equipment and process performance under normal operations. It also provides the necessary action to be taken if E-STOP is activated. 'Interlocks' do not include override actions caused by field generated alarms, equipment or instrument failure, and total plant or area power outage.

6. Alarms:

- a. Alarm: This Section provides required annunciation, control action and priority of field generated alarms, logic generated alarms, and logic generated warnings. Logic generated alarms and warnings are identified in the control strategy. These alarms include:
  - (1) OOR Analog Input: For all analog inputs, issue an Out of Range (OOR) alarm if an analog input is outside of the 4 to 20 mA range for 30 seconds.
  - (2) FAIL-to-CLOSE: If a CLOSE command is issued and there is no CLOSE status feedback to indicate valve has reached full closed position within 45 seconds or the CLOSE status is not present while valve is commanded to CLOSED position, then issue a FAIL-to-CLOSE alarm.
  - (3) FAIL-to-OPEN: If an OPEN command is issued and there is no OPEN status feedback to indicate valve has reached full open position within 45 seconds or the OPEN status is not present while valve is commanded to OPEN position, then issue a FAIL-to-OPEN alarm.
  - (4) FAIL-to-RUN: If a START command is issued and there is no ON status feedback to indicate device has started within 45 seconds or the ON status is not present while device is running, then issue a FAIL-to-RUN alarm.
  - (5) FAIL-to-STOP: If a STOP command is issued and there is still an ON status feedback after 45 seconds from issuing a STOP command, then issue a FAIL-to-STOP alarm.
  - (6) FEEDBACK FAILURE: A PID controller modulates a valve position or pump speed to maintain a process set point under AUTO mode and the controller's feedback used to determine off set from set point is  $\pm 5\%$  from the set point for 45 seconds then issue a FEEDBACK FAILURE alarm.

- (7) FORCE OVERRIDE: A failure condition occurs that requires the control logic to override a calculated value used for controlling a device such as valve position or pump speed, etc.
  - (8) NO STANDBY AVAILABLE: The control strategy has a ‘duty’ and ‘standby’ or Lead/Lag service operation under AUTO mode and there is only one pump available for AUTO control then issue a NO STANDBY AVAILABLE warning.
  - (9) TRACKING FAILURE: A variable speed device or modulating valve is commanded to a speed or position percentage and the feedback from the drive tachometer or actuator positioner is  $\pm 5\%$  from the commanded speed or position for 45 seconds then issue a TRACKING FAILURE alarm.
  - (10) POWER OUTAGE FORCED STOP: The equipment was running under PLC control in MANUAL mode prior to loss of power and due to the power outage, the equipment was stopped. Issue a POWER OUTAGE FORCED STOP alarm upon this condition.
7. Fault Mode: This Section provides the functional control requirements in the event that there is an equipment or instrument failure. An equipment failure is defined as the inability to control or monitor a device placed under REMOTE control due to an alarm condition. An instrument failure is defined as the inability to monitor a device due to an alarm condition.
8. Power Outage: This Section provides functional control requirements in the event of a loss of power and the functional control requirements upon power restoration. This Section assumes a power outage to be detected by the transfer of normal to generator power for all processes.

- E. HMI Generated Alarms: In addition, alarm priority levels are assigned a number from 1 to 4. The numbers are categorized by the urgency of the alarm condition and are as follows:

| Priority | Description   |
|----------|---|
| 1        | Human safety in Danger/Chemical Spill Potential/Toxic Gas Leak.                               |
| 2        | Equipment or system failure; or interlock to shutdown equipment to prevent mechanical damage. |
| 3        | Control override to prevent jeopardizing process performance or possible mechanical damage.   |
| 4        | Warning of potential problem effecting process performance or possible mechanical damage.     |

F. Control System Overview:

1. Tank

- a. Name: Sludge Tank 100-T-1.

2. Pumps

- a. Name: Truck Off-Loading Pumps Equipment No. 400-P-1.
- b. Name: Dewatering Feed Pumps Equipment No. 100-P-1, 100-P-2, 100-P-3.

3. System Description – Normal Operation

- a. Tank Status: Normal Operation will use the Sludge Holding Tank for sludge holding of:
  - (1) Truck Off-Loading Pump Station (400-P-1).
  - (2) Existing WRF scum pump station and feed piping.
  - (3) Combined Thickened Sludge Piping (Thickened WAS and Thickened Primary Sludge).

4. Pump Logic Status and Alarm Annunciation:

- a. The Truck Off-Loading Pumps will receive the following alarms:
  - (1) The Sludge Holding Tank High Level.
- b. The Dewatering Feed Pumps will receive the following alarms:
  - (1) The Sludge Holding Tank Low Level.
- c. The Dewatering Equipment (Centrifuge and/or Belt Filter Press – Shutdown Alarm).

5. System Description

a. Pump Logic Status:

- (1) The Truck Off-Loading Pump Station at the Sludge Holding Tank will not operate if tank is full.

(2) The Dewatering Feed Pumps will receive the following alarms:

- (a) Sludge Holding Tank Low Level to protect the Dewatering Feed Pumps from pumping dry.
- (b) The Dewatering Equipment (centrifuge and belt filter press) – Shut Down Alarm.

6. Pump Logic Status and Alarm Annunciation:

a. The Truck Off-Loading Pumps will receive the following alarms:

- (1) The Sludge Holding Tank High Level.

b. The Dewatering Feed Pumps will receive the following alarms:

- (1) Sludge Holding Tank Low Level.
- (2) The Dewatering Equipment (Centrifuge and/or Belt Filter Press – Shutdown Alarm).

G. Introduction to Control Description: The purpose of the control strategy is to provide a detailed description of the control, monitoring and alarm functional requirements associated with each process loop for the Plant's control system (PCS) to operate the following processes:

| No. | Control Strategy Description                   |
|-----|--|
| 100 | Sludge Storage Sludge & Dewatering Feed System |
| 400 | Truck Loading                                  |

1. Sludge Storage:

- a. One vertical Hyperboloid-body ragless type impeller mixer will be located in each of the Sludge Holding Tank. The mixer will be controlled by the manufacturer's Control Panel located at the top of the tank. Tank mixers are single speed with continual operation. Mixer will have a local panel with H/O/A switch. In Automatic (A) the mixer runs based on input from SCADA. In hand, the unit is operated locally by Operations Staff.

b. The one storage tank 100-T-1 with mixer 100-M-1 shall be monitored and controlled from the SCADA system or locally. The sequence of operations shall be as follows:

(1) Mixer Local Manual:

(a) The operator sets the HAND/OFF/REMOTE selector switch at the respective mixer to the HAND position.

(b) Status:

- i. Mixer Run.
- ii. Mixer in Hand.

(c) Alarms:

- i. Mixer Trouble.

(d) Interlocks:

- i. None.

(e) Historical:

- i. Record run time, status, and alarms.

(2) Mixer Remote Control:

(a) The operator sets the HAND/OFF/REMOTE selector switch at the respective mixer to the REMOTE position.

(b) The operator sets the HMI, ON/OFF selector switch to the desired position.

(c) Status:

- i. Mixer Run.
- ii. Mixer in Remote.

(d) Alarms:

- i. Mixer Trouble.

- (e) Interlocks:
    - i. Confirm Tank Levels.
  - (f) Historical:
    - i. Record run time, status, and alarms.
- (3) Storage Tank:
- (a) The SCADA system shall monitor Sludge Holding Tank.
  - (b) Status:
    - i. Tank Level.
  - (c) Alarms:
    - i. Tank Impeding High Level (Operator Adjustable).
    - ii. Tank Impeding Low Level (Operator Adjustable).
    - iii. Tank Emergency High Level (Float).
    - iv. Tank Impeding Low Level (Float).
  - (d) Interlocks:
    - i. Shut Down Truck off loading at High Level.
    - ii. Shut Down Feed Pumps on Low Level.
  - (e) Historical:
    - i. Record level, status, and alarms.
2. Sludge Dewatering Feed System:
- a. Three progressing cavity pumps, two dedicated and one back-up, are proposed. The pumps will be controlled with Variable Frequency Drives (VFDs) to allow the pump to handle variations in sludge flows. The VFD will be controlled by the selected dewatering system chosen for that pump (Centrifuge Control Panel (CP) and/or Belt Filter Press). The operator will manually select

and operate which pumps will be used with which dewatering system. Any of the progressing cavity pumps will be capable of pumping to any of the dewatering processes (Belt Filter Press or Centrifuge) through manual manipulation of the valves and pump selection on the SCADA system HMI. The sludge dewatering feed pumps 100-P-1,2,3 shall be monitored and controlled from the SCADA system or locally. The sequence of operations shall be as follows:

(1) Local Manual:

(a) The operator sets the HAND/OFF/REMOTE selector switch at the motor to the HAND position.

(b) The operator at the motor will adjust the speed.

(c) Status:

- i. Pump Run.
- ii. Pump in REMOTE.
- iii. Pump Speed.
- iv. Pump in HAND.

(d) Alarms:

- i. VFD Trouble.
- ii. Motor High Temp.
- iii. Pump High Temp.
- iv. Pump High Pressure.

(e) Interlocks:

- i. Off position at motor HOA will not allow pump to start.

(f) Historical:

- i. Record run time, status, and alarms.

(2) Remote Control:

(a) The operator sets the local HAND/OFF/REMOTE selector switch at the motor to the REMOTE position.

(b) Status:

- i. Pump Run.
- ii. Pump in REMOTE.
- iii. Pump Speed.
- iv. Pump in HAND.

(c) Alarms:

- i. VFD Trouble.
- ii. Motor High Temp.
- iii. Pump High Temp.
- iv. Pump High Pressure.

(d) Interlocks:

- i. In REMOTE at VFD.
- ii. VFD fault.

(e) Historical:

- i. Record run time, status, and alarms.

(3) Remote Control at Dewatering Equipment (Belt Press or Centrifuge OIT):

(a) The sequence of operation is as follows at the OIT:

- i. The operator sets the sludge feed pump local HAND/OFF/REMOTE selector switch at the motor to the REMOTE position.
- ii. The operator selects which feed pumps will serve the press. Pump 100-P-1 is dedicated to the Belt Press, Pump 100-P-3 is dedicated to the centrifuge. Pump 100-P-2 is a swing pump that will serve either the press or the centrifuge from the SCADA system HMI.
- iii. The operator will control the belt press or centrifuge from the process equipment OIT.

- (b) Status:
- i. Pump Run.
  - ii. Pump in REMOTE.
  - iii. Pump Speed.
  - iv. Centrifuge Flow.
  - v. Belt Press Flow.
- (c) Alarms:
- i. VFD Trouble.
  - ii. Motor High Temp.
  - iii. Pump High Temp.
  - iv. Pump High Pressure.
- (d) Interlocks:
- i. OFF position of field selector switches will not allow pump to start.
  - ii. If the liquid level in the Sludge Holding Tank is at the Low Level the pump will be turned off and a signal will be initiated indicating that the pump was turned off due to the low liquid level in the Sludge Holding Tank. This will signal an alarm to the SCADA system.
  - iii. The dewatering feed pumps will only be controlled as called for by the selected and associated dewatering equipment specific for each pump (Belt Filter Press and Centrifuge).
  - iv. If there is a failure at the respective belt filter press or centrifuge: the pumps will immediately turn-off.
  - v. The dry running protection devices or high pressure equipped by the pump manufacturer will also be able to turn the pumps off.
- (e) Historical:
- i. Record run time, status, and alarms.

3. Truck Loading:

a. One progressing cavity pump is proposed. Pumps are constant speed and will have a local control panel at the pump to allow truck haulers to Start/Stop pumps. The local panel will be integrated into the SCADA system for monitoring, alarm annunciation and recording. The pump will be operated based on Start/Stop push buttons at the local control panel. If Sludge Holding Tank is at high level as determined by the level control in the tank, the off-loading authorization will not be granted, and the pump will not be able to be turned on and the HMI will display “Tank at High Level Contact Operations Staff”. The sequence of operation is as follows:

(1) Control at Truck Loading:

(a) The operator sets the ON/OFF selector switch at the local control panel in the ON position.

(b) Status:

i. Pump Run.

(c) Alarms:

i. Motor High Temp.

ii. Pump High Temp.

iii. Pump High Pressure.

(d) Interlocks:

i. OFF position of field selector switches will not allow pump to start.

ii. Start /Stop push button to be controlled by Truck Hauler for pump start operation and stop button to be pushed when truck is empty.

iii. Lock-out if Sludge Holding Tank has insufficient volume based on tank high-level annunciation and notification on HMI Screen.

iv. Locks-out after a specified elapse time (adjustable by plant staff only).

v. Pump off and lock-out if liquid level reaches the high-high level in the Sludge Holding Tank.

(e) Historical:

i. Record run time, status, and alarms

### 3.05 ATTACHMENTS

A. The Attachment listed below, following "END OF SECTION," is part of this Section.

1. Table 13316-1, PLC-DW I/O Schedule.

END OF SECTION

**Table 13316-1**  
**PLC-PB I/O Schedule**

Table 13316-1  
PLC-DW I/O SCHEDULE  
6-15-20

| Description                              | ISA Tag  | Type | Signal | Range/<br>N.O. Status | Units/<br>N.C. Status | Field Wiring                 |                         | Specification Section | Remarks            |
|--|----------|------|--------|-----------------------|-----------------------|------------------------------|-------------------------|-----------------------|--------------------|
|  |          |      |        |                       |                       | ISA Signal<br>Source Design. | Signal Source<br>Device |                       |                    |
| <b>Process 100 Sludge Storage Tank</b>   |          |      |        |                       |                       |                              |                         |                       |                    |
| Mixer #1 Run Status                      | YIQR-100 | DI   | Form C | Stopped               | Running               | YS-100                       | 100-LCP-1               | 11228                 | EVT, CRT, DRT, DSC |
| Mixer #1 Trouble                         | YAR-100B | DI   | Form C | Normal                | Alarm                 | YS-100B                      | 100-LCP-1               | 11228                 | EVT                |
| Mixer #1 In Auto                         | ZS-100   | DI   | Form C | Normal                | Auto                  | ZS-100                       | 100-LCP-1               | 11228                 | EVT                |
| Mixer #1 In Hand                         | ZS-100B  | DI   | Form C | Normal                | Hand                  | ZS-100B                      | 100-LCP-1               | 11228                 | EVT                |
| Mixer #1 Motor Fail                      | EUIR-100 | DI   | Form C | Normal                | Alarm                 | ES-100                       | 100-LCP-1               | 11228                 | EVT                |
| Mixer #1 Command                         | YCC-100  | DO   | Form C | Normal                | Open                  | YS-100                       | PLC-PB                  | 13401                 |                    |
| Sludge Tank Level                        | LI-100   | AI   | 4-20mA | 0-30                  | ft.in                 | LT-100                       | LIT-201                 | 13401                 | EVT                |
| Sludge Tank High Level                   | LAH-100  | DI   | Form C | Normal                | Alarm                 | LSH-100                      | LSH-201                 | 13401                 | EVT                |
| Sludge Tank Low Level                    | LAL-100  | DI   | Form C | Normal                | Alarm                 | LSL-100                      | LSL-201                 | 13401                 | EVT                |
| Sludge Tank High Level                   | LAC-100  | DO   | Form C | Normal                | Alarm                 | LSH-100                      | LSH-201                 | 13401                 | EVT                |
| Sludge Tank Low Level                    | LAC-100  | DO   | Form C | Normal                | Alarm                 | LSL-100                      | LSL-201                 | 13401                 | EVT                |
| <b>Process 100 Dewatering Feed Pumps</b> |          |      |        |                       |                       |                              |                         |                       |                    |
| Feed Pump #1 Run Status                  | YIQR-101 | ENET | ENET   | Stopped               | Running               | YS-101                       | VFD                     | 16370                 | EVT, CRT, DRT, DSC |
| Feed Pump #1 VFD Manual                  | ZS-101A  | ENET | ENET   | Normal                | Manual                | ZS-101A                      | VFD                     | 16370                 | EVT                |
| Feed Pump #1 VFD Remote                  | ZS-101B  | ENET | ENET   | Normal                | Remote                | ZS-101B                      | VFD                     | 16370                 | EVT                |
| Feed Pump #1 VFD Trouble                 | YA-101A  | ENET | ENET   | Normal                | Alarm                 | YS-101A                      | VFD                     | 16370                 | EVT                |
| Feed Pump #1 Motor High Temperature      | TAH-101  | ENET | ENET   | Normal                | Alarm                 | TS-101                       | VFD                     | 11356                 | EVT                |
| Feed Pump #1 Motor Overload              | EUA-101  | ENET | ENET   | Normal                | Alarm                 | ES-101                       | VFD                     | 16370                 | EVT                |
| Feed Pump #1 Speed Feedback              | SI-101   | ENET | ENET   | 0-100                 | %                     | SR-101                       | VFD                     | 16370                 | MN, MX, MA         |
| Feed Pump #1 Speed Control               | SC-101   | ENET | ENET   | 0-100                 | %                     | ST-101                       | VFD                     | 13401                 | MN, MX, MA         |
| Feed Pump #1 Run Command                 | YC-101   | ENET | ENET   | Start                 | Stop                  | YS-101                       | VFD                     | 13401                 | EVT                |
| Feed Pump #1 Pressure                    | PA-101   | ENET | ENET   | 0-25                  | psi                   | PS-101                       | VFD                     | 11356                 | MN, MX, MA         |
| Feed Pump #1 Temperature                 | TI-101   | ENET | ENET   | 0-200                 | F                     | TS-101                       | VFD                     | 11356                 | MN, MX, MA         |
| Feed Pump #2 Run Status                  | YIQR-102 | ENET | ENET   | Stopped               | Running               | YS-102                       | VFD                     | 16370                 | EVT, CRT, DRT, DSC |
| Feed Pump #2 VFD Manual                  | ZS-102A  | ENET | ENET   | Normal                | Manual                | ZS-102A                      | VFD                     | 16370                 | EVT                |
| Feed Pump #2 VFD Remote                  | ZS-102B  | ENET | ENET   | Normal                | Remote                | ZS-102B                      | VFD                     | 16370                 | EVT                |
| Feed Pump #2 VFD Trouble                 | YA-102A  | ENET | ENET   | Normal                | Alarm                 | YS-102A                      | VFD                     | 16370                 | EVT                |
| Feed Pump #2 Motor High Temperature      | TAH-102  | ENET | ENET   | Normal                | Alarm                 | TS-102                       | VFD                     | 11356                 | EVT                |
| Feed Pump #2 Motor Overload              | EUA-102  | ENET | ENET   | Normal                | Alarm                 | ES-102                       | VFD                     | 16370                 | EVT                |
| Feed Pump #2 Speed Feedback              | SI-102   | ENET | ENET   | 0-100                 | %                     | SR-102                       | VFD                     | 16370                 | MN, MX, MA         |
| Feed Pump #2 Speed Control               | SC-102   | ENET | ENET   | 0-100                 | %                     | ST-102                       | VFD                     | 13401                 | MN, MX, MA         |
| Feed Pump #2 Run Command                 | YC-102   | ENET | ENET   | Start                 | Stop                  | YS-102                       | VFD                     | 13401                 | EVT                |
| Feed Pump #2 Pressure                    | PA-102   | ENET | ENET   | 0-25                  | psi                   | PS-102                       | VFD                     | 11356                 | MN, MX, MA         |
| Feed Pump #2 Temperature                 | TI-102   | ENET | ENET   | 0-200                 | F                     | TS-102                       | VFD                     | 11356                 | MN, MX, MA         |
| Feed Pump #3 Run Status                  | YIQR-103 | ENET | ENET   | Stopped               | Running               | YS-103                       | VFD                     | 16370                 | EVT, CRT, DRT, DSC |
| Feed Pump #3 VFD Manual                  | ZS-103A  | ENET | ENET   | Normal                | Manual                | ZS-103A                      | VFD                     | 16370                 | EVT                |
| Feed Pump #3 VFD Remote                  | ZS-103B  | ENET | ENET   | Normal                | Remote                | ZS-103B                      | VFD                     | 16370                 | EVT                |
| Feed Pump #3 VFD Trouble                 | YA-103A  | ENET | ENET   | Normal                | Alarm                 | YS-103A                      | VFD                     | 16370                 | EVT                |
| Feed Pump #3 Motor High Temperature      | TAH-103  | ENET | ENET   | Normal                | Alarm                 | TS-103                       | VFD                     | 11356                 | EVT                |
| Feed Pump #3 Motor Overload              | EUA-103  | ENET | ENET   | Normal                | Alarm                 | ES-103                       | VFD                     | 16370                 | EVT                |
| Feed Pump #3 Speed Feedback              | SI-103   | ENET | ENET   | 0-100                 | %                     | SR-103                       | VFD                     | 16370                 | MN, MX, MA         |
| Feed Pump #3 Speed Control               | SC-103   | ENET | ENET   | 0-100                 | %                     | ST-103                       | VFD                     | 13401                 | MN, MX, MA         |
| Feed Pump #3 Run Command                 | YC-103   | ENET | ENET   | Start                 | Stop                  | YS-103                       | VFD                     | 13401                 | EVT                |
| Feed Pump #3 Pressure                    | PA-103   | ENET | ENET   | 0-25                  | psi                   | PS-103                       | VFD                     | 11356                 | MN, MX, MA         |
| Feed Pump #3 Temperature                 | TI-103   | ENET | ENET   | 0-200                 | F                     | TS-103                       | VFD                     | 11356                 | MN, MX, MA         |

Table 13316-1  
PLC-DW I/O SCHEDULE  
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| Description                            | ISA Tag   | Type | Signal | Range/<br>N.O. Status | Units/<br>N.C. Status | Field Wiring              |                      | Specification Section | Remarks            |
|--|-----------|------|--------|-----------------------|-----------------------|---------------------------|----------------------|-----------------------|--------------------|
|  |           |      |        |                       |                       | ISA Signal Source Design. | Signal Source Device |                       |                    |
| Valve 130-ZS-1 Open Status             | ZI-101    | DI   | Form C | Normal                | Open                  | ZSC-101                   | 100-ZS-1             | 15110                 | EVT                |
| Valve 130-ZS-1 Closed Status           | ZO-101    | DI   | Form C | Normal                | Closed                | ZSO-101                   | 100-ZS-1             | 15110                 | EVT                |
| Valve 130-ZS-2 Open Status             | ZI-102    | DI   | Form C | Normal                | Open                  | ZSC-102                   | 100-ZS-2             | 15110                 | EVT                |
| Valve 130-ZS-2 Closed Status           | ZO-102    | DI   | Form C | Normal                | Closed                | ZSO-102                   | 100-ZS-2             | 15110                 | EVT                |
| Valve 130-ZS-3 Open Status             | ZI-103    | DI   | Form C | Normal                | Open                  | ZSC-103                   | 100-ZS-3             | 15110                 | EVT                |
| Valve 130-ZS-3 Closed Status           | ZO-103    | DI   | Form C | Normal                | Closed                | ZSO-103                   | 100-ZS-3             | 15110                 | EVT                |
| Valve 130-ZS-4 Open Status             | ZI-104    | DI   | Form C | Normal                | Open                  | ZSC-104                   | 100-ZS-4             | 15110                 | EVT                |
| Valve 130-ZS-4 Closed Status           | ZO-104    | DI   | Form C | Normal                | Closed                | ZSO-104                   | 100-ZS-4             | 15110                 | EVT                |
| Valve 130-ZS-5 Open Status             | ZI-105    | DI   | Form C | Normal                | Open                  | ZSC-105                   | 100-ZS-5             | 15110                 | EVT                |
| Valve 130-ZS-5 Closed Status           | ZO-105    | DI   | Form C | Normal                | Closed                | ZSO-105                   | 100-ZS-5             | 15110                 | EVT                |
| Valve 130-ZS-6 Open Status             | ZI-106    | DI   | Form C | Normal                | Open                  | ZSC-106                   | 100-ZS-6             | 15110                 | EVT                |
| Valve 130-ZS-6 Closed Status           | ZO-106    | DI   | Form C | Normal                | Closed                | ZSO-106                   | 100-ZS-6             | 15110                 | EVT                |
| Valve 130-ZS-7 Open Status             | ZI-107    | DI   | Form C | Normal                | Open                  | ZSC-107                   | 100-ZS-7             | 15110                 | EVT                |
| Valve 130-ZS-7 Closed Status           | ZO-107    | DI   | Form C | Normal                | Closed                | ZSO-107                   | 100-ZS-7             | 15110                 | EVT                |
| Valve 130-ZS-8 Open Status             | ZI-108    | DI   | Form C | Normal                | Open                  | ZSC-108                   | 100-ZS-8             | 15110                 | EVT                |
| Valve 130-ZS-8 Closed Status           | ZO-108    | DI   | Form C | Normal                | Closed                | ZSO-108                   | 100-ZS-8             | 15110                 | EVT                |
| Valve 130-ZS-9 Open Status             | ZI-109    | DI   | Form C | Normal                | Open                  | ZSC-109                   | 100-ZS-9             | 15110                 | EVT                |
| Valve 130-ZS-9 Closed Status           | ZO-109    | DI   | Form C | Normal                | Closed                | ZSO-109                   | 100-ZS-9             | 15110                 | EVT                |
| Valve 130-ZS-9 Open Status             | ZI-110    | DI   | Form C | Normal                | Open                  | ZSC-110                   | 100-ZS-10            | 15110                 | EVT                |
| Valve 130-ZS-9 Closed Status           | ZO-110    | DI   | Form C | Normal                | Closed                | ZSO-110                   | 100-ZS-10            | 15110                 | EVT                |
| <hr/>                                  |           |      |        |                       |                       |                           |                      |                       |                    |
| <b>Process 400 Truck Loading Pumps</b> |           |      |        |                       |                       |                           |                      |                       |                    |
| Loading Pump #1 Run Status             | YIQR-401  | DI   | Form C | Stopped               | Running               | YS-401                    | 101-LCP-1            | 13401                 | EVT, CRT, DRT, DSC |
| Loading Pump #1 Pressure               | PA-401    | DI   | Form C | 0-24                  | psi                   | PS-401                    | 101-LCP-1            | 13401                 | MN, MX, MA         |
| Loading Pump #1 Temperature            | TI-401    | DI   | Form C | 0-200                 | F                     | TS-401                    | 101-LCP-1            | 13401                 | MN, MX, MA         |
| Sludge Tank Level                      | LI-400    | AO   | 4-20mA | 0-30                  | ft.in                 | LT-400                    | LIT-100              | 13401                 | MN, MX, HH, LL     |
| Truck Driver Start Comand              | YC-403A   | DI   | Form C | Normal                | Start                 | YS-403A                   | 101-LCP-1            | 13401                 |                    |
| Truck Driver Stop Comand               | YC-403B   | DI   | Form C | Normal                | Stop                  | YS-403B                   | 101-LCP-1            | 13401                 |                    |
| Loading Pump #1 Command                | YC-401    | DO   | Form C | Start                 | Stop                  | YR-401                    | PLC-DW               | 13401                 | EVT, CRT, DRT, DSC |
| <hr/>                                  |           |      |        |                       |                       |                           |                      |                       |                    |
| General Alarm                          | YA-100    | DO   | Form C | Normal                | Alarm                 | YR-100                    | PLC-DW               | 13401                 |                    |
| <hr/>                                  |           |      |        |                       |                       |                           |                      |                       |                    |
| Belt Press Flow                        | FIQR-101  | AI   | 4-20mA | 0-200                 | gpm                   | FIT-101                   | FIT-101              | 13401                 | MN, MX, MA         |
| <hr/>                                  |           |      |        |                       |                       |                           |                      |                       |                    |
| <b>Centrifuge</b>                      |           |      |        |                       |                       |                           |                      |                       |                    |
| Feed Pump #1 Run Status                | YIQR-101A | DO   | Form C | Stopped               | Running               | YS-101A                   | PLC-DW               | 13401                 |                    |
| Feed Pump #1 Trouble                   | YA-101A   | DO   | Form C | Normal                | Alarm                 | YA-101A                   | PLC-DW               | 13401                 |                    |
| Feed Pump #1 Run Command               | YC-101A   | DI   | Form C | Start                 | Stop                  | YR-101A                   | CCP                  | 13401                 |                    |
| <hr/>                                  |           |      |        |                       |                       |                           |                      |                       |                    |
| Feed Pump #2 Run Status                | YIQR-102A | DO   | Form C | Stopped               | Running               | YS-102A                   | PLC-DW               | 13401                 |                    |
| Feed Pump #2 Trouble                   | YA-102A   | DO   | Form C | Normal                | Alarm                 | YA-102A                   | PLC-DW               | 13401                 |                    |
| Feed Pump #2 Run Command               | YC-102A   | DI   | Form C | Start                 | Stop                  | YR-102A                   | CCP                  | 13401                 |                    |
| <hr/>                                  |           |      |        |                       |                       |                           |                      |                       |                    |
| Feed Pump #3 Run Status                | YIQR-103A | DO   | Form C | Stopped               | Running               | YS-103A                   | PLC-DW               | 13401                 |                    |
| Feed Pump #3 Trouble                   | YA-103A   | DO   | Form C | Normal                | Alarm                 | YA-103A                   | PLC-DW               | 13401                 |                    |
| Feed Pump #3 Run Command               | YC-103A   | DI   | Form C | Start                 | Stop                  | YR-103A                   | CCP                  | 13401                 |                    |

Table 13316-1  
PLC-DW I/O SCHEDULE  
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| Description               | ISA Tag   | Type | Signal | Range/<br>N.O. Status | Units/<br>N.C. Status | Field Wiring              |                      | Specification Section | Remarks |
|---------------------------|-----------|------|--------|-----------------------|-----------------------|---------------------------|----------------------|-----------------------|---------|
|                           |           |      |        |                       |                       | ISA Signal Source Design. | Signal Source Device |                       |         |
| Feed Pump #1 Feed Rate    | SI-101A   | AO   | 4-20mA | FC                    | FC                    | ST-101A                   | PLC-DW               | 13401                 |         |
| Feed Pump #1 Feed Control | SC-101A   | AI   | 4-20mA | FC                    | FC                    | SR-101A                   | CCP                  | 13401                 |         |
| Feed Pump #2 Feed Rate    | SI-102A   | AO   | 4-20mA | FC                    | FC                    | ST-102A                   | PLC-DW               | 13401                 |         |
| Feed Pump #2 Feed Control | SC-102A   | AI   | 4-20mA | FC                    | FC                    | SR-102A                   | CCP                  | 13401                 |         |
| Feed Pump #3 Feed Rate    | SI-103A   | AO   | 4-20mA | FC                    | FC                    | ST-103A                   | PLC-DW               | 13401                 |         |
| Feed Pump #3 Feed Control | SC-103A   | AI   | 4-20mA | FC                    | FC                    | SR-103A                   | CCP                  | 13401                 |         |
| <b>Belt Press</b>         |           |      |        |                       |                       |                           |                      |                       |         |
| Feed Pump #1 Run Status   | YIQR-101B | DO   | Form C | Stopped               | Running               | YS-101B                   | PLC-DW               | 13401                 |         |
| Feed Pump #1 Trouble      | YB-101B   | DO   | Form C | Normal                | Alarm                 | YB-101B                   | PLC-DW               | 13401                 |         |
| Feed Pump #1 Run Command  | YC-101B   | DI   | Form C | Start                 | Stop                  | YR-101B                   | BPCP                 | 13401                 |         |
| Feed Pump #2 Run Status   | YIQR-102B | DO   | Form C | Stopped               | Running               | YS-102B                   | PLC-DW               | 13401                 |         |
| Feed Pump #2 Trouble      | YB-102B   | DO   | Form C | Normal                | Alarm                 | YB-102B                   | PLC-DW               | 13401                 |         |
| Feed Pump #2 Run Command  | YC-102B   | DI   | Form C | Start                 | Stop                  | YR-102B                   | BPCP                 | 13401                 |         |
| Feed Pump #3 Run Status   | YIQR-103B | DO   | Form C | Stopped               | Running               | YS-103B                   | PLC-DW               | 13401                 |         |
| Feed Pump #3 Trouble      | YB-103B   | DO   | Form C | Normal                | Alarm                 | YB-103B                   | PLC-DW               | 13401                 |         |
| Feed Pump #3 Run Command  | YC-103B   | DI   | Form C | Start                 | Stop                  | YR-103B                   | BPCP                 | 13401                 |         |
| Feed Pump #1 Feed Rate    | SI-101B   | AO   | 4-20mA | FC                    | FC                    | ST-101B                   | PLC-DW               | 13401                 |         |
| Feed Pump #1 Feed Control | SC-101B   | AI   | 4-20mA | FC                    | FC                    | SR-101B                   | BPCP                 | 13401                 |         |
| Feed Pump #2 Feed Rate    | SI-102B   | AO   | 4-20mA | FC                    | FC                    | ST-102B                   | PLC-DW               | 13401                 |         |
| Feed Pump #2 Feed Control | SC-102B   | AI   | 4-20mA | FC                    | FC                    | SR-102B                   | BPCP                 | 13401                 |         |
| Feed Pump #3 Feed Rate    | SI-103B   | AO   | 4-20mA | FC                    | FC                    | ST-103B                   | PLC-DW               | 13401                 |         |
| Feed Pump #3 Feed Control | SC-103B   | AI   | 4-20mA | FC                    | FC                    | SR-103B                   | BPCP                 | 13401                 |         |

**Abbreviations:**

Confirm all I/O locations with the Contractor and approved shop drawings before submitting I&C for review and approvals  
 Provide 10% spare I/O of each type including programming services typical for status or alarm for all spare DI, process indication, trending and historical database for typical spare AI, and typical interlocking for all spare DO, plus retransmit for all spare AO. Wire all spares to field terminal block.

|        |                             |    |                  |      |      |                  |
|--------|-----------------------------|----|------------------|------|------|------------------|
| MCC    | Motor Control Center        | MX | Daily Maximum    | BTCP | CCP  | Centrifuge Panel |
| MA     | Daily Average               | MN | Daily Minimum    | GCP  | BPCP | Belt Press Panel |
| DT     | Daily Flow Total            | HH | High Limit Alarm | EFD  | FC   | Field Confirm    |
| CT     | Continuous Flow Total       | LL | Low Limit Alarm  | DSC  |      |                  |
| DRT    | Daily Run Time              | DI | Discrete Input   | PU   |      |                  |
| CRT    | Continuous Run Time         | DO | Discrete Output  | LSW  |      |                  |
| Form C | Dry Contact Form C*         | AI | Analog Input     | ENET |      |                  |
| EVT    | Log Events of Status Change | AO | Analog Output    | LPMR |      |                  |
| SSS    | Solid State Starter         | SD | Smoke Detector   | DTCP |      |                  |

**SECTION 13401**  
**PROCESS INSTRUMENTATION AND CONTROLS (PICS)**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. The Contractor shall perform all work necessary to furnish, install, commission, test, document, and start up the instrumentation and control (I&C) system, including modifying the existing I&C system. The Contractor shall provide all materials, labor, equipment, incidentals, and services required for a complete and operational system.
- B. The Contractor shall acquire the services of a single, experienced I&C system provider specifically trained in the type of equipment to be provided. The provider shall assume responsibility for satisfactory operation of the process I&Cs as an integrated system including integration with the existing SCADA system.

**1.02 RELATED WORK**

- A. The provisions of all other sections of the Specifications are fully applicable to this Section as if incorporated in this Section.
- B. The Contractor shall be responsible for coordinating work with the Owner and Subcontractors.

**1.03 SUBMITTALS**

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Provide shop drawings for all equipment, field panels (FPs), and enclosures.
  - 1. At a minimum the Drawings shall show the fabrication design, internal equipment arrangement, internal wiring, and external wiring connections.
  - 2. Provide panel elementary diagrams. The diagrams shall show all control functions, power distribution, switched analog signals, and auxiliary devices such as relays, alarms, fuses, lights, fans, etc.
  - 3. Provide power requirement (voltages, currents, phases) and heat dissipation (maximum Btu/hr) summary for all panels.
  - 4. Panel connection drawings shall show ISA wire tags.
  - 5. Provide any needed installation details to adequately define the installation of panels and field components.

- B. Provide loop diagrams for each specified loop. The loop diagrams shall meet the minimum requirements of ISA 5.4. Loop diagram(s) shall show the wiring and/or piping for all major components, resistors, diodes, DC power supplies, shield terminations, tubing, piping, valving, test taps, and other appurtenances for process connections. Each analog diagram shall tabulate loop impedances. An individual loop shall be shown on a diagram divided into three areas for identifying element locations: panel face, back-of-panel, and field. Loop diagrams shall be on 8-1/2-x-11-inch or 11-x-17-inch drawings.
1. Provide an operation description for each loop.
- C. Provide electrical interconnection diagrams showing all component and panel connection/terminal identification numbers and external wire numbers. These diagrams shall include all intermediate terminations (e.g., at terminal junction blocks and motor control centers).
1. The interconnection diagrams shall be coordinated with other suppliers and the electrical subcontractor. The electrical subcontractor shall review and approve the diagrams before any submission to the Engineer.
  2. The diagrams, device designations, and symbols shall be in accordance with NEMA ICS 1-101.
- D. The Contractor shall submit a complete list of materials and equipment to be incorporated in the work to the Engineer within 30 days after Award of Contract.
1. The list shall include catalog numbers, cut sheets, diagrams, and other descriptive data required to demonstrate conformance with the Specifications. Partial lists will not be acceptable.
  2. The basis of acceptance will be the manufacturer's published ratings for the equipment. The manufacturer shall be regularly engaged in the manufacture of the products specified.
- E. The Contractor shall submit testing procedures, test reports, and a training program.
1. Provide a test procedure outline, example operational report, and example functional test procedures and schedules.
  2. Provide a factory test report.
  3. Provide an operational acceptance report. The report shall contain a completed status sheet for each loop. Each sheet shall be signed off on by the Contractor's field crew. The report shall be reviewed, verified, and signed off on by the Contractor.
  4. Provide a training program and schedule.

- F. Each submittal shall be complete, neat, orderly, and bound with a table of contents and section divider tabs.
- G. Each submittal shall include but not be limited to the requirements described in this Section.
- H. Or equal materials or products may be submitted for approval. Submissions shall be accompanied with adequate data to demonstrate equality. Equality of materials or products shall be the decision of the Engineer.
- I. Each submittal shall be accompanied by a cover letter describing any exceptions or deviations from the Specifications. Cover letters addressing resubmitted materials shall also describe any changes which have been made since the previous submittal and include a brief response to the Engineer's comments.

#### 1.04 WORK SEQUENCE (NOT USED)

#### 1.05 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American Society for Testing and Materials (ASTM)
- B. American National Standards Institute (ANSI)
  - 1. ANSI/TIA 568-C.2—Balance Twisted-Pair Telecommunications Cabling and Components.
- C. International Electrotechnical Commission (IEC)
  - 1. IEC 61935—Specification for the Testing of Balanced and Coaxial Information Technology Cabling – Part 1: Installed Balanced Cabling as specified in ISO/IEC 11810 and Related Standards.
- D. International Organization of Standardization (ISO)
  - 1. ISO/IEC TR 24750:2007—Information Technology – Assessment and Mitigation of Installed Balanced Cabling Channels in order to Support of 10GBASE-T.

- E. International Society of Automation (ISA)
  - 1. ISA 5.1—Instrumentation Symbols and Identification (NRC ADOPTED).
  - 2. ISA 5.4—Instrument Loop Diagrams.
  - 3. ISA 20—Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.
  - 4. ISA 50.00.01—Compatibility of Analog Signals for Electronic Industrial Process Instruments.
  - 5. ISA RP7.1—Pneumatic Control Circuit Pressure Test.
  - 6. ISA RP55.1—Hardware Testing of Digital Process Computers.

- F. National Electrical Manufacturers Association (NEMA)
  - 1. NEMA ICS-1—Industrial Control and Systems General Requirements.

- G. National Institute of Standards and Technology (NIST)
- H. Underwriter's Laboratories, Inc. (UL)

## 1.06 QUALITY ASSURANCE

- A. SCADA Integrators shall be City-approved including: McKim & Creed, Commerce Controls, Curry Controls, and Revere Controls.

## 1.07 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.
- B. All work, equipment, and materials supplied shall be warranted against defective design, materials, and workmanship for 1 year. The warranty period shall begin at the time of project completion and acceptance by the Owner.
- C. The warranty shall cover replacement equipment and/or repair, including labor, travel time and miscellaneous expenses, at no cost to the Owner for the full warranty period.

## 1.08 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

- B. Deliver materials and equipment with the manufacturer's tags and labels and UL labels intact. Deliver packaged material in the manufacturer's original, unopened containers bearing the manufacturer's name, brand, and UL label.
- C. Throughout this Contract the Contractor shall provide suitable protection for materials and equipment against loss or damage and the effects of weather and the construction environment. The Contractor shall be responsible for the condition of materials and equipment until the acceptance of equipment by the Owner.
- D. Before installation, store material and equipment indoors in a dry, clean location. Handle and store to avoid damage. Heat storage areas that contain items subject to corrosion under damp conditions.
- E. Turn off power to panels and equipment and close and cover CPs and equipment during any dusty construction to prevent degrading the operation or service life.
- F. Follow the manufacturer's installation instructions explicitly, unless otherwise indicated. Wherever any conflict arises between the manufacturer's instructions and these Contract Documents, follow the Engineer's decision at no additional cost to the Owner. Keep a copy of the manufacturer's installation instructions on the job site and available for review at all times.
- G. Keep the premises free of waste material or rubbish. Before final inspection and testing and upon completion of the work, remove materials, scraps, and debris from the premises and from the interior and exterior of all devices and equipment.
- H. Touch up scratches, scrapes, or chips in interior and exterior surfaces of devices and equipment with finishes matching as nearly as possible the type, color, and consistency of the original finish.

## 1.09 RECORD DRAWINGS

- A. Record Drawings shall be submitted in accordance with Section 01785, Record Documents, and this Section.
- B. The Contractor shall provide one set of Record Drawings on CD or DVD in AutoCAD "DWG" or "DXF" format, consisting of the following:
  1. Process and instrumentation diagrams.
  2. Loop diagrams.
  3. Panel elementary diagrams.
  4. Interconnecting wiring diagrams.

## 1.10 SYSTEM DESCRIPTION

- A. The general arrangement of the instruments, controls, and monitoring systems are shown on the Drawings and specified in this Section. The location of all transmitters, controllers, recorders, indicators, etc., shall be as shown on the Drawings and/or as indicated in this Section. The Contractor shall be responsible for all detail installation drawings showing wiring and shall be responsible for furnishing all devices required for a complete and functioning system.

## 1.11 OPERATION AND MAINTENANCE (O&M) MANUAL

- A. O&M Manuals shall be in accordance with General Conditions, Supplementary Conditions, and Section 01830, Operations and Maintenance Manuals.
- B. Before final acceptance of this project, the Contractor shall submit an O&M Manual to the Engineer for all components provided under this Section. The manual shall comply with the following:
  1. The literature shall have sufficiently detailed descriptions and figures to facilitate the operation, removal, installation, adjustment, calibration, and maintenance of each component to the printed circuit board level.
  2. The manual shall include internal wiring and piping diagrams. Termination designations and wire and pipe numbers shall be clearly shown. Diagrams, device designations, and symbols shall be in accordance with NEMA ICS 1-101.
  3. The manual shall include an updated set of the manufacturer's literature, data sheets, loop descriptions of operations, drawings corrected in accordance with shop drawing review comments and Record Drawing modifications and components parts list.
  4. Instructions and parts lists shall have been prepared for the specific equipment furnished.
  5. List of suppliers and/or service shops that can provide parts and accessories and equipment repair for the components provided under this Section. The list shall include a contact name, telephone number, and address.
- C. The general arrangement of the instruments, controls, and monitoring systems is shown on the Drawings and specified in this Section. The location of all transmitters, controllers, recorders, indicators, totalizers, etc., shall be as shown on the Drawings and/or as indicated in this Section. The Contractor shall be responsible for all detail installation drawings showing wiring and shall be responsible for furnishing all devices required for a complete and functioning system.

## 1.12 PATENTS AND LICENSES (NOT USED)

## 1.13 MANUFACTURER'S LITERATURE

- A. The Contractor shall provide descriptive literature for all equipment provided under this Section. The literature shall include major components, electrical devices, panel materials, panel components, panel paints and colors, mechanical devices, equipment tags, tubing, valves, fittings, fasteners, and appurtenances. This descriptive literature shall include catalog information, external wiring information, dimensional data, and mounting requirements.
- B. Provide data (specification) sheets for all equipment and components. Provide a separate data sheet for each major component. The data sheets shall show the "component name," tag numbers, quantities, specific catalog/ordering numbers, specific features, and special options.
- C. Provide a components parts list with exact and complete (including options and accessories) manufacturer's part number. Group the list by the component name used in these Specifications. Group each component type by tag number used in these Specifications. Components without tag numbers shall be grouped by the manufacturer's part number.
- D. Provide a list of recommended spares, spare parts, and expendables with tag number, part number, unit pricing, and total purchase cost.
- E. Provide storage requirements for all components provided under this Section.

## 1.14 CERTIFICATION/DOCUMENTATION

- A. The instrument system supplier(s) shall verify the calibration and operation of all control, instrumentation, and telemetry components and shall present written certification of the operation.

## 1.15 PERMITS AND FEES

- A. The Contractor shall obtain all necessary permits, licenses, and inspections required for the work of this Section and pay all charges incidental to these permits, licenses, and inspections. The Contractor shall deliver to the Engineer all certificates of inspection and licenses issued by authorities having jurisdiction.

## 1.16 ABBREVIATIONS AND ACRONYMS

- A. ASD: Adjustable Speed Drive.
- B. CA: Calculated Analog.

- C. CP: Control Panel.
- D. CPU: Central Processing Unit.
- E. CS: Computer Subsystem.
- F. FDT: Factory Demonstration Test.
- G. FP: Field Panel.
- H. HMI: Human/Machine Interface.
- I. ISA: International Society of Automation.
- J. I&C: Instrumentation and Control.
- K. IPS: Instrument and Panel Subsystem.
- L. I/O: Inputs and Outputs.
- M. LAN: Local Area Network.
- N. MCC: Motor Control Center.
- O. OIU: Operator Interface Unit.
- P. OIT: Operator Interface Terminal.
- Q. O&M: Operation and Maintenance.
- R. ORT: Operational Readiness Test.
- S. PAT: Performance Acceptance Test.
- T. PC: Personal Computer.
- U. PICS: Process I&C System.
- V. P&ID: Piping and Instrument Drawing.
- W. PLC: Programmable Logic Controller.
- X. RIO: Remote Input/Output.
- Y. RTU: Remote Terminal Unit.
- Z. SCADA: Supervisory Control and Data Acquisition.
- AA. TSP: Twisted Shielded Pairs.
- BB. UPS: Uninterruptable Power Supply.
- CC. VFD: Variable Speed Drive (see ASD).
- DD. WAN: Wide Area Network.
- EE. WiFi: Wireless.

## 1.17 DEFINITIONS

- A. *Enclosure*: CP, console, cabinet, or instrument housing.
- B. *Instructor Day*: 8 hours of actual instruction time.
- C. *Software*: Programs or configuration data for digital devices, stored in read-only memory, programmable read-only memory, read/write memory, disk, tape, or other electronic storage device. Types of software are defined as follows:
  - 1. *Standard Software*: Packages that are independent of the project on which they are used. Standard software includes Operating Systems, Office Suites, and the Process Monitoring and Control software.

2. *Application Software:* Code or configuration of the standard software to provide functions unique to this project.
- D. *Rising/Falling:* Terms used to define actions of discrete devices about their set points.
1. *Rising:* Contacts close when an increasing process variable rises through set point.
  2. *Falling:* Contacts close when a decreasing process variable falls through set point.
- E. Analog Signals, Current Type:
1. 4 to 20 mA DC signals conforming to ISA S50.1.
  2. Unless otherwise indicated for specific PICS Subsystem components, use the following ISA 50.1 options:
    - a. Transmitter Type: Number 2, two-wire.
    - b. Transmitter Load Resistance Capacity: Class L.
    - c. Fully isolated transmitters and receivers.
- F. *Analog Signals, Voltage Type:* 1 to 5 volts DC within panels where a common high precision-dropping resistor is used.
- G. *Discrete Signals:* Two-state logic signals using 24 VDC or 120VAC sources as indicated.
- H. Pulse Frequency Signals:
1. Direct current pulses whose repetition rate is linearly proportional to process variable.
  2. Pulses generated by contact closures or solid-state switches as indicated.
  3. Power source less than 30 VDC.
- I. *Special Signals:* Other types of signals used to transmit analog and digital information between field elements, transmitters, receivers, controllers, and digital devices.
- J. *Instrument Tag Numbers:* A shorthand tag number notation is used in the Loop Specifications. For example: 10-PI-2(A/B).

| Notation | Explanation  |
|----------|--|
| 10       | Unit process/Loop designation.   |
| PI       | ISA designator for Pressure Indicator.   |
| (2)      | Unit designation; alphanumeric designation of same process types in a given loop; -1, -2 in this example.        |
| (A/B)    | Component designation; Alphanumeric designation of same component type within a process; -A, -B in this example. |

In this example, 10-PI-(2)(A/B) is shorthand for:

10-PI-1-A, 10-PI-1-B, 10-PI-2-A, 10-PI-2-B.

K. *Activity Completion:* The following is a list of key activities and their completion criteria:

1. Administrative Submittals: Reviewed and accepted.
2. Shop Drawings: Reviewed and approved.
3. Quality Control Submittals: Reviewed and accepted.
4. Tests (Except ORT): Tests have been completed and required test documentation has been accepted.
  - a. ORT: ORT has been completed and the Engineer has spot-checked associated test forms and checklists in field.
  - b. Hardware Delivery: Hardware has been delivered to site and inventoried by the Owner.
  - c. Ready for Operation: ORT has been completed.

L. *PICS Substantial Completion:* Prerequisites for Substantial Completion for each stage of work include:

1. PICS Submittals have been accepted or approved, as specified.
2. PICS Subcontractor has successfully completed PAT.
3. Owner training plan is on schedule.
4. Spares, expendables, and test equipment have been delivered to the Owner.

M. *PICS Acceptance:* When the Engineer issues a written notice of acceptance, the following prerequisites shall have been met:

1. PICS Certificate of Substantial Completion for both stages of work.
2. Punch-list items completed.

3. Final revisions to O&M manuals accepted.
4. Maintenance service agreements for PICS accepted by the Owner.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. The manufacturer(s) and/or supplier(s) shall have regularly engaged in the manufacture of major components and/or assembly or I&C systems of the type and scope required for this project for a minimum of 5 years.
- B. It is recognized that one manufacturer may not make all the equipment required and specified under this Section. The Contractor shall be responsible for ensuring that the various manufacturers and equipment suppliers' products are coordinated and are compatible so that the equipment performs the specified functions. The Contractor shall ensure that they are fully aware and understand the requirements of the system.

### 2.02 GENERAL EQUIPMENT REQUIREMENTS

- A. All components and items of equipment that are necessary, whether indicated or not, to affect the required functions and performance shall be provided. In general, and unless otherwise noted, corrosion-resistant materials such as 316 stainless steel shall be used. Working pressures, spans, and other ratings shall be selected to best fit the application. All like equipment shall be by the same manufacturer.
- B. Whenever any material or product is indicated by patent or proprietary name, by name of manufacturer, or by catalog number, such specifications shall be deemed to be used to establish a standard of quality to expand the description of the material or product desired. Materials and products equal to the named material or product may be provided unless specifically noted otherwise.
- C. All equipment furnished under this Section shall be new and unused and shall be the standard product of a manufacturer having a minimum of 5 years successful experience in the manufacture of the equipment. Wherever possible, equipment items having the same or similar rated capacity or function shall be identical. Equipment shall be of the manufacturer's latest proven design.
- D. The design of the instrumentation and control system is based on the equipment and components specified in this Section. If more than one manufacturer is noted, the first named is the basis for design where there are differences. If the Contractor selects equipment which changes the design basis, the Contractor shall

obtain approval from the Engineer and make all approved changes at no additional cost to the Owner.

E. Electrical Transient Protection: All I&C equipment shall be equipped with suitable surge-arresting devices to protect the equipment from damage due to electrical transients induced in the interconnecting lines by lightning discharges or by nearby electrical devices.

1. Voltage surge and transient protectors for both power and analog field circuits shall be provided on the field end and destination end of the circuits.
2. Analog circuits shall be protected by DEHN or Phoenix suppressors.
  - a. All instrument 120-volt power and signal circuits shall be protected by DEHN or Phoenix suppressor.
3. The devices shall be connected to the system ground. The total resistance of the ground circuit from the device to the driven ground rod shall not exceed 0.1 ohm.

F. Signal Characteristics

1. Analog signals shall be 4-20 mA DC and shall conform to the compatibility requirements of ISA 50.1. Unless otherwise noted, circuits shall be Type 2 two-wire. Transmitters shall have a load-resistance capability conforming to Class L. Transmitters and receivers shall be fully isolated.
2. Discrete signals are two-state logic signals of two types. Control signals shall use 120-VAC sources. Alarm signals that interface directly with an annunciator shall use less than 30-VDC sources. All alarm signals shall be “normally open, close to alarm” isolated contacts rated for 5 amperes at 120 VAC and 2 amperes at 30 VDC.

G. Environmental Conditions

1. Unconditioned air: 20 °F to 105 °F, 10% to 100% humidity, subject to wash down or rain, corrosive (assume marine salts and H<sub>2</sub>S as a minimum), and nonhazardous. Enclosures shall be NEMA 4X.
2. Other conditions as noted or approved.

- H. Nameplates, Name Tags, and Service Legends: All field- and panel-mounted components provided under this Section shall be provided with permanently mounted name tags bearing the entire ISA tag number of the component.
1. Panel-mounted tags shall be engraved plastic. Field-mounted tags shall be stamped 16-gauge 316 stainless steel with 3/16-inch-high characters.
  2. Nameplates shall be inscribed to identify the component listed and mounted near a panel-face-mounted instrument.
  3. Service legends shall be integrally mounted on a panel-mounted instrument. Unless otherwise noted, service legends shall be engraved with the functional explanation.
  4. Nameplates and service legends shall be engraved, rigid, laminated plastic plates attached to enclosure with stainless steel screws maintaining NEMA rating of enclosure. Unless otherwise noted, plate color shall be black with 3/16-inch-high white lettering. Panel nameplates shall have 1/2-inch-high lettering.
- I. Colors and Inscriptions: Unless otherwise noted, the following inscription and color code shall be used for all push buttons and indicating light lenses: ON, red; OFF, green; OPEN, green; CLOSED, red; AUTO, white; MANUAL, yellow; START, red; STOP, green; RESET, red; TEST, black; ACKNOWLEDGE, green; and READY, blue. All unused or non-inscribed buttons shall be black.
1. Lettering shall be black on white, amber, or yellow. Lettering shall be white on black, red, blue, or green.
- J. Relays
1. Analog signal switching relays shall be provided for switching 4-20 mA or 1-5 VDC signals. The relays shall have double-throw dry circuit contacts in a break-before-make configuration rated for 15 VA minimum. The relays shall be sealed to prevent dust, dirt, or moisture contamination. Relays shall be UL recognized and shall be Potter and Brumfield KUP or KUL Series or Struthers-Dunn Series 219.
  2. Control circuit switching relays shall be rated for not less than 2 amperes at 120 VAC or 28 VDC.
  3. All relay connections shall have a screw terminal interface with the wiring. Terminals shall have a permanent, legible identification and shall be mounted so that terminal identifications are clearly visible, and the terminals are readily accessible.
  4. Intrinsically safe relays shall be UL approved, solid state, dual channel, din rail mounted, Crouse Hinds Series MTL7700.

- K. Power Supplies: Provide DC and UPS power supplies as required to power instruments requiring external DC power.
1. Power supplies shall convert 120-VAC power to DC power of the appropriate voltage(s) with sufficient voltage regulation and ripple control to ensure that the instruments being supplied can operate within their required tolerances.
  2. Output overvoltage and overcurrent protective devices shall be provided with the power supply to protect the instruments from damage due to power supply failure and to protect the power supply from damage due to external failure.
  3. Each power supply shall be provided with a NEMA 1 enclosure for mounting within other enclosures. Power supplies shall be mounted so that dissipated heat does not adversely affect other components.
  4. UPS/DC power supply system shall be Phoenix Trio.
- L. Wiring: All electrical wiring and wiring identification shall be in accordance with the applicable requirements of Division 16, Electrical.
1. Wires shall be 600-volt class, PVC insulated, stranded copper.
  2. Wiring for 120-volt circuits and signals shall be sized as required for the current to be carried, but not smaller than 14 AWG if enclosed in sheet metal raceway or plastic wiring duct. Wiring for signal circuits shall be TSP not smaller than 16 AWG. Analog signals shall be separated from any power wiring by at least 6 inches. All interconnecting wires to other enclosures shall be terminated at numbered terminal blocks. All external connections shall be to numbered terminal blocks. All connections for future functions shall be wired to numbered blocks. Terminal blocks shall be grouped to keep circuits of different voltages separate. Provide sufficient terminal blocks for all functions required, all spare annunciator points, and all spare conductors plus 15% spare. Terminal blocks shall be one-piece molded-plastic blocks with screw-type terminals and barriers rated for 300 volts. Terminals shall be double sided and supplied with removable covers that prevent accidental contact with live circuits. Terminals shall have permanent and legible identification and be clearly visible with the protective cover removed.
  3. Wires shall be terminated at the terminal blocks with crimp-type, pre-insulated, ring-tongue lugs. Lugs shall be the appropriate size for the size of the terminal block screws and the size and number of wires terminated.

4. All analog signal wiring shall be TSP with tie points at terminal blocks. Provide external dropping resistors or diodes to allow an instrument to be removed from the loop without opening the circuit.
5. Shields shall be interconnected within each loop at terminals. Shield wires shall be dressed with heat-shrink tubing. Ground signal shields at CPs only (not field devices).
6. Enclosures shall conform to the National Electrical Manufacturer's Association, NEMA-12, unless otherwise noted. Construction shall be of 316 stainless steel unless otherwise noted. Aluminum construction shall use 5052 H-32 aluminum alloy and shall provide for noncontact of dissimilar metals. Minimum metal thickness shall be 14 gauge. Where practical, enclosures shall be manufactured by Hoffman or H.F. Cox. Doors shall be rubber gasketed with a continuous hinge. Panels mounted outside or in unheated areas shall be provided with thermostatically controlled heaters that will maintain the inside panel temperature above 40° F. Panels shall be sized to adequately dissipate heat generated by equipment in or on the panel. Provide a breaker-protected 120-volt, 15-amp duplex receptacle in the panel.

#### M. Ethernet Switches

1. Ethernet switch, six RJ45 ports, 10/100/1000 Mbps on all RJ45 ports, two multi-mode SC-D ports, 1 Gbps full duplex, auto negotiation (RJ45), auto-crossing function, with signal contact and QoS, extended temperature range.
2. Interface 1 Ethernet (RJ45) ports 6 (RJ45 ports). Connection method RJ45 Ethernet in RJ45 twisted pair Transmission speed 10/100/1000 MBit/s. Interface 2 Fiber optic interface with 2 SC multi-mode. Connection method shall be SC Transmission physics multi-mode fiberglass. Transmission speed shall be 1,000 MBit/s (full duplex). Transmission length shall be 220 m (Fiberglass 62.5/125) 550 m (Fiberglass 50/125). Wavelength 850 nm Interface 4 Potential-free signaling contact with connection method as plug-in/screw connection via COMBICON.
3. Ethernet switches shall be as manufactured by Cisco.

#### N. Programmable Logic Controller (PLC)

1. The PLC CPU shall be as manufactured by Allen-Bradley CompactLogix with built-in Ethernet network.
2. Each discrete input module shall accept up to sixteen (16) 120Vac input signals received from devices such as pushbuttons, selector switches, pressure switches, temperature switches, or limit switches and converts

them into voltage logic levels that can be processed by the controller. Input signals shall be wired in two groups of eight signals per module. Each group of eight points shall be protected by a .16 amp external indicating fuse block. Each input shall be optically isolated and protected with a red LED to indicate the presence of the 24Vdc power (circuit closed indication). A green LED shall be provided to indicate the presence of the I/O module supply voltage of each group. Discrete input modules shall be as manufactured by Allen-Bradley.

3. Each discrete output module shall provide eight relay switched, 120Vac output signals that can drive loads up to 1 amp such as relays, starters, and solenoid valves. The outputs shall be optically isolated from the system. Output signals shall be field wired in two groups of four outputs per module. Each group of four points shall be protected by an external .16A indicating fuse block. Each output shall be isolated and provided with a red LED to indicate the output is turned "on". A green LED shall be provided to indicate the presence of the required 24Vdc supply voltage. External, panel mounted, 10Amp, interposing relays shall be provided for interfacing to control devices that are external to the local control panel or to devices that exceed the rating of the output module. Where LED type status indicators are used, a loading resister shall be installed to prevent leakage current from keeping the lamps falsely lit. Discrete input modules shall be as manufactured by Allen-Bradley.
4. Analog input modules shall be eight channels with opto-isolation. Inputs shall accept 4-20mA DC signals. Input shall be set for Unipolar with Offset and Extended Resolution mode to detect loss of signal or low input indication. Resolution shall be 11-bit plus sign with a 10 ms conversion time. The four points shall be protected by an external .16A indicating fuse block. A green LED shall be provided to indicate the presence of the required 24Vdc supply voltage. A second green LED shall be provided to indicate the module is healthy. Removal of any panel-mounted devices shall not interrupt the input signals to the PLC. Analog values shall continue to function properly. Inputs shall be provided for Flow and Level. Analog input modules shall be as manufactured by Allen-Bradley
5. Analog Output Module shall be eight channels with opto-isolation. Outputs shall drive 4-20mA DC signals. Output shall be set for Unipolar with Offset and Extended Resolution mode to detect loss of signal or low input indication. Resolution shall be 11-bit plus sign with a 10 ms conversion time. The four points shall be protected by an external .16A indicating fuse block. A green LED shall be provided to indicate the presence of the required 24Vdc supply voltage. A second green LED shall be provided to indicate the module is healthy. Removal of any panel-mounted devices shall not interrupt the input signals to the PLC. Analog values shall continue to function properly. Outputs shall be provided for

VFD speed pacing. Analog output modules shall be as manufactured by Allen-Bradley.

## 2.03 INSTRUMENTATION

### A. Wastewater Meter

#### 1. Flow Element-Magnetic Meter

##### a. Tags:

| ISA Designation | Line Size (Inches) | Service |
|-----------------|--------------------|---------|
| FE/FIT-100      | 8                  | Sludge  |
| FE/FIT-101      | 6                  | Sludge  |

- b. Flow element shall be of the electromagnetic type using the pulsed DC-type coil excitation principle with high preamp input impedance. The flow measuring system, consisting of flow element, transmitter, and appurtenances, shall have an overall accuracy of 1% of rate with a 10:1 turndown for all flows resulting from pipe velocities of 1 to 33 feet per second. The system shall operate on 120-volt (10%), 60-Hz power. The unit shall have a zero-stability feature, thereby eliminating the need to stop flow to check zero alignment.
- c. The flow element shall be of watertight, NEMA 6P construction, unless otherwise noted. The meter shall consist of a 316 stainless-steel meter tube, 150-pound ANSI carbon steel raised face flanges, Teflon liner, and 316 stainless-steel electrodes, unless otherwise noted. Electrodes shall be either flush or bullet-nose type. Meters 4 inches and smaller with Teflon liners shall be wafer-style design. Suitable covers shall be provided for flow element ends to protect the tube liner during shipment. The unit shall be furnished with grounding rings or shall be provided with built-in grounding electrodes.
- d. The remote flow transmitter shall be indicating, both flow rate and totalized flow, and suitable for pipe stand mounting, with integral indicators and totalizers furnished. The transmitter output shall be a 4 to 20mA DC signal in linear proportion to flow and shall drive loads with impedances in the range of 0 to 800 ohms without load adjustments for a 24VDC supply. Output span and zero shall be manually adjustable. Both transmitter and primary element shall be powered from the same 120-volt, 60-Hz source.

- e. Sufficient special cable(s) shall be provided for interconnection between the flow element and the transmitter. Cable(s) shall facilitate both signal and power for the flow element (120-volt, 60-Hz power will be made available at the transmitter).
- f. For each size of flow tube, provide one spool piece with identical laying length and flanges. Provide lifting rings on each spool piece to facilitate the replacement of a flow tube by the spool piece.
- g. Provide stainless steel sunshield and transient surge protection for the incoming 120VAC and DC signals as manufactured by DEHN or Phoenix series. Transient surge protection shall be mounted in a 316 stainless-steel box.
- h. The manufacturer of the flow meter shall be Rosemount, ABB or Sparling.

## B. Level Floats

### 1. Flow Element-Floats

- a. Tags:

| ISA Designation | Service |
|-----------------|---------|
| LE/LSH-100      | Sludge  |
| LE/LSL-100      | Sludge  |

### 2. Type:

- a. Tilting float actuation.
- b. SPDT non-mercury switch.
- c. Polypropylene casing.

### 3. Operation:

- a. Function: To produce a contact output at a predetermined liquid level.
- b. Operating Principle: A sealed switch encased in a weighted float freely suspended from a cable is actuated by the tilting motion of the float when it is displaced by the liquid level.

4. Functional:
  - a. Output: Form C (SPDT) hermetically sealed non-mercury switch, rated 6 amps at 250 volts ac.
5. Physical:
  - a. Float: Hermetically sealed, molded polypropylene casing.
  - b. Cable: Three-conductor No. 19 AWG PVC-jacketed.
  - c. Mounting: Cable suspended by waterproof compression connector.
6. Performance:
  - a. Angular operating Differential 20 degrees.
  - b. Vertical operating Differential 1/2-inch.
7. Manufacturer:
  - a. Float switch shall be Roto-Float, 3- or 4-wire, or equal.
8. Accessories:
  - a. Support bracket with adjustable clamp for setting switch height.
  - b. NEMA 4X junction box.

C. Level Meter Ultrasonic

| ISA Designation | Service        |
|-----------------|----------------|
| LE/LIT-100      | Sludge Holding |

1. Unit shall be ultrasonic type, continuous level-measuring system consisting of level element, transmitter, and cable for connection from level element to transmitter.
2. Level element shall be ultrasonic-type transducer. Transducer shall be of waterproof construction with operating range of -20 to +50 degrees C at 1 atmosphere, unless otherwise noted. Transducer shall be furnished with 4-inch PVC blind flange for mounting where shown or noted.
3. Transmitter shall contain solid-state programmable controls to operate transducer, provide pump controls, totalizer, and to provide a 4 to 20 mA dc output signal in linear proportion to the level being sensed. Transmitter shall be provided with high contrast four-digit 18-mm LCD display and five LEDs to indicate alarm conditions. Transmitter scale range shall be as noted. Transmitters for storage tank shall be characterized for the storage

tank shape. Transmitter shall be mounted in a NEMA 4X enclosure, unless otherwise noted, suitable for mounting as noted or shown.

4. Level system shall have an overall accuracy of plus or minus 0.25 percent of full scale and shall operate on 120-volt, 50/60-Hz power.
5. Transmitter shall provide five discrete outputs, adjustable over the entire scale range. At the noted set point, unit shall transfer SPDT contacts, which shall be rated for 5 amperes, continuous, at 120Vac. Set points shall be screwdriver adjustable from inside the enclosure and shall be repeatable within plus or minus 1/4 percent of full scale.
6. Interconnecting cable between the transducer and transmitter shall be furnished with the unit with length as shown.
7. Provide transient surge protection for the incoming 120Vac and dc signals
8. Unit shall be Milltronics "HydroRanger."

D. Flasher

| ISA Designation | Service |
|-----------------|---------|
| YI-100          |         |

1. General:
  - a. Function: alarm flasher.
  - b. Type: NEMA 4X, LED Red.
  - c. Conduit mounted on 316 stainless steel box.
  - d. Gasket.
  - e. 100,000 hours, 120VAC.
  - f. Conduit mounted on 316 stainless steel box.
  - g. Manufacturer: Edwards Signaling 125 Class.

## PART 3 EXECUTION

### 3.01 GENERAL

- A. The Contractor shall lay out the work and be responsible for necessary lines, levels, elevations, and measurements. Installations shall comply with the applicable requirements of Division 16, Electrical. The Drawings indicate the extent and general arrangement of the components. The Contractor shall familiarize himself with work of other trades engaged in the construction. Exact routing of raceways, piping, and locations of equipment may be governed by

structural conditions and obstructions. The Contractor shall coordinate the details of equipment shop drawings for connections to equipment furnished by others. This is not to be construed to permit redesigning systems.

### 3.02 INSTALLATION

- A. The Contractor shall comply with referenced standards, National Electrical Code (NEC), National Electrical Safety Code, local codes, and rules and regulations of local agencies having jurisdiction. The size of conductors, circuit breakers, motor controllers, and protective devices indicated or specified shall meet all requirements of the NEC.

### 3.03 INSTALLER QUALIFICATIONS

- A. The installer shall be acceptable to the manufacturer and/or supplier of the I&C systems. The installer shall have a minimum of 5 years of experience installing I&C systems of a similar type and scope.

### 3.04 WORKMANSHIP

- A. General
  - 1. Install materials and equipment in a workmanlike manner using craftsmen skilled in the particular trade. Provide work which has a neat and finished appearance.
  - 2. Coordinate the work with the Owner, the Engineer, and the work of other trades to avoid conflicts, errors, delays, and unnecessary interference.
- B. Electrical Power and Signal Wiring
  - 1. Control and signal wiring in enclosures and racks shall be restrained by plastic ties or ducts. Hinge wiring shall be secured at each end so that any bending or twisting will be around the longitudinal axis of the wire and the bend area shall be protected with a sleeve.
  - 2. Arrange wiring neatly, cut to proper length, and remove surplus wire. Provide abrasion protection for any wire bundles which pass through holes or across edges of sheet metal.
  - 3. Use the manufacturer's recommended tool with the proper sized anvil for all crimp terminations. No more than one wire shall be terminated in a single crimp lug and no more than two lugs shall be installed on a single-screw terminal.
  - 4. Wiring shall not be spliced or tapped except at device terminals or terminal blocks. All devices with pig-tail wiring shall terminate on terminal blocks within or near the device.

5. All materials, equipment, and workmanship shall be subject to inspection at any time by the Engineer. The Contractor shall correct any work, materials, or equipment not in accordance with these Contract Documents or found to be deficient or defective. Corrections shall be made in a manner satisfactory to the Engineer at no additional cost to the Owner.

### 3.05 TESTING

- A. General: All elements of the I&C system shall be tested to demonstrate that the total system satisfies all of the requirements of this Specification.
  1. All testing materials and equipment shall be provided by the Contractor. Where it is not practical to test with real process variables, the Contractor shall provide a suitable means of simulation. These simulation techniques shall be acceptable to the Engineer.
  2. The Contractor shall have an updated set of Drawings and Specifications, a master copy of approved test procedures, and the master copy of current test failures and solutions to test failures.
  3. Testing will not be considered complete until all portions of the test have been approved by the Engineer. If a test or a portion of a test fails to the point where it needs to be rescheduled, the additional testing cost shall be borne by the Contractor.
- B. Factory Testing: The components shall be tested with simulated I/O at the factory. Factory tests shall generally conform to the applicable sections of ISA RP55.1. The Engineer and/or Owner shall be notified of when and where the testing is to take place and given the option to attend and observe the testing.
- C. Operational Acceptance Testing: The objective of these tests is to demonstrate that each portion of the I&C system is ready for operation.
  1. All components of the system shall be checked for proper installation, adjusted, and calibrated on a loop-by-loop basis.
  2. All elements shall be checked to verify that they have been properly installed and that all terminations have been made correctly. All pneumatic tubing shall be tested in accordance with ISA procedure RP7.1.
  3. All discrete elements and systems shall have their set points adjusted and shall be checked for proper operation.
  4. All continuous elements and systems shall have three-point calibrations performed. All controller tuning constants shall be adjusted to preliminary settings.
  5. The Contractor shall prepare operational acceptance test status report sheets for each loop listing the checks and adjustments performed and the

calibration points actually set. Copies of completed status report sheets shall be submitted before final acceptance.

- D. Functional Acceptance Testing: The objective of these tests is to demonstrate that the I&C system is operating and complying with the specified performance requirements.
1. Each loop function shall be demonstrated to the Engineer in accordance with approved test procedures. Each loop shall be signed off by the Contractor and the Engineer upon satisfactory completion.
  2. A test date may be set after the testing submittal has been approved and pre-test training has been completed.
  3. No modifications shall be made to the system during the functional acceptance test period except as required to maintain Owner operations. The test shall not interrupt normal operations unless approved by the Owner.
  4. If a test fails to produce the expected results, the Contractor will need to respond quickly to determine the cause and take corrective action. Construction shall not interfere with the tests unless approved by the Engineer.
  5. All failed tests shall be retested until the result complies with the Specifications and/or is acceptable to the Engineer and Owner.
  6. At the end of the test, a punch list will be provided to the Contractor. The Contractor shall then determine the cause of the failure, correct the deficiency, and report to the Engineer why the test failed and the corrective action taken. The Engineer will then determine if the function needs to be retested and determine any other tests which may be required.
  7. Within 10 working days from the end of a test period or retest period, a formal punch list will be transmitted to the Contractor. The Contractor shall submit a single test report for the test period and reschedule retesting if needed. Retesting shall be scheduled for not less than 1 week after the Engineer receives the test report and the retest dates shall be acceptable to all.

### 3.06 ON-SITE SUPERVISION

- A. The Contractor shall provide factory-trained, onsite service engineers to supervise and coordinate installation, adjustment, testing, training, and startup of the I&C system.
- B. The Contractor shall provide startup and testing assistance by engineers and programmers as required to thoroughly check all of the equipment and perform all operational and functional tests required.

- C. The service engineer shall be specifically trained on the type of equipment specified and shall advise the Contractor in the location and method of installing special cable, mounting, pipe, and wiring of one of each type of device. The service engineer shall supervise the calibration, commissioning, and initial start-up of the I&C system. A signed and dated calibration sticker shall be affixed to each device.

### 3.07 TRAINING

- A. The Contractor shall provide a minimum of two 8-hour days' on-site training for the Owner's O&M personnel at the job site before functional acceptance testing.
- B. The training program shall include classroom and field instruction by experienced and knowledgeable technicians and engineers on the O&M of the I&C elements, components, and systems provided.

### 3.08 FUNCTIONAL DESCRIPTIONS

- A. Functional Descriptions shall be in accordance with Section 13316, Software Control Block Descriptions.

END OF SECTION

**SECTION 13420**  
**FIBER OPTIC COMMUNICATION SUBSYSTEM (FOCS)**

**PART 1 GENERAL**

**1.01 GENERAL REQUIREMENTS**

- A. This Section specifies the requirement to provide and install the fiber optic communication media, complete. Work specified herein is to be coordinated with work specified in Section 13401, Process Instrumentation and Control Systems (PICS).

**1.02 REFERENCES**

The following is a list of standards that may be referenced in this Section:

- A. Telecommunications Industries Association/Electronic Industries Alliance (TIA/EIA)
  - 1. TIA/EIA-568 C.3 Optical Fiber Cabling Components Standard.
  - 2. TIA/EIA-598-B Optical Fiber Cable Color Coding.
  - 3. TIA 492AAAC Detail Specification for 850-nm Laser- Optimized, 50-mm Core Diameter/125-MM Cladding Diameter Class IA Graded-Index Multimode Optical Fibers.
  - 4. TIA/EIA-526-14-B OFSTP-14B Optical Power Loss Measurement of Installed Multimode Cable.
- B. National Electrical Code (NEC)
- C. International Organization for Standardization (ISO)
- D. CSMA/CD (Ethernet): ISO 8802-3.

**1.03 SUMMARY**

- A. The function of the FOCS is to transmit digital data between network nodes. The requirements listed identify the minimum acceptable system performance. Provide all hardware and software required for operational system.
- B. Provide a standards-based, multimode FOCS segment implement an industrial, Ethernet-based, network.

- C. The work consists of providing, installing, terminating, and testing two OM-3 optical fiber links supporting communications between a central operations center and two process facilities located within the wastewater plant campus.
- D. The requirements listed identify the minimum acceptable system performance. Provide all hardware and software required for operational system.

#### 1.04 ABBREVIATIONS

- A. ANSI: American National Standards Institute.
- B. ATM: Asynchronous transfer mode.
- C. AUI: Attachment unit interface.
- D. dB: Decibel.
- E. DNI: Desktop network interface.
- F. EIA: Electronic Industries Association.
- G. FDDI: Fiber distributed data interface.
- H. FOA: Fiber Optic Association
- I. FOCS: Fiber Optic Communication Subsystem.
- J. FOIRL: Fiber Optic Inter Repeater Link.
- K. LAN: Local area network.
- L. m: Meter.
- M. MHz: Megahertz.
- N.  $\mu$ : Micro,  $\times 10^{-6}$ .
- O. Mbps: Megabits per second.
- P. N:
  - 1. Newton.
  - 2. Nano,  $\times 10^{-9}$ .
- Q. OLTS: Optical Loss Test Set.
- R. OTDR: Optical time-domain reflectometer.
- S. TIA: Telecommunications Industries Association.

#### 1.05 SUBMITTALS

- A. Cable Schedule Showing
  - 1. Cable identifications.
  - 2. Fiber counts for each cable and identifications of used fiber pairs.
  - 3. Cable length and attenuation with two connector pairs and zero splices based on TIA/EIA-568-C3. If calculation indicates that any cable will attenuate signals more than 8 dB, reroute in cooperation with the Engineer.

B. Component Submittal: For each FOCS component:

1. Manufacturer and model number.
2. General data and description.
3. Engineering specifications and data sheets.
4. Manufacturers suggested installation practice.

C. Quality Control Submittals

1. Contractor Qualifications Submittal:

- a. FOCS Subcontractor Statement of Qualifications.
- b. FOCS Subcontractor Site Supervisor Resume.

2. Testing-Related Submittals:

- a. OLTS calibration certification.
- b. Insertion Loss Test Procedures.
- c. FOA Fiber Optic Technician Certification.
- d. Insertion Loss Test Results.

## 1.06 ENVIRONMENTAL REQUIREMENTS

A. Optical Fiber Cable

1. Outside, Underground, Submerged: -5 to 25°C.
2. Outside, Overhead: Wet/icy, -20 to 40°C.
3. Outside, Aboveground in Conduit: -20 to 40°C.
4. Inside: Wet, 0 to 40°C.

B. Other Equipment

1. Outside Aboveground: Wet/icy, -20 to 40°C.
2. Control Rooms, Equipment Rooms, and Telecommunications Closets: 30 to 55% relative humidity, 18 to 24°C.
3. Other Areas: 0 to 100% relative humidity, 5 to 35°C.

## 1.07 TESTING

A. Test components of the installation in accordance with standards and specifications, TIA/EIA-526-14-B OFSTP-14B as a minimum.

- B. Provide equipment, instrumentation, supplies, and skilled staff necessary to perform testing. The testing technician shall have current FOA Fiber Optic Technician certification.
- C. Advise the Engineer at least 48 hours in advance of each test. The Owner and the Engineer shall have option to witness and participate actively in tests. Document test results of each cable to confirm that specified number of fibers per cable meet standards.
- D. Submit documented results of tests. Indicate the measured optical loss for each strand in the cable measured from both ends each.

## 1.08 MINIMUM FOCS CONTRACTOR QUALIFICATIONS

- A. FOCS Subcontractor: Minimum of 5 years of experience providing, integrating, installing, and starting up similar systems as required for this Project.
- B. FOCS Subcontractor's Site Representative: Minimum of 5 years of experience installing systems similar to FOCS as required for this Project.

## PART 2 PRODUCTS

### 2.01 FIBER OPTIC CABLE

- A. General
  - 1. Temperature Range:
    - a. Storage and Operational: -40 to 70°C.
    - b. Installation: -30 to 70°C.
  - 2. Suitable for outdoor and direct buried installation.
- B. Multi-Mode Fiber Characteristics
  - 1. Fiber shall comply with requirements of TIA – 492AAAC (OM3).
  - 2. Fiber material and core/cladding size: glass, multi-mode 50/125 µm.

3. Performance:

a. Maximum Attenuation:

- (1) 850 nm: 3.0 dB/km.
- (2) 1,300 nm: 1.0 dB/km.

b. Bandwidth with overfilled launch:

- (1) 850 nm: 1,500 MHz-km.
- (2) 1,300 nm: 500 MHz-km.

c. Serial 1 Gigabit Ethernet distance:

- (1) 850 nm: 1,000 m.
- (2) 1,300 nm: 600 m.

4. Color coded tubes and fibers, in accordance with TIA/EIA-598-B.

5. Minimum Bend Radius, Buffer End Fiber: 1 inch.

C. Tube Configuration

- 1. Loose tube, gel-free with water swell-able tape and yarns.
- 2. Shared tube.
- 3. Fibers Per Tube: 6, maximum.

D. Cable

1. Fiber Count: As noted on the Drawings. Six (6) fibers per cable minimum.

2. All-Dielectric Construction: No electrically conductive components in the fiber optic cable.

3. Strength Member:

- a. Nonconductive; integral part of cable; supports stress of installation and load during use.
- b. Fiberglass epoxy rod aramid fiber, Kevlar.
- c. Minimum Tensile Strength: 600 pounds.

4. Protective Covering:
  - a. Flame-Retardant, UV resistant, Non Halogen outer jacket.
  - b. In any single length of cable continuous and free from holes, splices, blisters, and other imperfections.
5. Minimum Bend Radius:
  - a. Short-Term Under Tension: 15 times cable diameter, minimum.
  - b. Long-Term Without Tension: 10 times cable diameter, minimum.
6. Miscellaneous:
  - a. Ripcord.
  - b. Dielectric central member.
  - c. Interstitial filling.
7. Manufacturers and Model:
  - a. Corning Cable Systems, Altos® Lite™ Gel-Free Cable.
  - b. Or Equal.

## 2.02 CONNECTORS

- A. Features
  1. In accordance with requirements of TIA/EIA-568-C3.
  2. SC connectors with 12.7-millimeter spacing between ferrules.
  3. Designed to support Ultra Polish Connector (UPC).
  4. Pull Strength: 2.2 N minimum.
  5. Durability: Sustain minimum 500 mating cycles without violating other requirements.
  6. Ferrules: Zirconia.
  7. Polarizing key on duplex connector systems.
- B. All fibers strands per cable shall be terminated on connectors.
- C. Attenuation
  1. In accordance with requirements of TIA/EIA-568-C3.
  2. Maximum of 0.75 dB per connector pair.
- D. Maximum Return Loss Value: 55dB.

E. Manufacturer and Model

1. Corning Cable Systems TRM-31.
2. Leviton 49990.
3. Or Equal.

2.03 FAN OUT KITS

A. General: Supports field termination of loose-tube, fiber optic cables.

B. Features

1. In accordance with requirements of TIA/EIA-568-C3.
2. Suitable for outdoor application.
3. 25-inch long, 900- $\mu$ m buffer tube.
4. Color coded in accordance with TIA/EIA 598 B.
5. Snap-together, plastic furcation unit.
6. Number of buffer tubes to match cable buffer tube count.

C. Manufacturer and Model

1. Corning Cable Systems FAN-OD.
2. Leviton 49887.
3. Or equal.

2.04 JUMPER CABLES (PATCH CORDS)

A. In accordance with requirements of TIA/EIA-568-C3.

B. Function: To connect from fiber centers to hubs or network nodes.

C. Fiber Characteristics: In accordance with requirements for fiber optic cable.

D. Tube Configuration:

1. Individual tight thermoplastic buffer tubes.
2. Protected with Kevlar strength member sand enclosed in thermoplastic jacket.

E. Length: Standard lengths to meet project installation requirements, plus minimum 3-m spare at workstations.

F. Connectors: To meet requirements of paragraph 2.02 Connectors, and:

1. On-Axial Pull Strength: 33 N.
2. Normal-to-Axial Pull Strength: 22 N.

G. Spares: Provide 100% spare jumpers of each length needed.

## 2.05 TEXTILE INNERDUCT

- A. Provide with each fiber optic cable a detectable textile innerduct and inflatable closure system suitable for installation in 2-inch conduit. The innerduct shall be configured with a minimum of two cells.
- B. The inner duct shall be fabricated from a polyester/nylon fabric. Inside each cell shall be a flat, woven polyester pull tape that runs the entire length of the inner duct. Each tape shall be color-coded and rated for 1,250 pound pull tension, as a minimum. An 18G, TFN solid core, copper cable shall be sewn in the innerduct seam for tracing. The trace cable shall be 600 VAC rated, with a minimum ampacity of 6 A. The trace cable jacket shall be green polyvinyl.
- C. The innerduct assembly shall be factory lubricated.
- D. Seal each end of the conduit with an inflatable foil termination bag. The termination bag shall be the innerduct manufacturer's standard, suitable for water-tight installations.
- E. Innerduct shall be 2-inch, 2-cell Maxcell Innerduct, or equal.

## PART 3 EXECUTION

### 3.01 INNERDUCT SYSTEM

- A. Provide and install innerduct per manufacturers' instruction. Leave the pull tape in the innerduct's empty cell to facilitate future cable installations.
- B. Install the termination bag at each conduit open ends per manufacturer's instruction.

### 3.02 FIBER OPTIC CABLE

- A. Install cables as specified and in accordance with the manufacturer's requirements.

- B. Install cable directly from shipping reels. Ensure that cable is not:
1. Dented, nicked, or kinked.
  2. Subjected to pull stress greater or bend radius less than specified or manufacturer's specification, whichever is the more stringent requirement.
  3. Subjected to treatment, which may damage fiber strands during installation.
- C. Cables per Conduit: In accordance with NEC conduit fill limitations, as shown on the Drawings, whichever is the more stringent requirement.
- D. Splices:
1. For segment runs 2,000 feet or shorter, install fiber optic cables in unspliced lengths throughout the system.
  2. Fusion splice connection(s) may be used for segment runs greater than 2,000 feet. Submit to the Engineer for their approval the quantity and location of splice. Include with this submittal an accounting of the optical budget for the entire fiber optic segment (from transceiver to transceiver).
  3. The Engineer will approve the use of splice connections on an exception basis. Splices will not be approved to correct installer error.
- E. Identification:
1. Identify each cable on both ends and in all access holes and pull points it goes through.
  2. Use waterproof tags and identifications.
- F. Sealing: Seal conduits around cable, after installation and testing, to stop ingress of water and grit.

### 3.03 CABLE TERMINATIONS

- A. Terminate cables in accordance with TIA/EIA-568-C3.
- B. Fan out fiber cable to allow direct connectorization of connectors. Sleeve over individual fibers with transparent furcation tubes. At point of convergence of furcation tubes, provide strain relief with metal or high-density plastic fan-out collar.
- C. Breakout Kits:
1. Terminate all cables using manufacturer-supplied breakout kits.
  2. Terminate in accordance with the manufacturers' recommendations.

D. Identification: Ensure that each fiber's identification is clearly visible, or identify individually.

E. Slack:

1. In Fiber Centers and at Hubs and Switches: Minimum 3-m slack fiber at each end, coiled neatly in the cable management equipment.
2. In Communications Management Outlets: Minimum 1-m slack fiber, coiled neatly in the outlet box.

F. Connectors:

1. Terminate 100% fibers in each cable to specified connectors.
2. Connect connectors into fiber management system wherever possible.

### 3.04 CABLE TESTING

- A. Provide equipment, instrumentation, and supplies necessary to perform testing. The Owner and the Engineer shall have option to observe the onsite tests.
- B. Perform an Insertion Loss Test on delivery while the fiber cable is on the reel. The use of temporary termination connectors are permissible for this test. All strands must meet the requirements of TIA/EIA-526-14-B OFSTP-14B. Any fiber not meeting this requirement for all strands shall be rejected.
- C. Complete cable installation and termination of all strands prior to final testing. The use of temporary termination connectors is not permissible for the final test.
- D. Demonstrate that all strands in each cable meet the requirements of TIA/EIA-526-14-B OFSTP-14B, as modified here:
  1. Measure attenuation in *both* directions, not in one direction only.
  2. Measure attenuation at 850 and 1,300 nm.
- E. Replace all cables that do not have specified number of fibers meeting specified attenuation standards. Re-test until cable meets requirements.

END OF SECTION

**DIVISION 15**

**MECHANICAL**

**SECTION 15055**  
**PIPING SYSTEMS—GENERAL**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. This Specification describes responsibilities and requirements for Piping Systems including the following:
  - 1. Labor, materials, tools, equipment, and services to be furnished in accordance with the provisions of the Contract Documents. The materials to be used for the piping systems shown in the Drawings are listed by service in the Piping Schedule, included in the Contract Drawings.
  - 2. Coordination of work with other trades.
  - 3. Furnishing and installing all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation, although such work is not specifically indicated.
  - 4. Furnishing Record Drawings and documents for piping systems.

**1.02 RELATED WORK**

- A. Section 01300, Contract Administration.
- B. Section 01330, Submittals and Acceptance.
- C. Section 01650, Delivery, Storage, and Handling.
- D. Section 01780, Warranties and Bonds.
- E. Section 01785, Record Documents.
- F. Section 01830, Operations and Maintenance Manuals.
- G. Section 02305, Earthwork for Utilities.
- H. Section 09900, Painting and Coating.
- I. Section 15075, Process Equipment, Piping, and Valve Identification.
- J. Section 15144, Pressure Testing of Piping.
- K. Section 15155, Ductile Iron Pipe and Fittings.
- L. Section 15290, PVC Pipe, 3 Inches and Smaller.

**1.03 SUBMITTALS**

The Contractor shall submit the following in accordance with Section 01330, Submittals and Acceptance:

- A. If the Contractor deviates from the piping layout as shown on the Contract Drawings, the Contractor shall submit scaled piping drawings showing locations and dimensions to and from fittings, valves, tanks, equipment, structures, and related appurtenances. Provide scaled drawings to a minimum scale of 1 inch

equals 10 feet. Provide details to minimum scale of 1/8 inch equals 1 foot. Elevations shall correspond to reference vertical elevation datum shown or provided for this project.

- B. Copies of any manufacturer's written directions regarding material handling, delivery, storage, and installation.
- C. Record piping drawings shall meet the requirements of Section 01300, Contract Administration, and Section 01785, Record Documents. During the work, the Contractor shall maintain accurate, up-to-date Record Drawings of piping systems installed in the project, including pre-existing piping discovered, relocated, or at locations other than as originally shown on the Drawings. When the work is completed and accepted by the Owner and the Engineer, the Contractor shall submit Record Drawings in accordance with Section 01785, Record Documents. The Contractor shall identify complete location, elevations, and description of piping systems. Piping systems and fittings are to be identified from three points on structures and/or stationary appurtenances.
- D. Submit copies of forms documenting required field pressure testing work and results.
- E. Submit welding certificate copies.
- F. Submit certified copies of mill test reports for bolts and nuts, including coatings if specified. Provide recertification by an independent domestic testing laboratory for materials originating outside of the United States.
- G. Submit manufacturer's data sheet for gaskets supplied showing dimensions and bolting recommendations.
- H. Support Systems:
  - 1. Drawings of each piping system locating each support, guide, and anchor.
  - 2. Identify support, guide, and anchor type by catalog number and shop/Contract Drawing detail number

## 1.04 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American Society for Testing and Materials (ASTM)
  - 1. ASTM A183—Specification for Carbon Steel Track Bolts and Nuts.
  - 2. ASTM A193/A193M—Standard Specification for Alloy Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
  - 3. ASTM A194/A194M—Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service.
  - 4. ASTM A307—Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 psi Tensile Strength.
  - 5. ASTM D1330—Standard Specification for Rubber Sheet Gaskets.
  - 6. ASTM F467—Standard Specification for Nonferrous Nuts for General Use.
- B. American Society of Mechanical Engineers (ASME)
  - 1. ASME B1.1—Unified Inch Screw Threads (UN and UNR Thread Form).
  - 2. ASME B1.20.1—Pipe Threads, General Purpose (Inch).
  - 3. ASME B16.21—Nonmetallic Flat Gaskets for Pipe Flanges.
  - 4. ASME B18.2.1—Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series).
  - 5. ASME B18.2.2—Nuts for General Applications: Machine Screw Huts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series).
  - 6. ASME B31.1—Power Piping.
  - 7. ASME B31.3—Process Piping.
  - 8. ASME BPVC—Boiler and Pressure Vessel Code.
- C. American Water Works Association (AWWA)
  - 1. AWWA C111/A21.11—Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
  - 2. AWWA C207—Steel Pipe Flanges for Waterworks Service, Sizes 4 Inches Through 144 Inches (100 mm Through 3,600 mm).
- D. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS)
  - 1. MSS SP 58—Pipe Hangars and Supports – Material, Design, Manufacture, Selection, Application, and Installation.
- E. NSF International (NSF)
  - 1. NSF 61—Drinking Water System Components – Health Effects.

## 1.05 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

## 1.06 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.
- B. The Contractor shall protect the pipe from kinks, cuts, end damage, and other defects when transporting all piping. Binding and tie-down methods shall not damage or deflect the pipes in any way. Pipe damaged during shipment shall be rejected.
- C. Pipe shall be stored on level ground, preferably turf or sand, free of sharp objects that could damage the pipe. Stacking of any pipe shall be limited to a height that will not cause excessive deformation of the lower layers of pipe under anticipated temperature conditions. When necessary due to ground conditions, the pipe shall be stored on wooden sleepers, spaced suitably and of such widths to not allow deformation of the pipe at the point of contact with the sleeper or between supports. Pipe shall not be removed from storage until bedding or sub-grade work is complete and ready to receive the pipe.
- D. The joined pipe shall be handled in such a manner that the pipe is not damaged by dragging it over sharp and cutting objects. Ropes, fabric, or rubber-protected slings and straps shall be used when handling pipe. Chains, cables, or hooks inserted into the pipe ends shall not be used. Two slings spread apart shall be used for lifting each length of pipe. Pipe or fittings shall not be dropped. Slings for handling joined pipe shall not be positioned at socket-welded joints. Sections of the pipes with cuts and gouges shall be removed and the ends of the pipe rejoined. In accordance with the pipe manufacturer's written instructions, the Contractor shall repair all pipe with damaged linings and pipe exterior coatings that have been damaged before the pipe is installed.
- E. The Contractor shall cover all pipe stored on the site with canvas or other opaque material to protect it from sunlight. Provide air circulation under the covering.
- F. The Contractor shall inspect all pipe, fittings, and other accessories upon delivery and during the work. Any defective or damaged materials found during field inspection or during tests shall be removed from the site and replaced by, and at the expense of, the Contractor.

- G. The interior of all pipe, fittings, and other accessories shall be kept free from dirt and foreign matter at all times. Fittings shall be drained and stored in a manner that will protect them from damage by freezing.
- H. Gaskets shall be placed in a cool location out of direct sunlight. Gaskets shall not come in contact with petroleum products. Gaskets shall be used on a first-delivered-to-site and first-to-be-installed rotation basis. Mechanical-joint glands, bolts, and washers shall be handled and stored in a manner that will ensure proper use with respect to types and sizes.

## 1.07 OPERATIONS AND MAINTENANCE (O&M) MANUALS

- A. O&M Manuals shall be in accordance with General Conditions, Supplementary Conditions, and Section 01830, Operations and Maintenance Manuals.

## 1.08 DEFINITIONS OF BURIED, EXPOSED, AND SUBMERGED PIPING

- A. Buried piping is piping buried in soil, beneath a structure and/or encased in concrete. Where an exterior pipe coating is specified to be factory- or field-applied, the Contractor shall provide the coating up to the penetration of a structure. Piping encased in concrete does not require an exterior coating other than what is factory furnished.
- B. Exposed piping is piping in any of the following conditions or locations:
  1. Visible piping above ground.
  2. Visible piping inside buildings, vaults, or other structures.
  3. Visible piping in underground concrete trenches or galleries that are accessible.
- C. Submerged piping is considered to be all piping within a liquid holding tank.
- D. Concealed piping is piping above grade that is not visible or accessible and is contained within building walls, attics, floor spaces, pipe chases, pipe galleries, or structures.

## 1.09 SYSTEM DESIGN REQUIREMENTS

- A. General
  - 1. The Project Specifications and Contract Drawings are not all inclusive of explicit piping details; provide piping for intended use in compliance with laws and regulations, including ASME B31.1 Code (Power Piping).

2. Pressure ratings and materials specified represent minimum acceptable standards for piping systems.
3. Piping Systems: Suitable for the services specified and intended.
4. Piping shall be color coded in accordance with the Florida Department of Environmental Protection requirements.

B. Support Systems

1. The absence of pipe supports and details on the Contract Drawings shall not relieve the Contractor of responsibility for sizing and providing supports for this project.
2. Select and design within the specified spans and component requirements.
3. Comply with requirements of MSS SP 58, Pipe Hangers and Supports – Materials, Design, and Manufacture.
4. Criteria for structural design and selection of pipe support system components:
  - a. Dead loads imposed by the weight of the pipes filled with water, within specified spans and component requirements, plus any insulation.
  - b. Safety factor: Minimum of 5.
5. Design, size, and space support anchoring devices, including anchor bolts, inserts, and other devices used to anchor the support, to withstand the shear and pullout loads imposed by loading and spacing on each particular support.
  - a. Piping smaller than 30 inches: Supports are shown only where specific types and locations are required; additional pipe supports may be required and are to be provided and installed by the Contractor at no additional cost to the Owner.

C. Adapters

1. No attempt has been made to show all adapters, spool pieces, reducers, bushings, or other fittings required to accommodate the connection of pipes, fittings, and valves of various joint design and sizes throughout the project. The Contractor is completely responsible for providing, at his expense, all adapters, reducers, sleeves, spool pieces, restraints, and other fittings and appurtenances necessary for connection and restraint of pipe (for the same pipe material or a transition of pipe materials), valves,

fittings, and appurtenances throughout the project, which shall be constructed of appropriate materials, coated and lined to match the materials, coatings, and linings specified for the connected components. All adapters, reducers, sleeves, spool pieces, and other fittings shall be coated and lined in accordance with the specifications for each individual pipe system.

D. Unions

1. No attempt has been made to show all unions required for the project. The Contractor shall provide unions at all connections of threaded pipe to installed equipment unless deleted by the Engineer, in writing, at certain locations. The unions shall meet or exceed the quality of materials, pressure rating, service, and painting requirements of connected piping.

## PART 2 PRODUCTS

### 2.01 PIPING SYSTEM GENERAL REQUIREMENTS SCHEDULE

- A. Unless noted otherwise in the Contract Drawings, piping system materials, fittings, and appurtenances are subject to requirements of the individual Specifications for the piping systems.

### 2.02 PIPING SCHEDULE

- A. A piping schedule (flow stream identification) listing the piping identification abbreviations, piping materials, operating pressures, field test pressures, lining systems, and color coding as identified and provided on the Contract Drawings. In project locations where the piping system material referenced on the piping schedule is not appropriate, the required piping material is indicated on the Contract Drawings. Materials called out in the Contract Drawings shall govern over materials stated in the piping schedule.

### 2.03 THREAD FORMING FOR STAINLESS STEEL BOLTS

- A. Form threads for stainless steel bolts by rolling, not by cutting or grinding.

### 2.04 BOLTS AND NUTS FOR FLANGES FOR DUCTILE IRON PIPE FLANGES

- A. Bolts, washers, and nuts for pipe installed indoors, outdoors above and below ground, and in vaults and structures shall be as specified in Section 15155, Ductile Iron Pipe and Fittings.

- B. Unless specified elsewhere, bolts, washers, and nuts for submerged Class 150 flanges shall be Type 304 stainless steel conforming to ASTM A193/A193M (Grade B8) for bolts and ASTM A194/A194M (Grade 8) for nuts. Fit shall be Class 2A conforming to ASME B1.1 when connecting to cast-iron valves having body bolt holes.

## 2.05 BOLTS AND NUTS FOR TYPE 304 STAINLESS STEEL PIPE FLANGES

- A. Bolts, washers, and nuts for flanges shall be Type 304 stainless steel conforming to ASTM A193/A193M, Grade B8, for bolts and ASTM A194/A194M, Grade 8, for nuts.

## 2.06 BOLTS AND NUTS FOR TYPE 316 STAINLESS-STEEL PIPE FLANGES

- A. Bolts, washers, and nuts for flanges shall be Type 316 stainless steel conforming to ASTM A193/A193M, Grade B8, for bolts and ASTM A194/A194M, Grade 8, for nuts.

## 2.07 BOLTS AND NUTS FOR PVC, CPVC, AND PVDF PIPE FLANGES

- A. Bolts for piping in sodium hypochlorite service shall be made of titanium, in accordance with ASTM F467, Grade Ti1, Ti2, or Ti7. Nuts and washers shall conform to ASTM F467 and shall be made of titanium.
- B. Bolts, washers, and nuts in chemical service other than sodium hypochlorite shall be Type 304 stainless steel conforming to ASTM A193/A193M, Grade B8, for bolts and ASTM A194/A194M, Grade 8, for nuts, unless specified elsewhere.
- C. Unless specified elsewhere, bolts, washers, and nuts for buried and submerged flanges and flanges located outdoors above ground or in vaults and structures shall be Type 304 stainless steel conforming to ASTM A193/A193M, Grade B8, for bolts and ASTM A194/A194M, Grade 8, for nuts.
- D. The Contractor shall provide a washer under each nut and under each bolthead. Washers shall be of the same material as the nuts.

## 2.08 BOLTS AND NUTS FOR STEEL PIPE FLANGES

- A. Unless specified elsewhere, bolts, washers, and nuts for Class 150 flanges (including AWWA C207, Class D) located indoors, outdoors above ground, in vaults, and in structures shall be carbon steel, ASTM A307, Grade B. Bolts, washers, and nuts for buried service shall also be hot-dipped galvanized.

- B. Unless specified elsewhere, bolts, washers, and nuts for submerged Class 150 flanges shall be Type 304 stainless steel conforming to ASTM A193/A193M (Grade B8) for bolts and ASTM A194/A194M (Grade 8) for nuts. Fit shall be Class 2A in accordance with ASME B1.1 when connecting to cast-iron valves having body bolt holes.

## 2.09 LUBRICANT FOR STAINLESS STEEL BOLTS AND NUTS

- A. Anti-seize thread lubricant shall be applied to the thread portion of all (above grade and below grade) stainless steel bolts (stainless steel tie rods, etc.) during assembly. Anti-seize lubricant shall be chloride free and shall be nongalling NSF approved. Anti-seize thread lubricant shall be Jet-Lube "Nikal," John Crane "Thred Gard Nickel," Never-Seez "Pure Nickel Special," or Permatex "Nickel Anti-Seize."

## 2.10 FLANGE GASKETS FOR STEEL, DUCTILE IRON, AND STAINLESS STEEL PIPE

- A. Flange gaskets shall be in accordance with AWWA C207, except as modified in this Section. Gaskets shall be ring type. All gasket material shall be suitable for the fluid being conveyed and shall be resistant to free chlorine concentrations up to 10 mg/L. All gasket material shall be rated to the surge pressures listed in the pipe schedule. Gaskets shall be EPDM or an approved equal.

## 2.11 FLANGE GASKETS FOR DUCTILE-IRON PIPE AND FITTINGS IN RAW SEWAGE

- A. Gaskets shall be full face, 1/8 inch thick, Buna-N having a Brinell Hardness of 55 to 65 durometer. Gaskets shall be suitable for a water pressure of 200 psi at a temperature of 250°F. Gaskets shall have "nominal" pipe size inside diameters, not the inside diameters indicated in ASME B16.21. Provide Garlock Style 9122 or equal. The Contractor shall verify that the gaskets are compatible with all chemicals being used.

## 2.12 FLANGE GASKETS FOR PVC AND CPVC PIPE

- A. Gaskets for flanged joints shall be full faced, 1/8 inch thick, having a Brinell Hardness of 50 to 70 durometer A. Gasket material shall be EPR unless noted or specified otherwise. Gasket material for sodium hypochlorite service shall be Viton ETP unless noted or specified otherwise. Gaskets shall be compatible with the fluids conveyed.

## 2.13 FLANGE GASKETS FOR PVDF PIPE

- A. Gaskets for flanged joints shall be full faced, 5/64 inch thick (minimum), made of Teflon-bonded EPDM or PVDF-bonded EPDM. The EPDM shall have a Brinell

Hardness of 65 to 70 Durometer "A." Gaskets shall be suitable for a fluid temperature range of -40°F to +210°F and compatible with the fluids conveyed.

**2.14 FLANGE GASKETS FOR STAINLESS-STEEL PIPE IN CHEMICAL SERVICE (NOT USED)**

**2.15 LOCATOR WIRE AND DETECTABLE MARKING TAPE**

- A. All 2-inch and larger buried piping shall be laid with two insulated, 12-gauge minimum AWG, THWN strand copper wires tied to the nonmetallic pipe at 18 inches on center for location purposes.
- B. All 2-inch and larger buried piping shall be laid with underground detectable caution tape, 2-inch tape for a maximum of 12-inch depth and 6-inch tape for a maximum of 24-inch depth. Tape shall be placed a minimum of 1 foot above the top of pipe.
- C. Marking tape shall be as detailed herein and also in accordance with Section 15075, Process Equipment, Piping, and Valve Identification.

**PART 3 EXECUTION**

**3.01 PREPARATION**

- A. Field Alignment:
  - 1. The piping shown on the Contract Drawings is generally indicative of the work, with symbols and notations provided for clarity. However, the Contract Drawings are not an exact representation of all conditions involved; therefore, install piping to suit actual field conditions and measurements as approved by the Engineer. No extra compensation will be made for work due to differences between indicated and actual dimensions.
  - 2. The Contractor shall install all adapters, fittings, flanged connections, closures, restrained joints, etc. not specified but necessary for a complete installation acceptable to the Engineer.
  - 3. The Contract Drawings do not indicate all adapters, fittings, spool pieces, bushings, unions, supports, hangers, and other items required to accommodate the installing and connecting of pipe, fittings, valves, and equipment of various joint designs and sizes. Provide such required items of appropriate designs, materials, coatings, and linings acceptable to the Engineer.
  - 4. An extensive network of underground piping, duct, conduit, direct-buried conductors, and related structures of various sizes, materials, alignments,

age, and function exist within the project site. Conclusive information concerning these facilities is not available. Consequently, the design of new piping indicated on the Contract Drawings is approximate. Adjust alignment, fitting, valve, and joint locations as required and as approved by the Engineer to accommodate and protect existing facilities and provide the intended functionality of new piping.

### 3.02 FIELD LAYOUT AND MODIFICATIONS

- A. Unless directed otherwise, the Contractor shall be responsible for setting construction layout stakes and/or offsets required to complete the designated work. The Contractor shall ensure that those stakes and/or offsets are protected and any re-staking required for any reason including work stoppage shall be included in the bid price and no additional compensation to the Contractor will be made.
- B. The Engineer has the right to make any modifications the Engineer deems necessary due to field conditions, conflicts with other utilities, or to protect other properties.

### 3.03 PIPE PRODUCTS INSPECTION

- A. The Contractor shall obtain from the pipe manufacturer a certificate of inspection to the effect that the pipe, fittings, gaskets, glands, bolts, and nuts supplied for this Contract have been inspected at the plant and that they meet the requirements of these specifications. The Contractor shall submit these certificates to the Engineer before installing the pipe materials. The Contractor shall visually inspect all pipe and fittings at delivery and before they are lowered into the trench to be installed. Pipe or fittings that do not conform to these Specifications or have been damaged in any manner will be rejected and the Contractor must remove them immediately. The entire product of any plant may be rejected when, in the opinion of the Engineer, the methods or quality assurance and uniformity of manufacturer fail to secure acceptable and uniform pipe products or where the materials used produce inferior pipe products.

### 3.04 REMOVAL OF EXISTING PIPE AND FITTINGS

- A. Pipe, fittings, and valves specifically identified on the Contract Drawings to be removed or replaced from service shall be physically taken out of the ground. The limits of pipe to be removed shall be specifically called for in the plans or shall be approved in writing by the Engineer. Any other removal not specifically called for shall be approved in writing and shall be considered incidental to construction of other items in the contract and the Contractor will not receive compensation for such work.

- B. When removing pipe and fittings, the Contractor shall excavate a trench wide enough to dislodge the pipe from the surrounding soil and long enough to be able to handle the pipe and fittings without causing any damage to nearby utilities, structures, or adjacent property.
- C. The removed pipe, fitting, and appurtenances will become the Contractor's property unless noted otherwise in the Contract Drawings or specified elsewhere to become the property of the Owner, and the Contractor shall be responsible for proper disposal and any required permits for disposal.
- D. Regarding pipe remaining in the ground subsequent to removal of connected pipe or pipe fittings, the remaining buried pipes, openings, and fittings shall be plugged or capped as approved by the Engineer.
- E. Pipe that will be abandoned in place shall be plugged or capped as approved by the Engineer.

### 3.05 BURIED PIPING AND PIPE FITTINGS

- A. Trenching and backfilling for all pipe and fittings shall also be in accordance with Section 02305, Earthwork for Utilities.
- B. Installation:
  1. Inspect all piping for defects and remove all lumps or excess coatings before installation. The inside of the mechanical joint and outside of plain-end pipe shall be cleaned before joining pipe. Caution shall be taken to prevent damage to the pipe during lowering into the trench. Remove all foreign matter that has entered the pipe during storage and installation. The Contractor shall cover the pipe ends during installation to prevent debris from entering the pipe. No debris, tools, clothing, or other material shall be placed in the pipe.
  2. After being placed in the trench, the pipe shall be brought to the proper line and grade by compacting the approved backfill material under it, except at the bell end. Joint deflection shall not exceed 75% of the manufacturer's limit.
  3. The Contractor shall install temporary water-tight plugs on the pipe ends during the time that the pipe is in the trench but no work is in progress. If there is water in the trench upon beginning work, this plug shall remain in place until the trench has been pumped dry, unless otherwise approved by the Engineer, the Engineer's Representative, or the Owner's Representative.

4. Buried carbon steel bolts and nuts shall be coated in accordance with Section 09900, Painting and Coating, System No. 23.
5. Coat threaded portions of stainless steel bolts and nuts with lubricant before assembly.
6. Restrained plugs or caps shall be inserted into all buried dead-end pipes, tees, or crosses. Provide blind flanges for all flanged exposed piping. Restrained plugs and caps installed for pressure testing shall be fully secured and blocked to withstand the test pressure.
7. Where plugging is required because of contract division or phasing for later connection, the ends of such lines shall be equipped with a suitable cast-iron or ductile-iron plug/cap or blind flange with or without a blowoff cock, as shown on the Drawings. Installation or removal of such plugging shall be considered incidental to the work and the Contractor shall not be compensated by the Owner for performing this work.

### 3.06 FLANGED JOINTS FOR EXPOSED PIPE AND FITTINGS

- A. When bolting flanged joints, the Contractor shall avoid restraint on the opposite end of the pipe or fitting, which would prevent uniform gasket compression or which would cause unnecessary stress in the flanges. One flange shall be free to move in any direction while the flange bolts are being tightened. Bolts shall be tightened gradually and at a uniform rate to ensure uniform compression of the gasket, in accordance with pipe and fitting manufacturer's recommendations.
- B. Coat threaded portions of stainless steel bolts and nuts with lubricant before assembly.

### 3.07 PIPING CONNECTIONS TO PUMPS AND OTHER EQUIPMENT

- A. When connecting to pumps and equipment, the Contractor shall ensure that piping stresses are not transmitted to the pump and equipment. All connecting pipe shall be permanently supported and aligned so that accurate matching of bolt holes and uniform contact over the entire surface of pump flanges are obtained before any bolts are installed in the flanges or pipe is threaded into pump and equipment. In addition, pump connection piping shall be free to move parallel to its longitudinal center line while the bolts are being tightened.
  1. Pumps and equipment shall be leveled, aligned, and wedged into a position that will fit the connecting pipe, but shall not be grouted until the initial fitting and alignment of the pump and equipment may be shifted on its foundation if necessary to properly install the connecting pipe. Each pump and piece of equipment shall, however, be grouted before final bolting of the connecting piping.

2. After final alignment and bolting, the pump and equipment connections shall be tested for applied piping stresses by loosening the flange bolts which, if the piping is properly installed, should result in no movement of the piping relative to the pump or opening of the pump connection joints. If any movement is observed, the piping shall be loosened and re-aligned as required and then the flanges bolted back together. The flange bolts then shall be loosened and the process repeated until no movement is observed.
3. All carbon steel bolts and nuts shall be coated with the same exterior coating applied to the piping system.

### 3.08 ANCHORING AND RESTRAINING

- A. Thrust blocks shall be used in new lines and shall be limited to areas in which a new fitting has been installed in an existing line where field restraining joints are not feasible or when directed by the Engineer.

### 3.09 FLUSHING, CLEANING, TESTING AND INSPECTION OF PIPING

- A. See Section 15144, Pressure Testing of Piping, for the requirements of pipe flushing, cleaning, pressure testing, and inspection requirements.

### 3.10 SPECIAL REQUIREMENTS AND PIPING SPECIALTIES

- A. Welding:
  1. Use only certified welders meeting procedures and performance outlined in Section IX of the ASME BPVC and other codes and requirements in accordance with local building and utility requirements. Submit Welder's certificates to the Engineer for the project record before beginning any welding on the project. The Welder must be certified for all positions (flat, vertical, and overhead).
  2. Have all welds conform to highest industrial practice in accordance with ASME B31.1 and ASME B31.3 or other codes and requirements in accordance with local building and utility requirements.

### 3.11 PIPE COLOR CODING

- A. The pipe color shall be as identified on the Pipe Schedule in the Contract Drawings. The Contractor shall coordinate with the Engineer and the Owner to generate a list of acceptable pipe colors for exposed piping systems. Where color-coding is achieved by painting exterior surfaces of the piping systems, painting shall be provided in accordance with Section 09900, Painting and Coating. On applicable pipes, color shall be in accordance with FDEP color-coding

requirements and Recommended Standards for Wastewater Facilities  
2014 Edition.

END OF SECTION

**SECTION 15060**  
**PIPE HANGERS AND SUPPORTS**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. This Section includes requirements for materials and installation of pipe hangers and supports, including accessory items such as anchor bolts and screws, pipe spiders, neoprene isolation pads, cable trays for hoses, and drip guards.

**1.02 RELATED WORK**

- A. Section 01330, Submittals.
- B. Section 01650, Delivery, Storage, and Handling.
- C. Section 01780, Warranties and Bonds.
- D. Section 05500, Metal Fabrications.
- E. Section 09900, Painting and Coating.
- F. Division 15, Mechanical.

**1.03 SUBMITTALS**

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Provide line drawings of each piping system to the scale shown on the Contract Drawings, locating each support or hanger. Identify each type of hanger or support by the manufacturer's catalog number or figure.
- B. Provide installation drawings and manufacturer's catalog information on each type of hanger and support used. Clearly indicate the actual pipe outside diameter (not just nominal pipe size) that is used for the hangers and supports.
- C. Submit layout drawings for the drip guards, showing dimensions and thicknesses. Show design of seam or joint where field connections will be made between sections and pieces of drip guards.
- D. Submit a certificate listing the type of resin to be used, describing the manufacturer's brand name or designation, composition, and characteristics.

**1.04 REFERENCE STANDARDS**

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of

this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. American Society for Testing and Materials (ASTM)

1. ASTM A36/A36M—Standard Specification for Carbon Structural Steel.
2. ASTM A47/A47M—Standard Specification for Ferritic Malleable Iron Castings.
3. ASTM A48/A48M—Standard Specification for Gray Iron Castings.
4. ASTM A153/A153M—Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
5. ASTM A194/A194M—Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
6. ASTM A276/A276M—Standard Specification for Stainless Steel Bars and Shapes.
7. ASTM A307—Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 psi Tensile Strength.
8. ASTM A575—Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades.
9. ASTM A576—Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality.
10. ASTM A635/A635M—Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for.
11. ASTM A1011/A1011M—Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
12. ASTM D256—Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
13. ASTM E84—Standard Test Method for Surface Burning Characteristics of Building Materials.
14. ASTM F593—Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
15. ASTM F594—Standard Specification for Stainless Steel Nuts.

B. American Society of Mechanical Engineers (ASME)

1. ASME B31.1—Power Piping.

C. Manufacturer's Standardization Society

1. MSS SP-58—Pipe Hangers and Supports – Materials, Design, Manufacture, Selection, Application, and Installation.

## 1.05 QUALITY ASSURANCE

- A. All hangers, supports, and appurtenances shall conform to the latest applicable requirements of ASME B31.1, except as supplemented or modified by the requirements of this Section.
- B. All hangers, supports, and appurtenances shall be of approved standard design where possible and shall be adequate to maintain the supported load in proper position under all operating conditions. The minimum working factor of safety for all supporting equipment, with the exception of springs, shall be five times the ultimate tensile strength of the material, assuming 10 feet of water-filled pipe being supported.
- C. All pipe and appurtenances connected to equipment shall be supported so as to prevent any strain being imposed on the equipment. When manufacturers have indicated requirements that piping loads shall not be transmitted to their equipment, the Contractor shall submit certification stating that such requirements have been complied with.

## 1.06 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

## 1.07 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.
- B. All supports and hangers shall be crated, delivered, and uncrated to protect against any damage.
- C. All parts shall be properly protected so that no damage or deterioration shall occur during a prolonged delay from the time of shipment until installation is completed.
- D. Finished iron or steel surfaces not galvanized or painted shall be properly protected to prevent rust and corrosion.

## PART 2 PRODUCTS

### 2.01 GENERAL

- A. Not all pipe supports or hangers required are shown on the Drawings. The Contractor shall provide pipe supports for every piping system installed. Support piping by pipe support where it connects to pumps or other mechanical equipment.
- B. The Contractor shall ensure that pipe support and hanger components shall withstand the dead loads imposed by the weight of the pipes, fittings, and valves (all filled with water) plus valve actuators and any insulation and shall have a minimum safety factor of 5 based on the material's ultimate strength.
- C. All of the equipment specified in this Section is intended to support the various types of pipe and piping systems. The details shown on the Drawings are intended to indicate the generally desired methods of support under normal conditions. The Contractor shall develop final details and any details associated with special conditions not already covered to meet the system conditions specified in the respective Pipe Sections of Division 15, Mechanical.
- D. All pipe and tubing shall be supported as required to prevent significant stresses in the pipe or tubing material, valves, fittings, and other pipe appurtenances and to support and secure the pipe in the intended position and alignment. All supports shall be designed to adequately secure the pipe against excessive dislocation due to thermal expansion and contraction, internal flow forces, and all probable external forces such as equipment, pipe, and personnel contact. Any structural steel members required to brace any piping from excessive dislocation shall conform to the applicable requirements of Section 05500, Metal Fabrications, and shall be furnished and installed under this Section.
- E. Hangers and supports shall be spaced in accordance with ASME B31.1 except that the maximum unsupported span shall not exceed 10 feet unless otherwise specified in this Section.
- F. Where flexible couplings are required at equipment, tanks, etc., the end opposite to the piece of equipment, tank, etc. shall be rigidly supported.
- G. All pipe and appurtenances connected to the equipment shall be supported so as to prevent any strain from being imposed on the equipment or piping system.
- H. All rods, clamps, hangers, inserts, anchor bolts, brackets, and components for interior pipe supports shall be furnished with galvanized finish, hot-dipped, or electro-galvanized coated, except where field welding is required. Interior clamps on plastic pipe shall be plastic coated. Supports for copper pipe shall be copper

plated or shall have a 1/16-inch plastic coating. All rods, clamps, hangers, inserts, anchor bolts, brackets, and components for exterior pipe and pipe within outdoor structures shall be of AISI Type 316 stainless steel.

- I. Supports shall be sufficiently close together so that the sag of the pipe is within limits that will permit drainage and avoid excessive bending stresses from concentrated loads between supports.
- J. All un-insulated non-metallic piping such as PVC, CPVC, etc., shall be protected from local stress concentrations at each support point. Protection shall be provided by galvanized steel protection shields or other method as approved by the Engineer. Where pipes are bottom supported 180°, arc shields shall be furnished. Where 360° arc support is required, such as U bolts, protection shields shall be provided for the entire pipe circumference. Protection shields shall have an 18-gauge minimum thickness, not be less than 12 inches in length, and be securely fastened to pipe with stainless steel or galvanized metal straps not less than 1/2-inch wide.
- K. All insulated pipe shall be furnished with a rigid foam insulating saddle at each pipe support location as specified under respective pipe insulation. Provide galvanized protection shields as specified in Paragraph 2.01J above at each location.
- L. Where pipe hangers and supports come in contact with copper piping, provide protection from galvanic corrosion by wrapping pipe with 1/16-inch-thick neoprene sheet material and galvanized protection shield or copper-plated or PVC-coated hangers and supports.
- M. Pipe supports shall be provided as follows:
  - 1. Cast-iron and ductile-iron piping shall be supported at a maximum support spacing of 10 feet with a minimum of one support per pipe section at the joints.
  - 2. Steel and stainless steel piping 2-1/2 inches or larger diameter shall be supported at a maximum support spacing of 10 feet with a minimum of one support per pipe section at the joints.
  - 3. Support spacing for steel and stainless piping 2 inches and smaller diameter and copper tubing shall not exceed 5 feet.
  - 4. Supports for multiple PVC plastic piping shall be continuous wherever possible. Individually supported PVC pipes shall be supported as recommended by the manufacturer except that support-spacing shall not exceed 3 feet. Multiple, suspended, horizontal plastic PVC pipe runs shall, where possible, be supported by ladder-type cable trays such as the Electray Ladder by Husky-Burndy; Cable Tray by Enduro Composite Systems; the Globetray by the Metal Products Division of United States

Gypsum or equal. Ladder shall be of FRP construction. Rung spacing shall be 12 inches. Tray width shall be approximately 6 inches for single runs and 12 inches for double runs. Ladder-type cable trays shall be furnished complete with all hanger rods, rod couplings, concrete inserts, hanger clips, etc., required for a complete support system. Individual plastic pipes shall be secured to the rungs of the cable tray by strap clamps, or fasteners similar to Globe, Model M-CAC; Husky-Burndy, Model SCR; or equal. Spacing between clamps shall not exceed 9 feet. The cable trays shall provide continuous support along the length of the pipe. Individual clamps, hangers, and supports in contact with plastic PVC pipe shall provide firm support but not so firm as to prevent longitudinal movement due to thermal expansion and contraction.

5. All vertical pipes shall be supported at each floor or at intervals of not more than 12 feet by approved pipe collars, clamps, brackets, or wall rests and at all points necessary to ensure rigid construction.
  6. Pipe supports shall not induce point loadings, but shall distribute pipe loads evenly along the pipe circumference.
  7. Supports shall be provided at changes in direction and elsewhere as shown on the Drawings or as specified in this Section. No piping shall be supported from other piping or from metal stairs, ladders, and walkways, unless specifically directed or authorized by the Engineer.
  8. Pipe supports shall be provided to minimize lateral forces through valves, both sides of split-type couplings, and sleeve-type couplings and to minimize all pipe forces on pump housings. Pump housings shall not be used to support connecting pipes.
  9. Effects of thermal expansion and contraction of the pipe shall be accounted for in the pipe support selection and installation.
- N. Any required pipe support for which the supports specified in this Section are not applicable shall be fabricated or constructed from standard structural steel shapes and concrete and anchor hardware similar to items previously specified in this Section and shall be subject to the approval of the Engineer.

## 2.02 HANGER AND SUPPORT SYSTEMS

- A. Pipe hangers and supports shall be as manufactured by Anvil, Unistrut, Cooper B-Line, Aikinstrut, Superstrut, or equal.
- B. Pipe hangers and supports shall comply with MSS SP-58 for the standard types referenced on the Drawings. The Contractor shall construct special hangers and supports if detailed in the Drawings. Type numbers for standard hangers and supports shall be in accordance with MSS SP-58 as listed herein:

| Type Number | Description                                    | Manufacturer and Model (or Equal)  |
|-------------|--|--|
| 1           | Adjustable steel clevis                        | Anvil Fig. 590 or 260, B-Line B3100 or B3102                                     |
| 3           | Steel double-bolt pipe clamp                   | Anvil Fig. 295A or 295H, B-Line B3144 or B3144A                                  |
| 4           | Steel pipe clamp (pipes smaller than 3 inches) | Anvil Fig. 212, B-Line B3140   |
| 4           | Steel pipe clamp (pipes 3 inches and larger)   | Anvil Fig. 216, B-Line 3142  |
| 5           | Pipe hanger                                    | B-Line B6690   |
| 6           | Adjustable swivel pipe ring                    | Anvil Superstrut 714, Anvil Fig. 104   |
| 7           | Adjustable steel band hanger                   | B-Line B3172   |
| 8           | Extension pipe or riser clamp                  | Anvil Fig. 261, B-Line B5573   |
| 9           | Adjustable band hanger                         | Anvil Fig. 97  |
| 10          | Adjustable swivel ring band hanger             | Anvil Fig. 70, B-Line B3170 NF   |
| 11          | Split pipe ring with adjustable turnbuckle     | Anvil Fig. 108, B-Line B3173   |
| 13          | Steel turnbuckle                               | Anvil Fig. 230, B-Line B3202   |
| 14          | Steel clevis                                   | Anvil Fig. 299, B-Line B3201   |
| 15          | Swivel turnbuckle                              | Anvil Fig. 114, B-Line B3224   |
| 16          | Malleable iron socket                          | Anvil Fig. 110R, B-Line B3222  |
| 17          | Steel weldless eye nut                         | B-Line B3200   |
| 18          | Steel or malleable iron concrete insert        | Anvil Fig. 281, Superstrut 452   |
| 19          | Top beam C-clamp                               | Anvil Fig. 92, B-Line B3033  |
| 20          | Side I-beam or channel clamp                   | Anvil Fig. 14 or 217   |
| 21          | Center I-beam clamp                            | Anvil Figure 134   |
| 22          | Welded attachment type                         | Anvil Fig. 66 B-Line B3083   |
| 23          | C-clamp  | Anvil Fig. 86, B-Line B3036L   |
| 24          | U-bolt   | Anvil Fig. 137, B-Line B3188   |
| 26          | Clip   | Anvil Fig. 262, B-Line B3180   |
| 28          | Steel I-beam clamp with eye nut                | Anvil Fig. 228   |
| 29          | Steel wide flange                              | Anvil Fig. 228 clamp with eye nut  |
| 30          | Malleable iron beam clamp with extension piece | Superstrut CM-754, B-Line B3054  |
| 31          | Light welded steel bracket                     | Anvil Fig. 194, B-Line B3063   |
| 32          | Medium welded steel bracket                    | Anvil Fig. 195, B-Line B3066   |
| 33          | Heavy welded steel bracket                     | Anvil Fig. 199, B-Line B3067   |
| 34          | Side beam bracket                              | Anvil Fig. 202, B-Line B3062   |
| 36          | Pipe saddle support                            | Anvil Fig. 258, B-Line B3095   |
| 37          | Pipe stanchion saddle                          | Anvil Fig. 259, B-Line B3090   |
| 38          | Adjustable pipe saddle support                 | Anvil Fig. 264, B-Line B3093/B3089   |
| 39          | Steel pipe covering                            | Anvil Fig. 160, 161, 162, 163, 164, or 165; Superstrut A 789; B-Line B3160/B3165 |
| 40          | Insulation protection shield                   | Anvil Fig. 167, B-Line B3151   |
| 41          | Single pipe roll                               | Anvil Fig. 171, B-Line B3114   |
| 43          | Adjustable roller hanger with swivel           | Anvil Fig. 181, B-Line B3110   |
| 44          | Pipe roll, complete                            | Anvil Fig. 271, B-Line B3117SL   |

- C. Unless specified elsewhere or shown in the Contract Drawings, pipe hangers and supports shall be hot-dipped galvanized according to ASTM A153/A153M carbon steel (ASTM A36/A36M, A575, or A576). Bases, rollers, and anchors shall be steel as described above or may be cast iron (ASTM A48/A48M). Pipe clamps shall be steel as described above or may be malleable iron (ASTM A47/A47M).
- D. Offset Pipe Clamp.
- E. Anvil Figure 103, Cooper B-Line B3148, or equal. Material shall be Type 316 stainless steel unless otherwise noted.

## 2.03 MISCELLANEOUS PIPE SUPPORTS AND HANGERS

- A. Pipe Anchor Chair: Anvil Figure 198 or equal.
- B. One Hole Clamp: Anvil Figure 126 or equal.
- C. Roller Chair: Anvil Figure 175 or equal.

## 2.04 STEEL CHANNEL FRAMING SYSTEM

- A. Steel channel frames shall be 1-5/8 inches wide by 1-5/8 or 3-1/4 inches high by 12-gauge metal thickness, unless otherwise shown on the Drawings. Material shall conform to ASTM A36/A36M, A1011/A1011M (Grade 33 minimum), or A653 unless stainless steel is indicated on the Drawings. Stainless steel shall be Type 304. One side of the channel shall have a continuous open slot with inturned clamping ridges. Maximum allowable stress under any combination of applied uniformly distributed loads and concentrated loads shall not exceed those recommended in the AISC or AISI. Deflection shall not exceed 1/240 of span. The Contractor shall use multiple back-to-back channels to achieve these criteria if single channels are not sufficient. Products: Unistrut P1000 or P5000 Series, B-Line B11 or B22 Series, or equal.
- B. Steel channels shall be hot-dipped galvanized according to ASTM A153/A153M.
- C. Nuts shall be machined and case hardened. The Contractor shall provide rectangular nuts with the ends shaped to permit a quarter turn crosswise in the framing channel. Provide two serrated grooves in the nut to engage the inturned edges of the channel.
- D. Pipe clamps (including attachment screws and nuts) shall be Unistrut P1100 or P2000 Series, B-Line B2000 Series, or equal. Material shall be Type 304 stainless steel.
- E. Hanger rods for trapezes shall be carbon steel (ASTM A36/A36M, A575, or A576) unless stainless steel is indicated on the Contract Drawings. Stainless-steel hanger rod material shall comply with ASTM A276/A276M, Type 304.

- F. Accessory fittings and brackets shall be the same material as the channel or trapeze. Provide coating on carbon steel fittings and brackets as specified for the channels and frames.
1. Flat Plate Fittings: Unistrut P1065, P1066, P1925; Superstrut AB-206, AB-207; or equal.
  2. Post Bases: Unistrut P2072A, Superstrut AP-232, or equal.
  3. 90° Brackets: Unistrut P1326, P1346; Superstrut AB-203; or equal.
  4. Rounded-End Flat Plate Fittings: Unistrut P2325, Superstrut X-240, or equal.
- G. Parallel pipe clamps shall be Unistrut P1563 through P1573, Superstrut AB-719, or equal. Material shall be Type 304 stainless steel.

## 2.05 FIBERGLASS-REINFORCED PLASTIC (FRP) CHANNEL FRAMING SYSTEM

- A. FRP pipe hangers and supports shall be Aickinstrut, Inc. or equal.
- B. Material properties shall be as follows:

| Longitudinal Direction                   |                |
|--|----------------|
| Ultimate Tensile (psi)                   | 37,500 minimum |
| Ultimate Compressive (psi)               | 35,000 minimum |
| Ultimate Flexural (psi)                  | 37,500 minimum |
| Tensile Modulus (psi) x 10**6            | 3.00 minimum   |
| Flexural Modulus (psi) x 10**6           | 2.00 minimum   |
| Ultimate Shear Strength (psi)            | 6,000 minimum  |
| Ultimate Bearing Stress (psi)            | 35,000 minimum |
| Izod Impact (ASTM D256) ft-lb/inch notch | 30 minimum     |
| Transverse Direction                     |                |
| Ultimate Tensile (psi)                   | 10,000 minimum |
| Ultimate Compressive (psi)               | 20,000 minimum |
| Ultimate Flexural (psi)                  | 14,000 minimum |
| Tensile Modulus (psi) x 10**6            | 1.0 minimum    |
| Compressive Modulus (psi) x 10**6        | 1.4 minimum    |
| Flexural Modulus (psi) x 10**6           | 1.0 minimum    |
| Ultimate Shear Strength (psi)            | 5,500 minimum  |
| Ultimate Bearing Stress (psi)            | 35,000 minimum |
| Izod Impact, ft-lb notch                 | 5 minimum      |
| Hardness                                 |                |
| Barcol Test                              | 50 minimum     |

- C. Glass-fiber-reinforced composites and plastic products shall have a flame spread rating of 25 or less when tested in accordance with ASTM E84.

- D. Channel framing shall be 1-5/8 inches deep by 1-5/8 inches wide and shall be made using vinylester resin equal to Ashland Derakane 411, Ashland Hetron 922, or Reichhold Dion 9800. It shall have a nexus polyester surfacing veil over 100% of the surface which, along with a filler system, will protect against degradation from ultraviolet light. Channel shall be supplied with integral notches 1 inch on center. Notches shall be located on the interior flange to prevent slippage of pipe clamps and fittings after installation. In place of notched channel, unnotched channel may be used if the vertical channel sections supporting the horizontal piping are provided with stop lock hardware at each pipe clamp to prevent slippage. Channel framing shall be Aickinstrut G.R.P. Type V 2000 series or equal.
- E. Channel framing connections shall be made with vinylester glass fiber composite nuts, bolts, all threaded rods, channel fittings, bases, and hanger assemblies. Nut, bolts, and rods shall be Aickinstrut 4200 series, Strut Tech PVCG, or equal. Channel fittings shall be Aickinstrut 2800 style or equal.
- F. Load-bearing pipe clamps and nonload-bearing pipe straps shall be nonmetallic and nonconductive and shall be made by the injection-molding process using polyurethane-base resin. Pipe clamps and straps shall be Aickinstrut 3100 Series or equal.
- G. Clevis hangers shall be made with vinylester glass fiber and be Aickinstrut 1500 Series or equal.
- H. Hanger rods for trapezes shall be carbon steel (ASTM A36/A36M, A575, or A576) unless stainless steel or FRP is indicated on the Contract Drawings. Stainless steel hanger rod material shall comply with ASTM A276/A276M, Type 304. FRP hanger rod shall be by Aickinstrut, StrutTech, or equal.

## 2.06 PIPE SPIDERS

- A. Cooper B-Line B3281 to 3286, Superstrut S-794 or equal.

## 2.07 WAFFLE ISOLATION PADS

- A. Mason Type "W;" Machinery Installation Systems "Unisorb" Type S, SB, F, or FB; or equal. Provide minimum 1/4-inch thickness.

## 2.08 NEOPRENE ISOLATING SLEEVES FOR METAL PIPE 6 INCHES AND SMALLER

- A. Unistrut P2600, B-Line "Vibrocushion," or equal.

## 2.09 ANCHOR BOLTS AND SCREWS

- A. Anchor bolts and screws for attaching pipe supports and hangers to walls, floors, ceilings, and roof beams shall be Type 316 stainless steel, ASTM A276/A276M or F593. Nuts shall be Type 316 stainless steel, ASTM A194/A194M, Grade 8M, or ASTM F594, Type 316 stainless steel.

## PART 3 EXECUTION

### 3.01 PIPE HANGER AND WALL SUPPORT SPACING

- A. The Contractor shall install pipe hangers and wall supports on horizontal and vertical runs at the spacing shown or detailed on the Contract Drawings. Provide hanger rods (for horizontal runs) and wall supports of the sizes shown or detailed on the Contract Drawings. If no spacing or rod sizes are given on the Contract Drawings or in the Project Specifications for a particular piping system, use the following:

1. Pipe Hanger and Wall Support Spacing for Steel and Ductile-Iron Pipe (Section 15155, Ductile Iron Pipe and Fittings):

| Pipe Size (inches) | Maximum Support or Hanger Spacing (feet) | Minimum Rod Size (inches) |
|--------------------|--|---------------------------|
| 3/8 and smaller    | 4  | 3/8                       |
| 1/2 through 1      | 6  | 3/8                       |
| 1-1/4 through 2    | 8  | 3/8                       |
| 2-1/2 and 3        | 10                                       | 1/2                       |
| 3-1/2 and 4        | 10                                       | 5/8                       |
| 6                  | 12                                       | 3/4                       |
| 8                  | 12                                       | 7/8                       |
| 10 and 12          | 14                                       | 7/8                       |
| 14 and 16          | 16                                       | 1                         |
| 18                 | 15                                       | 1                         |
| 20 through 24      | 9  | 1                         |
| 30                 | 6  | 1                         |

- B. Pipe Hanger or Wall Support Spacing for PVC Pipe (Section 15290, PVC Pipe, 3 Inches and Smaller):

| Pipe Size (inches) | Maximum Support or Hanger Spacing (feet) | Minimum Rod Size (inches) |
|--------------------|--|---------------------------|
| 3/4                | 4  | 3/8                       |
| 1                  | 4  | 3/8                       |
| 1-1/2              | 5  | 3/8                       |
| 2                  | 5  | 3/8                       |
| 2-1/2              | 5  | 1/2                       |
| 3                  | 6  | 1/2                       |

- C. For piping services not described, the Contractor shall provide hangers and supports according to MSS SP-58 and SP-69.
- D. The Contractor shall provide bracing for piping 8 inches and smaller that is installed on hangers or trapezes according to MSS SP-127, except provide lateral bracing at maximum 10-foot center-to-center spacings. Provide sway bracing for hangers for piping larger than 8 inches as detailed on the Contract Drawings.

### 3.02 PIPE SUPPORT SPACING FOR SUPPORTS ON TOP OF SLABS OR GRADE

- A. The Contractor shall install pipe supports on horizontal runs at the spacing shown or detailed on the Contract Drawings. Provide supports of the type shown or detailed on the Contract Drawings. If no spacings are given on the Contract Drawings or in the Project Specifications for a particular piping system, use the following:
  - 1. Pipe Support Spacing for Steel and Ductile-Iron Pipe (Section 15155, Ductile Iron Pipe and Fittings:

| Pipe Size<br>(inches) | Maximum Support Spacing<br>(feet) |
|-----------------------|-----------------------------------|
| 3/8 and smaller       | 4                                 |
| 1/2 through 1         | 6                                 |
| 1-1/4 through 2       | 8                                 |
| 2-1/2 and 3           | 10                                |
| 3-1/2 and 4           | 10                                |
| 6                     | 12                                |
| 8                     | 12                                |
| 10 and 12             | 14                                |
| 14 and 16             | 16                                |
| 18                    | 16                                |
| 20 through 24         | 18                                |
| 30                    | 18                                |

- B. Pipe support spacing for other pipe materials shall be the same as described in Article 3.01 of this Section.

### 3.03 INSTALLING PIPE HANGERS AND SUPPORTS

The Contractor shall do the following:

- A. Provide separate hangers or supports at each valve. Provide one hanger or support around each end of the valve body or on the adjacent connecting pipe within one pipe diameter of the valve end. Provide additional hangers or supports to relieve eccentric loadings imposed by offset valve actuators.

- B. Provide separate hangers or supports at each pipe elbow, tee, or fitting. Provide separate hangers or supports on both sides of each nonrigid joint or flexible pipe coupling.
- C. Adjust pipe hangers according to MSS SP-89, Paragraph 10.6.
- D. Install leveling bolts beneath support baseplates. Provide 3/4-inch-thick grout pad beneath each base.
- E. Install piping without springing, forcing, or stressing the pipe or any connecting valves, pumps, and other equipment to which the pipe is connected.

#### 3.04 INSTALLING STEEL AND FRP CHANNEL FRAMES

- A. The Contractor shall use 1-5/8-inch-high channel frames, unless 3-1/4-inch is needed, to provide clearance from walls. Use multiple back-to-back channels if additional clearance is needed.

#### 3.05 INSTALLING NEOPRENE ISOLATING SLEEVES

- A. The Contractor shall install a sleeve around each metal pipe 6 inches and smaller at the point of bearing or contact with the pipe hanger or support.

#### 3.06 PAINTING AND COATING

The Contractor shall do the following regarding painting and coating:

- A. Grind the welds of fabricated steel pipe supports smooth, prepare surface by sandblasting, and apply coating system in accordance with Section 09900, Painting and Coating.
- B. Paint exposed metallic pipe hangers and supports to match the color of the adjacent wall using System No. 62 in accordance with Section 09900, Painting and Coating. If the adjacent wall is not painted, paint the hangers and supports to match color code of the largest pipe on the support.
- C. Coat submerged pipe hangers and supports in accordance with Section 09900, Painting and Coating.

- D. Coat FRP pipe hangers and supports exposed to direct sunlight with System No. 51 in accordance with Section 09900, Painting and Coating. FRP pipe hangers and supports that are hidden from direct sunlight need not be coated.

END OF SECTION

**SECTION 15075**  
**PROCESS EQUIPMENT, PIPING, AND VALVE IDENTIFICATION**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. This Section includes requirements for materials and installation of markers, labels, and signs for pipes, tanks, and valves; for mechanical equipment; for hazardous materials warnings; and for miscellaneous plant services.

**1.02 RELATED WORK**

- A. Section 01330, Submittals and Acceptance.
- B. Section 01650, Delivery, Storage, and Handling.
- C. Section 01780, Warranties and Bonds.

**1.03 SUBMITTALS**

- A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance.
- B. The Contractor shall submit an ID schedule for the piping, valves, equipment, tanks, and any signs required for this project for review and acceptance by the Engineer. This schedule shall be in a formatted list that is easy to follow and categorized in a logical manner.
- C. The Contractor shall submit manufacturer's catalog data and descriptive literature describing materials, colors, letter size, and size of labels.
- D. The locations of each nameplate shall be coordinated with the Engineer and Owner and approved by the Engineer and Owner before their installation.

**1.04 WORK SEQUENCE (NOT USED)**

**1.05 REFERENCE STANDARDS**

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of

this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. American Society of Mechanical Engineers (ASME)

1. ASME A13.1—Scheme for the Identification of Piping Systems.

## 1.06 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

## 1.07 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

## 1.08 OPERATIONS AND MAINTENANCE (O&M) MANUALS

- A. O&M Manuals shall be in accordance with General Conditions, Supplementary Conditions, and Section 01830, Operations and Maintenance Manuals.

# PART 2 PRODUCTS

## 2.01 LABELS FOR PIPING

- A. The Contractor shall provide 4" stenciled labels using weather- and UV-resistant acrylic. Labels shall include the direction of flow, Pipe Size, and Pipe Abbreviation in accordance with the Pipe Schedule on the Drawings.

## 2.02 LABELS FOR VALVES

- A. The Contractor shall provide each valve listed on the Tag Number list with an identification tag. The tag shall be 3-inch diameter circular aluminum or stainless steel: W. H. Brady, Seton Name Plate Corp, or Engineer approved equal. Tags shall have 1/8-inch cast in black-filled letters. The Contractor shall provide fiberglass tags for chemical system valves. The valve identification shall be as shown in the mechanical details of the Contract Drawings and include the valve size, flow stream, valve type, and direction and number of turns to open. The Contractor shall submit the valve tag label schedule for review by the Engineer in accordance with Paragraph 1.03.B of this Specification.

## 2.03 HOSE BIBB SIGNS—UNSAFE WATER

- A. The Contractor shall provide a rigid sign labeled "DO NOT DRINK" and "NO BEBER" for each hose bibb. Size and lettering shall conform to OSHA requirements. Signs shall be Seton Nameplate Company 20-gauge baked enamel, minimum size 7 inches by 3 inches; Brady B-120 Fiber-Shield fiberglass, minimum size 7 inches by 3 inches, 1/8 inch thick; or equal.

## 2.04 LABELS FOR MECHANICAL EQUIPMENT

- A. The Contractor shall provide a label for each installed pump, mixer, grinder, flow meter, or other piece of mechanical equipment as part of this Project. The label shall show the equipment name and tag number as shown on the Tag Number list or on the Contract Drawings. Labels shall be 1-1/2 inches (minimum) by 4 inches (minimum) brass, aluminum, or 1/8-inch-thick fiberglass tags.
- B. Provide fiberglass tags for chemical system equipment: Brady B-120 Fiber-Shield, Seton Style 2065, or equal. Contractor shall submit the mechanical equipment label schedule for review by the Engineer in accordance with Paragraph 1.03.B of this Specification.

## 2.05 LABELS FOR TANKS

- A. Signs shall be weather- and UV-resistant. Labels shall be Brady B-946, Seton Name Plate Corporation PSPL, or equal. Minimum size shall be 7 inches by 10 inches. Provide a sign on each quadrant of the tank bearing the tank tag number and the name and purpose of the liquid stored (e.g. "Sludge Holding Tank").
- B. All applicable tanks shall be properly labeled for safety with signs stating, "Permit Required Confined Space". Signs shall be clearly visible and placed at all access points to the tank including manways and tank hatches.

## 2.06 HAZARDOUS MATERIALS WARNING AND DANGER SIGNS (NOT USED)

## 2.07 UNDERGROUND PLASTIC WARNING TAPE FOR METAL PIPE

- A. The Contractor shall provide permanent, bright-colored, continuous-printed plastic tape intended for direct burial service, not less than 6 inches wide by 3.5 mils thick. Tape shall be as detailed herein and also in accordance with Section 15055, Piping Systems—General. Provide tape with printing that most

accurately indicates the type of service of buried pipe. Provide the following colored tape for the various piping services:

| Service   | Color  | Service         | Color  |
|-----------|--------|-----------------|--------|
| Cable TV  | Orange | Water           | Blue   |
| Gas       | Yellow | Sewer           | Green  |
| Electric  | Red    | Chemical        | Yellow |
| Telephone | Orange | Reclaimed Water | Violet |

## 2.08 UNDERGROUND DETECTABLE METALLIC PIPE WARNING TAPE

- A. The Contractor shall provide permanent, bright-colored, continuous-printed tape consisting of an aluminum or steel foil sheathed in a plastic laminate, not less than 2 inches wide by 3 mils thick. Tape shall be as detailed herein and also in accordance with Section 15055, Piping Systems—General. Provide tape with printing that most accurately indicates the type of buried service. Provide the following colored tape for the various piping services:

| Service   | Color  | Service         | Color  |
|-----------|--------|-----------------|--------|
| Cable TV  | Orange | Water           | Blue   |
| Gas       | Yellow | Sewer           | Green  |
| Electric  | Red    | Chemical        | Yellow |
| Telephone | Orange | Reclaimed Water | Violet |

## PART 3 EXECUTION

### 3.01 INSTALLING PIPE LABELS

- A. The Contractor shall provide a stenciled label and flow arrow at each connection to pumps or other mechanical equipment, at wall boundaries, at tees and crosses, and at 20-foot centers on straight runs of piping.
- B. The Contractor shall label all pipes in accordance with the Pipe Marking Standard for Labeling, ASME A13.1.

### 3.02 INSTALLING VALVE AND EQUIPMENT LABELS

- A. The Contractor shall attach labels to the valve or piece of equipment with Type 304 or 316 stainless steel chains unless otherwise noted. For sodium hypochlorite and hydrofluosilicic acid use thermoplastic chains to attach labels.
- B. The Contractor shall attach valve labels to the valve handwheels. If the valve has no handwheel, attach the label to the valve by tying the tag wire or chain around the operating shaft or nut.

- C. Installation of the valve collar with identification disk shall be in accordance with the Contract Drawings.

### 3.03 INSTALLING MISCELLANEOUS SIGNS

- A. The Contractor shall attach miscellaneous signs according to the sign manufacturer's recommendations and in accordance with OSHA requirements.

### 3.04 INSTALLING WALL AND DOOR SIGNS

- A. Attach to walls and doors using epoxy adhesive.

### 3.05 INSTALLING UNDERGROUND PLASTIC WARNING TAPE FOR METAL PIPE

- A. During backfilling of each exterior underground piping system, the Contractor shall install continuous underground-type plastic line marker directly over buried line at 6 to 8 inches above the top of the pipe. Where multiple small lines are buried in common trench and do not exceed overall width of 16 inches, install a single line marker.

### 3.06 INSTALLING UNDERGROUND DETECTABLE METALLIC PIPE WARNING TAPE

- A. The Contractor shall install tape 12 to 18 inches below finished ground surface directly over buried pipelines. Where multiple small pipelines are buried in a common trench and do not exceed an overall width of 16 inches, install a single marker tape.

END OF SECTION

**SECTION 15110**  
**MANUAL, CHECK, AND PROCESS VALVES**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. The Contractor shall furnish all labor, materials, equipment, and incidentals required and install complete and ready for operation all valves as shown in the Drawings and as specified in this Section. All valves shall be complete with all necessary manual actuators, valve boxes, extension stems, and floor stands, which are required for proper valve operation and completion of the work.
  1. All valves shall be of the sizes shown in the Drawings. All equipment of the same type shall be from one manufacturer, unless authorized in writing by the Engineer.
  2. The valves shall include but not be limited to the following:
    - a. Air Valves.
    - b. Ball Valves.
    - c. Check Valves.
    - d. Gate Valves.
    - e. Globe and Angle Valves.
    - f. Plug Valves.

**1.02 RELATED WORK**

- A. Section 01330, Submittals and Acceptance.
- B. Section 01650, Delivery, Storage, and Handling.
- C. Section 01780, Warranties and Bonds.
- D. Section 01830, Operations and Maintenance Manuals.
- E. Section 09900, Painting and Coating.
- F. Section 15055, Piping Systems—General.
- G. Section 15144, Pressure Testing of Piping.
- H. Section 15155, Ductile Iron Pipe and Fittings.

## 1.03 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Product technical submittal data shall contain the following information and data:
  - 1. Acknowledgment that products submitted meet requirements of standards referenced.
  - 2. Manufacturer's installation instructions.
  - 3. Manufacturer's operation and maintenance manuals.
  - 4. Data of valves, actuators, and accessories:
    - a. Pressure and temperature rating.
    - b. Materials of construction, with ASTM reference and grade.
    - c. Linings and coatings.
    - d. Dimensions and weight.
    - e. Flow coefficient.
    - f. Actuators and accessories details.
    - g. Manufacturer's product brochure, cut-sheets, and parts diagrams.
- B. Dimensions and orientation of valve actuators as installed on the valves. Show location of internal stops for gear actuators. State differential pressure and fluid velocity used to size actuators. For worm-gear actuators, state the radius of the gear sector in contact with the worm and state the handwheel diameter.
- C. The following test reports: Performance Tests; Leakage Tests; Hydrostatic Tests; and Proof-of-Design Tests as applicable or required.

## 1.04 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American Petroleum Institute (API)
  - 1. API SPEC 6D—Specification for Pipeline and Piping Valves.
  - 2. API SPEC 6FA—Specification for Fire Test for Valves.
  - 3. API STD 594—Check Valves: Flanged, Lug, Wafer and Butt-Welding.

4. API STD 607—Fire Test for Quarter-turn Valves and Valves Equipped with Nonmetallic Seats.
- B. American Society for Testing of Materials (ASTM)
1. ASTM A36/A36M—Standard Specification for Carbon Structural Steel.
  2. ASTM A47/A47M—Standard Specification for Ferritic Malleable Iron Castings.
  3. ASTM A48/A48M—Standard Specification for Gray Iron Castings.
  4. ASTM A105/A105M—Standard Specification for Carbon Steel forgings for Piping Applications.
  5. ASTM A108—Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
  6. ASTM A126—Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
  7. ASTM A148/A148M—Standard Specification for Steel Castings, High Strength, for Structural Purposes.
  8. ASTM A181/A181M—Standard Specification for Carbon-Steel forgings, for General-Purpose Piping.
  9. ASTM A182/A182M—Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
  10. ASTM A193/A193M—Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
  11. ASTM A194/A194M—Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
  12. ASTM A216/A216M—Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.
  13. ASTM A240/A240M—Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
  14. ASTM A269/A269M—Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Purpose.
  15. ASTM A276/A276M—Standard Specification for Stainless Steel Bars and Shapes.
  16. ASTM A313/A313M—Standard Specification for Stainless Steel Spring Wire.
  17. ASTM A322—Standard Specification for Steel Bars, Alloy, Standard Grades.
  18. ASTM A351/A351M—Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
  19. ASTM A395/A395M—Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.

20. ASTM A436—Standard Specification for Austenitic Gray Iron Castings.
21. ASTM A439/A439M—Standard Specification for Austenitic Ductile Iron Castings.
22. ASTM A449—Standard Specification for Hex Cap Screws, Bolts and Studs, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use.
23. ASTM A479/A479M—Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels.
24. ASTM A494/A494M—Standard Specification for Castings, Nickel and Nickel Alloy.
25. ASTM A516/A516M—Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service.
26. ASTM A536—Standard Specification for Ductile Iron Castings.
27. ASTM A564/A564M—Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes.
28. ASTM A582/A582M—Standard Specification for Free-Machining Stainless Steel Bars.
29. ASTM A666—Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
30. ASTM A743/A743M—Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.
31. ASTM A744/A744M—Standard Specification for Castings, Iron-Chromium-Nickel, Corrosion Resistant, for Severe Service.
32. ASTM A890/A890M—Standard Specification for Castings, Iron-Chromium-Nickel-Molybdenum Corrosion-Resistant, Duplex (Austenitic/Ferritic) for General Application.
33. ASTM B16/B16M—Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines.
34. ASTM B21/B21M—Standard Specification for Naval Brass Rod, Bar, and Shapes.
35. ASTM B61—Standard Specification for Steam or Valve Bronze Castings.
36. ASTM B62—Standard Specification for Composition Bronze or Ounce Metal Castings.
37. ASTM B98/B98M—Standard Specification for Copper-Silicon Alloy Rod, Bar and Shapes.
38. ASTM B99/B99M—Standard Specification for Copper-Silicon Alloy Wire for General Applications.
39. ASTM B127—Standard Specification for Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip.
40. ASTM B148—Standard Specification for Aluminum-Bronze Sand Castings.
41. ASTM B150/B150M—Standard Specification for Aluminum Bronze Rod, Bar, and Shapes.

42. ASTM B164—Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire.
43. ASTM B169/B169M—Standard Specification for Aluminum Bronze Sheet, Strip, and Rolled Bar.
44. ASTM B193—Standard Test Method for Resistivity of Electrical Conductor Materials.
45. ASTM B371/B371M—Standard Specification for Copper-Zinc-Silicon Alloy Rod.
46. ASTM B427—Standard Specification for Gear Bronze Alloy Castings.
47. ASTM B443—Standard Specification for Nickel-Chromium-Molybdenum-Columbium Alloy (UNS N06625) and Nickel-Chromium-Molybdenum-Silicon Alloy (UNS N06219) Plate, Sheet, and Strip.
48. ASTM B446—Standard Specification for Nickel-Chromium-Molybdenum-Columbium Alloy (UNS N06625), Nickel-Chromium-Molybdenum-Silicon Alloy (UNS N06219), and Nickel-Chromium-Molybdenum-Tungsten Alloy (UNS N06650) Rod and Bar.
49. ASTM B462—Standard Specification for Forged or Rolled UNS N06030, UNS N06022, UNS N06035, UNS N06200, UNS N06059, UNS N10362, UNS N06686, UNS N08020, UNS N08367, UNS N10276, UNS N10665, UNS N10675, UNS N10629, UNS N08031, UNS N06045, UNS N06025, UNS R20033 Alloy Pipe Flanges, Forged Fittings, and Valves and Parts for Corrosive High-Temperature Service.
50. ASTM B463—Standard Specification for UNS N08020 Alloy Plate, Sheet, and Strip.
51. ASTM B472—Standard Specification for Nickel Alloy Billets and Bars for Reforging.
52. ASTM B584—Standard Specification for Copper Alloy Sand Castings for General Applications.
53. ASTM B763/B763M—Standard Specification for Copper Alloy Sand Castings for Valve Applications.
54. ASTM D1248—Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
55. ASTM D1784—Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
56. ASTM D1785—Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
57. ASTM D2000—Standard Classification System for Rubber Products in Automotive Applications.
58. ASTM D3222—Standard Specification for Unmodified Poly (Vinylidene Fluoride) (PVDF) Molding Extrusion and Coating Materials.
59. ASTM D4101—Standard Classification system and Basis for Specification for Polypropylene Injection and Extrusion Materials.
60. ASTM F441/F441M—Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.

61. ASTM F467—Standard Specification for Nonferrous Nuts for General Use.
62. ASTM F468—Standard Specification for Nonferrous Bolts, Hex Cap Screws, Socket Head Cap Screws, and Studs for General Use.

C. American Society of Mechanical Engineers (ASME)

1. ASME B1.20.1—Pipe Threads, General Purpose (Inch).
2. ASME B1.20.7—Hose Coupling Screw Threads (Inch).
3. ASME B16.1—Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250.
4. ASME B16.5—Pipe Flanges and Flanged Fittings NPS 1/2 through NPS 24 Metric/Inch Standard.
5. ASME B16.10—Face-to-Face and End-to-End Dimensions of Valves.
6. ASME B16.11—Forged Fittings, Socket-Welding and Threaded.
7. ASME B16.18—Cast Copper Alloy Solder Joint Pressure Fittings.
8. ASME B16.24—Cast Copper Alloy Pipe Flanges, Flanged Fittings, and Valves Classes 150, 300, 600, 900, 1500, and 2500.
9. ASME B16.34—Valves Flanged, Threaded and Welding End.
10. ASME B16.42—Ductile Iron Pipe Flanges and Flanged Fittings Classes 150 and 300.
11. ASME B16.47—Large Diameter Steel Flanges NPS 26 through NPS 60 Metric/Inch Standard.
12. ASME B36.10—Welded and Seamless Wrought Steel Pipe.

D. American Society of Safety Engineers (ASSE)

1. ASSE 1011—Performance Requirements for Hose Connection Vacuum Breakers.

E. American Water Works Association (AWWA)

1. AWWA C110/A21.10—Ductile-Iron and Gray-Iron Fittings.
2. AWWA C111/A21.11—Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
3. AWWA C115/A21.15—Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
4. AWWA C207—Steel Pipe Flanges for Waterworks Service, Sizes 4-Inch through 144-Inch (100 mm through 3,600 mm).
5. AWWA C500—Metal-Seated Gate Valves for Water Supply Service.
6. AWWA C504—Rubber-Sealed Butterfly Valves.
7. AWWA C507—Ball Valves 6-Inch through 60-Inch (150 mm through 1,500 mm).
8. AWWA C508—Swing-Check Valves for Waterworks Service, 2-Inch through 48-Inch (50 mm through 1,200 mm) NPS.

9. AWWA C509—Resilient-Seated Gate Valves for Water Supply Service.
10. AWWA C512—Air Release, Air/Vacuum, and Combination Air Valves for Water and Wastewater Service.
11. AWWA C515—Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service.
12. AWWA C550—Protective Interior Coatings for Valves and Hydrants.
13. AWWA C606—Grooved and Shouldered Joints.
14. AWWA C800—Underground Service Line Valves and Fittings.

F. Fluid Controls Institute (FCI)

1. FCI 70-2—Control Valve Seat Leakage.

G. Manufacturers Standardization Society (MSS)

1. MSS SP-61—Pressure Testing of Valves.
2. MSS SP-67—Butterfly Valves.
3. MSS SP-68—High Pressure Butterfly Valves with Offset Design.
4. MSS SP-81—Stainless-Steel or Stainless-Steel-Lined, Bonnetless, Knife Gate Valves with Flanged Ends.
5. MSS SP-83—Class 3000 and 6000 Pipe Unions, Socket Welding and Threaded (Carbon Steel, Alloy Steel, Stainless Steels, and Nickel Alloys).
6. MSS SP-108—Resilient-Seated Cast Iron Eccentric Plug Valves.

H. National Fluid Power Association (NFPA)

1. NFPA T3.6.7—Fluid Power Systems and Products – Square Head Industrial Cylinders – Mounting Dimensions.
2. NFPA T3.6.68—Fluid Power – Square Head Cylinders – Determination of the Static Failure Pressure Rating of Pressure Containing Components.

I. NSF International (NSF)

1. NSF 61—Drinking Water System Components – Health Effects.

## 1.05 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

## 1.06 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

- B. All valves, unless otherwise directed, shall be loaded and unloaded by lifting, and under no circumstances shall valves be dropped, skidded, or rolled. Valves shall not be stacked or placed under pipe, fittings, or other valves in such a manner that damage could result.
- C. Slings, hooks, or tongs used for lifting shall be padded in such a manner as to prevent damage to exterior surface or interior linings and valve components. If any part of the coating, lining, or components is damaged, the repairs or replacement shall be made by the Contractor at his expense and in a manner satisfactory to the Engineer before attempting to install such valves.
- D. Only new valves will be allowed for installation and shall be stored in a manner to prevent damage and be kept free of dirt, mud, or other debris.

## 1.07 QUALIFICATIONS

- A. All of the valves shall be products of well-established firms which are fully experienced, reputable, have been selling this product for a minimum of 10 years, and are qualified in the manufacture of the particular product furnished. The valves shall be designed, constructed, and installed in accordance with the requirements and procedures of applicable AWWA standards and shall comply with these Specifications as applicable.

## 1.08 OPERATIONS AND MAINTENANCE (O&M) MANUALS

- A. O&M Manuals shall be in accordance with General Conditions, Supplementary Conditions, and Section 01830, Operations and Maintenance Manuals.

## 1.09 VALVE TYPE CLASSIFICATIONS

- A. Air Valves (Type 100 series):
  - 1. Type 140: Air Valves for Sewage Services, Air Release.
- B. Ball Valves (Type 200 series)
  - 1. Type 220: Regular Port Threaded Stainless Steel Ball Valves, 2 Inches and Smaller.
- C. Check Valves (Type 400 series):
  - 1. Type 430: Ductile-Iron Swing-Flex Check Valves, 2 Inches through 36 Inches.

- D. Gate Valves (Type 600 series):
  - 1. Type 652: Stainless-Steel Gate Valves, 2 Inches through 6 Inches.
- E. Globe and Angle Valves (Type 700 series):
  - 1. Type 710: Bronze Angle Hose Valves, 1 Inch through 3 Inches.
  - 2. Type 720: Bronze Hose Bibbs, 1/2 Inch through 1 Inch.
- F. Plug Valves (Type 900 series):
  - 1. Type 902: Eccentric Plug Valves, 4 Inches through 12 Inches
  - 2. Type 920: Cast-Iron Non-Lubricated Eccentric Plug Valves, 4 Inches and Larger.

## PART 2 PRODUCTS

### 2.01 GENERAL

- A. Valves are identified in the Drawings by size and type number. For example, a callout of 36V300 refers to a 36-inch-diameter Type 300 valve. A Type 300 valve is a flanged, rubber-seated butterfly valve that is 4 inches through 72 inches for exposed service.
- B. All valves shall be complete with all necessary geared actuators, chainwheels and chains, handwheels, levers, valve bonnets, valve boxes, extension stems, operating nuts, and T-handle wrenches, which are required for proper valve operating and completing of the work included under this Section. Renewable parts including discs, packing, and seats shall be of types specified in this Section and acceptable by valve manufacturer for the intended service. All units shall have the name of the manufacturer and the size of the valve cast on the body or bonnet or shown on a permanently attached stainless-steel plate in raised embossed letters. All isolation valves shall be suitable for the intended service with bubble-tight shutoff to flow in either direction.
- C. Bronze or brass components in contact with water shall comply with the following requirements:

| Constituent               | Content     |
|---------------------------|-------------|
| Zinc                      | 7% maximum  |
| Aluminum                  | 2% maximum  |
| Lead                      | 8% maximum  |
| Copper + Nickel + Silicon | 83% minimum |

- D. Valves and valve operators shall be factory prepared and primed and field finish coated in accordance with Section 09900, Painting and Coating.

## 2.02 VALVE ACTUATORS

- A. The valve actuator shall be an integral part of a valve. The valve actuator shall be provided, installed, and adjusted by the valve manufacturer. Actuator mounting arrangements shall facilitate operation and maintenance and shall be determined by the valve manufacturer unless indicated otherwise on the Drawings or directed by the Engineer.
- B. All valves shall open counter-clockwise as viewed from the top. Unless otherwise required by the Owner, the direction of rotation of the wheel or wrench nut to open each valve shall be to the left (counterclockwise). Each valve body or actuator shall have the word "Open" cast on it and an arrow indicating the direction to open.
- C. Actuators shall clearly indicate valve position and an adjustable stop shall be provided to set closing torque. All exposed nuts, bolts, and washers shall be AISI Type 304 stainless steel. Unless noted otherwise, valves shall be equipped with the following manual actuators:
1. Exposed Valves 6 Inches and Smaller: Removable lever or handwheel actuators.
  2. Exposed Valves 8 Inches and Larger: Geared actuators with handwheels.
  3. Buried or Submerged Valves 6 Inches and Smaller: 2-inch-square operating nuts (with valve bonnets, valve boxes, and extension stems as required) and T-handle wrench.
  4. Buried or Submerged Valves 8 Inches and Larger: Geared actuators with 2-inch-square operating nuts (with valve bonnets, valve boxes, and extension stems as required) and wrench.
- D. Levers or handwheels shall be provided to actuate the valves where the valves are within 6 feet and 7 inches from finished grade or the operating floor. Handwheels shall be constructed of ductile-iron. Levers and handwheels shall be coated in accordance with Section 09900, Painting and Coating. Handwheel diameters for traveling nut actuators shall not exceed 8 inches for valves 12 inches and smaller and shall not exceed 12 inches for valves 20 inches and smaller.
- E. Chainwheel and guide actuators shall be provided for all exposed valves installed with their centerlines more than 6 feet and 9 inches above finished grade. Chainwheels shall be cast-iron with stainless-steel stem, clip, and pins. The actuating chain shall be AISI Type 304 stainless steel. Stainless-steel chain

baskets shall also be provided with these units. Chainwheels shall be coated in accordance with Section 09900, Painting and Coating.

1. Chainwheels and guides shall be Clow Figure F-5680, DeZurik Series W or LWG, Stockham, or equal.
- F. Gear actuators for valves 8 inches through 20 inches shall be of the worm-and-gear or of the traveling-nut type. Gear actuators for valves 24 inches and larger shall be of the worm-and-gear type. Gear actuators for motorized valves shall be of the worm-and-gear type, regardless of size.
  1. Gear actuators should be designed assuming that the differential pressure across the valves is equal to the test pressure of the connecting piping and assuming a line fluid temperature range of 33°F to 125°F, unless otherwise required in the detailed valve specifications.
  2. Gear actuators shall be enclosed and oil lubricated with seals provided on shafts to prevent entry of dirt and water into the actuator. Gear actuators for valves aboveground or in vaults and structures shall have handwheels. The actuators for valves in exposed service shall contain a dial indicating the position of the valve disc or plug.
  3. Traveling nut and worm-and-gear actuators shall be of the totally enclosed design and proportioned to permit operation of the valve under full differential pressure rating of the valve with a maximum pull of 80 pounds on the handwheel or crank. Stop-limiting devices shall be provided in the actuators in the open and closed positions. Actuators shall be of the self-locking type to prevent the disc or plug from creeping. Design actuator components between the input and the stop-limiting devices to withstand without damage a pull of 200 pounds for handwheel or chainwheel actuators and an input torque of 300 foot-pounds for operating nuts when operating against the stops.
  4. The self-locking worm gear shall be a one-piece design of gear bronze material (ASTM B427; or ASTM B584, Alloy C86200) that is accurately machine cut. Actuators for eccentric and lubricated plug valves may use ductile-iron gears provided the gearing is totally enclosed with spring-loaded rubber lip seals on the shafts. The worm shall be hardened alloy steel (ASTM A322, Grade G41500 or G41400; or ASTM A148/A148M, Grade 105-85) with thread ground and polished. Support worm-gear shafts at each end by ball or tapered roller bearings. The reduction gearing shall run in a proper lubricant. The handwheel diameter shall be no more than twice the radius of the gear sector in contact with the worm. Worm-gear actuators shall be Limitorque Model HBC, EIM Series W, or equal.

- G. For buried or submerged service, provide watertight shaft seals and watertight valve and actuator cover gaskets. Provide totally enclosed actuators designed for buried or submerged service.
- H. All buried valves shall have non-rising stems. All buried valves 3 feet below grade or deeper as measured at the valve centerline shall be furnished with an operator stem extension to extend the operating nut within 6 inches from the top of the valve box cover.

## 2.03 VALVE END CONNECTIONS

- A. Provide valve end connections conforming to connected piping and as shown in the Drawings. Generally, all buried valves shall be mechanical joint type end connectors. Exposed valves shall be screwed-end, socket-weld end, or flanged to conform to adjacent exposed connected piping system.
- B. Comply with the following standards:
  1. Threaded: ASME B1.20.1.
  2. Flanged: ASME B16.1 Class 125 unless other noted or AWWA C207.
  3. Mechanical (gland) Type: AWWA C111.
  4. Soldered: ASME B16.18.
- C. Nuts, Bolts, and Washers: Wetted or internal to be bronze or stainless-steel. Exposed to be zinc or cadmium-plated.
- D. Epoxy Interior Coating: Provide epoxy coating for all interiors of ferrous valve body surfaces in accordance with AWWA C550. Coatings shall be NSF-approved for valves in all potable water piping services. Coatings shall not be required for stainless-steel valve interiors.

## 2.04 VALVE BOXES

- A. All buried valves 2-inch size and larger shall be equipped with a standard cast-iron roadway valve box. Valve boxes shall be of the slip or sliding type with a round lid marked "Sewer" for wastewater and a square lid marked "Reclaimed Water" for reclaimed water valves. The box shall be designed to prevent transfer of the surface loads directly to the valve or piping. Valve boxes must have a minimum adjustable range of 12 inches and a minimum inner diameter of 6 inches. All valve boxes and lids shall be produced from grey cast-iron conforming to the latest revision of specification for grey iron castings, ASTM A48, Class 20A-25A. All castings shall be true and free of holes and shall be cleaned according to good foundry practice, chipped and ground as needed to remove fins and rough places on castings. Valve boxes shall be rated to sustain

FDOT H-20 loadings and have a minimum depth of 8 inches. The valve box lid shall fit flush in the top of the box without forcing and shall not rock, tip, or rattle.

- B. Provide debris cap as required in the Contract Drawings.
- C. Coat buried cast-iron pieces as specified in Section 09900, Painting and Coating, System No. 23 or with fusion-bonded epoxy.
- D. Valve boxes shall be as manufactured by Tyler Pipe, Geneco, Star Pipe Products, or equal.

## 2.05 EXTENSION STEMS

- A. Where the depth of the valve is such that its centerline is more than 4 feet below grade, provide operating extension stems to bring the operating nut to a point 6 inches below the surface of the ground and/or box cover. Where the valve is submerged, provide operating extension stems to bring the operating nut to 6 inches above the water surface. Extension stems shall be Type 316 stainless steel, solid core, and shall be complete with 2-inch-square operating nut. The connections of the extension stems to the operating nuts and to the valves shall withstand without damage a pull of 300 foot-pounds.
- B. Extension stem diameters shall be as tabulated below:

| Valve Size<br>(inches) | Minimum Extension<br>Stem Diameter<br>(inches) |
|------------------------|--|
| 2                      | 3/4  |
| 3, 4                   | 7/8  |
| 6                      | 1  |
| 8                      | 1-1/8  |
| 10, 12                 | 1-1/4  |
| 14                     | 1-3/8  |
| 16, 18                 | 1-1/2  |
| 20, 24, 30, 36         | 1-3/4  |
| 42, 48, 54             | 2  |

- C. Provide buried valves or valves located inside manholes or vaults with valve boxes cast in the manhole or vault roof with a valve position indicator designed to fit standard 5-1/4-inch valve boxes. The indicators shall show valve position and the direction and number of turns required to fully open (or close). All internal gearing shall be sealed. Ship each unit ready for field installation complete with valve box cast-iron adapter, capscrews, guide bushing, position indicator, flexible washer, centering plate, and 2-inch AWWA nut. Valve box and indicator shall be provided by the valve manufacturer. Indicators shall be Westran Position Indicator, Pratt Diviner, or equal.

## 2.06 FLOOR STANDS

- A. When required by the installations, provide floor stands for the operation of valves. Floor stands shall be of the nonrising stem, indicating type, complete with steel extension stems, couplings, handwheels, stem guide brackets, and special yoke attachments as required by the valves and recommended and supplied by the stand manufacturer. Floor stands shall be cast-iron base type: Clow, Figure F-5515; Bingham and Taylor; Stockham; or equal. Handwheels shall turn counterclockwise to open the valves.
- B. Provide Type 316 stainless-steel anchor bolts.
- C. Provide Type 316 stainless-steel extension stems for valves in exposed service. Provide Type 316 stainless-steel stems for valves in submerged service.
- D. Provide adjustable stem guide brackets for extension stems. The bracket shall allow valve stems to be set over a range of 2 to 36 inches from walls. Provide bushings drilled to accept up to 2-inch-diameter stems. Base, arm, and clamp shall be Type 316 stainless-steel. Bushing shall be bronze (ASTM B584, Alloy C86400 or C83600). Bolts, nuts, screws, and washers (including wall anchor bolts) shall be Type 316 stainless steel. Provide slots in the bracket to accept 3/4-inch bolts for mounting the bracket to the wall. Products: Trumbull Industries, Inc., Adjustable Stem Guide or equal.

## 2.07 BOLTS, NUTS, AND GASKETS FOR FLANGED VALVES

- A. Bolts, nuts, and gaskets for flanged valves shall be as described in Section 15055, Piping Systems—General.

## 2.08 PAINTING AND COATING

- A. Coat metal valves located aboveground or in vaults and structures the same as the adjacent piping. If the adjacent piping is not coated, coat valves as specified in Section 09900, Painting and Coating, System No. 12. Apply the specified prime and finish coat at the place of manufacture. The finish coat shall match the color of the adjacent piping. Coat handwheels the same as the valves.
- B. Coat buried metal valves at the place of manufacture as specified in Section 09900, Painting and Coating, System No. 23.
- C. Coat submerged metal valves, stem guides, extension stems, and bonnets at the place of manufacture as specified in Section 09900, Painting and Coating, System No. 2 or 5 as applicable.

- D. Line the interior metal parts of metal valves 4 inches and larger, excluding seating areas and bronze and stainless-steel pieces, as specified in Section 09900, Painting and Coating, System No. 5. Apply lining at the place of manufacture.
- E. Coat floor stands as specified in Section 09900, Painting and Coating, System No. 12.
- F. Test the valve interior linings and exterior coatings at the factory with a low-voltage (22.5 to 80 volts, with approximately 80,000-ohm resistance) holiday detector, using a sponge saturated with a 0.5% sodium chloride solution. The lining shall be holiday free.
- G. Measure the thickness of the valve interior linings as specified in Section 09900, Painting and Coating. Repair areas having insufficient film thickness as specified in Section 09900, Painting and Coating.

## 2.09 AIR VALVES (TYPE 100 SERIES)

- A. General Description:
  - 1. All valves shall meet or exceed all applicable provisions of the latest revision of AWWA C512, Standard for Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service. All valves for drinking water services shall comply with NSF 61. Design pressure is 150 psig. Valves shall be operable for water temperatures of above freezing to 125°F.
  - 2. All valves shall consist of a float or a float assembly. Valves shall be identified properly in plates attached permanently on the valve body. The body and cover shall be cast-iron ASTM A126, Class B, or ASTM A48/A48M, Class 35. Valves 3 inches and smaller shall have threaded ends. Valves 4 inches and larger shall have flanged ends. Threaded ends shall comply with ASME B1.20.1. Flanges shall comply with ASME B16.1, Class 125. All flanges shall be flat faced.
  - 3. The float shall be Type 304 or 316 Stainless-Steel. For valves with inlet sizes less than 4 inches, the float shall be able to withstand a collapse pressure of 1,000 psig. For inlet sizes 4 inches and larger, the float shall be capable of withstanding collapse pressures of 750 psig. Trim shall be Type 304 or 316 Stainless-Steel. The valve seat shall be of EPDM or other rubber materials applicable to wastewater and sludge. The valve seat shall be easily removed and replaced in the field.
  - 4. Drain/test ports on all valves with inlet size 1 inch or larger shall have two 1/2-inch NPT minimum plugged ports, one near the bottom of the valve body and the other near the top of the valve. The plug shall be of bronze, ASTM B584, Alloy C83600.

B. Type 140—Air Valves for Sewage Services, Air Release:

1. Type 140 air valves for sewage service shall have elongated cylindrical chambers. All valves shall provide the following: 1/2-inch clearance around the float in the chamber; minimum size 1/2-inch isolation valve and quick-disconnect couplings at the valve venting for back-flushing; blowoff port and valve at the bottom of the chamber; and inlet valve at the valve inlet. A back-flushing assembly shall be provided for all valves. The back-flushing assembly shall consist of an inlet shutoff valve, a flush valve, a clear water inlet valve, rubber supply hose, and quick-disconnect couplings. Type 140 valves shall be air-release valves. Valves shall be APCO 450 Series, Val-Matic Model 49ABW, or equal.

## 2.10 BALL VALVES (TYPE 200 SERIES)

A. Type 220—Regular Port Threaded Stainless Steel Ball Valves, 2 Inches and Smaller:

1. Stainless-steel ball valves 2 inches and smaller shall be rated at a minimum pressure of 1,500 psi WOG at a temperature of 100°F. Valve body, ball, and stem shall be Type 316 stainless-steel, ASTM A276/A276M or ASTM A351. Seat and seals shall be reinforced PTFE. Valves shall have plastic-coated lever actuators. Valves shall have screwed ends (ASME B1.20.1) and nonblowout stems. Valves shall be Flowserve Marpac B780 Series, Apollo 76-100 Series, or approved equal.

## 2.11 CHECK VALVES (TYPE 400 SERIES)

A. Type 430—Ductile-Iron Swing-Flex Check Valves, 2 Inches through 36 inches:

1. The valve body and cover shall be constricted of ASTM A536 Grade 65-45-12 ductile-iron. The disc shall be precision-molded Buna-N, ASTM D2000 Class BG. A screw-type backflow actuator shall be provided to allow opening of the valve during no-flow conditions. Buna-N seals shall be used to seal the stainless-steel stem in a bronze bushing. The backflow device shall be of the rising-stem type to indicate position. A stainless-steel T-handle shall be provided for ease of operation. The valve shall be designed for a minimum working pressure of 150 psi. The manufacturer's name, initials, or trademark and the size of the valve, working pressure, and direction of flow shall be directly cast on the body. Swing check valves shall exceed the minimum requirements of AWWA C508 with a heavy-duty body of ductile-iron with integral flanges, faced and drilled in accordance with ASME B16.1 Class 125. Bolts, nuts, washers, etc., shall be 316 stainless-steel. The valve body shall be the full waterway type. The disk arm shall be ductile-iron or steel,

suspended from and keyed to a stainless-steel shaft, which is completely above the waterway and supported at each end by heavy bronze bushings. The shaft shall rotate freely without the need for external lubrication. The shaft shall be sealed where it passes through the body by means of a stuffing box and adjustable packing. Simple O-ring shaft seals are not acceptable. The valve interior shall be painted with epoxy coating by the valve manufacturer in accordance with AWWA C550. The check valve shall be Val-Matic Swing-Flex check valve, or approved equal.

## 2.12 GATE VALVES (TYPE 600 SERIES)

### A. Type 652—Stainless-Steel Gate Valves, 2 inches through 6 inches:

1. Stainless-steel gate valves 2 inches through 6 inches shall be of the wedge type, Class 150 with rising stem and handwheel. The bonnet shall be of the bolted type. Ends shall be flanged in accordance with ASME B16.5. Materials of construction shall be as follows:

| Component                     | Material        | Specification   |
|-------------------------------|-----------------|---|
| Body, bonnet, yoke, and wedge | Stainless-steel | ASTM A351,<br>Grade CF8M  |
| Stem and gland follower       | Stainless-steel | ASTM A276/A276M,<br>Type 316                                      |
| Handwheel                     | Malleable iron  | ASTM A47/A47M   |
| Nuts and bolts                | Stainless-steel | ASTM A194/A194M,<br>Grade 818F or<br>ASTM A193/A193M,<br>Grade 88 |
| Packing                       | Teflon          | --  |

2. Valves shall be Powell Figure 1832, Crane/Alloyco Figure 90, or equal.

## 2.13 GLOBE AND ANGLE VALVES (TYPE 700 SERIES)

### A. Type 710—Bronze Angle Hose Valves, 1 Inch through 3 Inches:

1. Angle-type hose valves 1 inch through 3 inches shall be brass or bronze (ASTM B62 or ASTM B584, Alloy C83600) body with rising or non-rising stem, composition disc, and bronze or malleable iron handwheel. The stem shall be bronze, ASTM B62, ASTM B584 (Alloy C83600), or ASTM B584 (Alloy C87600). Valves shall have a cold-water service pressure rating of at least 150 psi. Provide cap and chain with valve. Threads on the valve outlet shall be American National Standard fire hose

coupling screw thread. Valves shall be Nibco T-301-W, Powell Figure 151 with nipple adapter, Crane 17TF with hose nipple adapter, or approved equal.

- B. Type 720—Bronze Hose Bibbs, 1/2-Inch through 1 Inch:
1. Hose bibbs 1/2 inch, 3/4 inch, and 1 inch shall be all bronze (ASTM B62 or ASTM B584, Alloy C83600) with rising or non-rising stem, composition disc, bronze or malleable iron handwheel, and bronze stem (ASTM B99/B99M, Alloy C65100; ASTM B371/B371M, Alloy C69400; or ASTM B584, Alloy C87600). Packing shall be PTFE or graphite. Valves shall have a pressure rating of at least 125 psi for cold-water service. Threads on valve outlets shall be American National Standard fire hose coupling screw thread (ASME B1.20.7). Provide atmospheric vacuum breaker conforming to ASSE 1011 and IAPMO code. Valves shall be manufactured by Nibco or approved equal.

## 2.14 PLUG (TYPE 900 SERIES)

- A. Plug and Seating Design for Eccentric Plug Valves (910 and 920): Eccentric plug valves shall comply with MSS SP-108 and the following. Provide a rectangular plug design, with an associated rectangular seat. Provide bidirectional seating design. The valve shall seat with the rated pressure upstream and downstream of the closed plug. Provide geared actuators sized for bidirectional operation.
- B. For Types 910 and 920 eccentric plug valves, the metallic portion of the plug shall be one-piece design and shall be without external reinforcing ribs which result in a space between the rib and the main body of the plug through which water can pass. Valves shall be repackable without any disassembly of valve or actuator. The valve shall be capable of being repacked while under the design pressure in the open position. Nowhere in the valve or actuators shall the valve shaft be exposed to iron-on-iron contact. Sleeve bearings shall be stainless-steel in valve sizes 20 inches and smaller and bronze or stainless-steel in valve sizes 24 inches and larger. Provide enclosed worm-gear actuators for valves 6 inches and larger.
- C. Rubber compounds shall have less than 2% volume increase when tested in accordance with ASTM D471 after being immersed in distilled water at a temperature of  $73.4^{\circ}\text{F} \pm 2^{\circ}\text{F}$  for 70 hours.
- D. Where indicated on the Contract Drawings, Plug Valves shall be equipped with valve position indicators. Indicators shall have NEMA 4X enclosures, 2 NPT conduit connections, 2 SPDT mechanical switches, and external visual indicator. Indicators shall not exceed 16 amp rating. Indicators shall be as manufactured by Assured Automation, YF Series, or engineer-approved equal.

- E. Type 902—Eccentric Plug Valves, 4 Inches through 12 Inches:
1. Eccentric plug valves 4 inches through 12 inches shall be non-lubricated type. Minimum pressure rating shall be 175 psi. Bodies shall be cast-iron in accordance with ASTM A126, Class B. Ends shall be flanged, Class 125 in accordance with ANSI B16.1. Plugs shall be stainless-steel, cast-iron (ASTM A126, Class B), or ductile-iron (ASTM A536, Grade 65-45-12) with Buna-N facing. Valve body seats shall be Type 304 or 316 stainless-steel or have a raised welded-in overlay at least 1/8-inch thick of not less than 90% nickel. Body capscrews and bolts and nuts shall be Type 316 stainless-steel. Packing shall be butadiene-filled Teflon. Provide 100% port area. Valves shall be DeZurik PEC Note: DeZurik PET is 100% port, Clow F-5412, Val-Matic “Cam-Centric,” Milliken “Millcentric” Figure 601, Pratt “Ballcentric,” or approved equal.
- F. Type 920—Cast-Iron Non-Lubricated Eccentric Plug Valves, 4 Inches and Larger:
1. Plug valves 4 inches and larger shall be of the non-lubricated eccentric type with resilient faced plugs and shall be furnished with flanges or mechanical-joint end connections to match connecting piping and as shown in the Drawings. Flanged valves shall be 125-lb flanges and faced and drilled to the ASME B16.1, 125-lb standard. Mechanical joint ends shall conform to AWWA C111. Valve bodies shall be of ASTM A126 Class B cast-iron. Valves shall be furnished with a welded overlay seat of not less than 90% pure nickel. Seat area shall be raised, with raised surface completely covered with weld to ensure that the plug face contacts only nickel. Screwed-in seats shall not be acceptable. The plug shall have a cylindrical seating surface eccentrically offset from the center of the plug shaft. The interference between the plug face and body seat, with the plug in the closed position, shall be externally adjustable in the field with the valve in the line under pressure. Plugs shall be resilient faced with Hycar (Acrylonitrile-Butadiene) or Buna N, formulated and constructed to be suitable for use with wastewater. Minimum port areas shall be 80% of full pipe flow area. Valves shall have sleeve-type metal bearings and shall be of sintered, oil-impregnated, permanently lubricated Type 316 ASTM. Nonmetallic bearings shall not be acceptable. Valve shaft seals shall be of the multiple V-ring type or U-cup type and shall be externally adjustable and replaceable without removing the bonnet or actuator from the valve under pressure. Valves using O-ring seals or non-adjustable packing shall not be acceptable. All exposed nuts, bolts, springs, washers, and other fasteners shall be 300-series stainless-steel. Valve working pressure ratings shall be a minimum of 150 psi. Each valve shall be given a hydrostatic and seat test with certified copies of proof-of-design test

reports as outlined in AWWA C504, Section 5.5. Plug valves shall be DeZurik PEC Series, Henry Pratt Company “Ballcentric” Series, or approved equal.

## PART 3 EXECUTION

### 3.01 JOINTS

- A. Bolt holes of flanged valves shall straddle the horizontal and vertical centerlines of the pipe run to which the valves are attached. Clean flanges by wire brushing before installing flanged valves. Clean flange bolts and nuts by wire brushing, lubricate threads with oil and graphite, and tighten nuts uniformly and progressively. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reseat or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.
- B. Clean threaded joints by wire brushing or swabbing. Apply Teflon joint compound or Teflon tape to pipe threads before installing threaded valves. Joints shall be watertight.
- C. Install lug-type valves with separate hex head machine bolts at each bolt hole and each flange (two bolts per valve bolt hole).
- D. Install grooved-end couplings for valves in accordance with Section 15055, Piping Systems—General.

### 3.02 INSTALLING EXPOSED VALVES

- A. Unless otherwise indicated in the Drawings, install valves in horizontal runs of pipe having centerline elevations 4 feet 6 inches or less above the floor with their operating stems vertical. Install valves in horizontal runs of pipe having centerline elevations between 4 feet 6 inches and 6 feet 9 inches above the floor with their operating stems horizontal.
- B. Install valves on vertical runs of pipe that are next to walls with their stems horizontal, away from the wall. Valves on vertical runs of pipe that are not located next to walls shall be installed with their stems horizontal, oriented to facilitate valve operation.

### 3.03 INSTALLING BURIED VALVES

- A. Connect the valve, coat the flanges, apply tape wrapping or polyethylene encasement as required on the Drawings, and place and compact the backfill to the height of the valve stem.

- B. Place block pads under the extension pipe to maintain the valve box vertical during backfilling and repaving and to prevent the extension pipe from contacting the valve bonnet.
- C. Mount the upper slip pipe of the extension in midposition and secure with backfill around the extension pipe. Pour the concrete ring allowing a depression so the valve box cap will be flush with the pavement surface.
- D. Install debris cap as close as possible under the cast-iron cover without interfering with the cover operation. Trim flexible skirt to provide a smooth contact with the interior or the extension pipe.

### 3.04 INSTALLING EXTENSION STEM GUIDE BRACKETS

- A. Install extension stem guide brackets at 6- to 8-foot centers. Provide at least two support brackets for stems longer than 10 feet, with one support near the bottom of the stem and one near the top.

### 3.05 FIELD COATING BURIED VALVES

- A. Coat flanges of buried valves and the flanges of the adjacent piping and the bolts and nuts of flanges and mechanical joints, as specified in Section 09900, Painting and Coating, System No. 22.
- B. Wrap buried metal valves 6 inches and larger with polyethylene sheet as specified in Section 15155, Ductile Iron Pipe and Fittings.

### 3.06 VALVE LEAKAGE AND FIELD TESTING

- A. Test valves for leakage at the same time that the connecting pipelines are tested. See Section 15144, Pressure Testing of Piping, for pressure testing requirements. Protect or isolate any parts of valves, actuators, or control and instrumentation systems whose pressure rating is less than the pressure test. Valves shall show zero leakage. Repair or replace any leaking valves and retest.
- B. Operate manual valves through three full cycles of opening and closing. Valves shall operate from full open to full close without sticking or binding. Do not backfill buried valves until after verifying that valves operate from full open to full closed. If valves stick or bind or do not operate from full open to full closed, repair or replace the valve and repeat the tests.
- C. Test gear actuators through three full cycles from full-open to full-close without binding or sticking. The pull required to operate handwheel- or chainwheel-operated valves shall not exceed 80 pounds. The torque required to operate valves having 2-inch AWWA nuts shall not exceed 150 foot-pounds. If actuators stick or

bind or if pulling forces and torques exceed the values stated previously, repair or replace the actuators and repeat the tests. Operators shall be lubricated in accordance with the manufacturer's recommendations before operating.

# WATER SERVICE CARD

Date of Installation \_\_\_\_\_

Contract Drawing Number \_\_\_\_\_

Service Line Size (inches) \_\_\_\_\_

Length of Water Service Line (feet) \_\_\_\_\_

Meter Size (inches) \_\_\_\_\_

Name \_\_\_\_\_

House/Business Address or Location:

Phone # \_\_\_\_\_

GPS coordinate @ main \_\_\_\_\_

GPS coordinate @ meter \_\_\_\_\_

Confirm Photos are attached \_\_\_\_\_

Installation Foreman \_\_\_\_\_

## **Service Layout**

Provide a brief sketch of the installed configuration. Indicate lengths, depths of the water service, and show three ties to meter box and to corporation stop:

Depth @ Main (feet) \_\_\_\_\_

Depth @ stub out (feet) \_\_\_\_\_

---

Contractor Signature

(Rev 2 – 15 Oct 2006)

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Resident Observer Signature

# ISOLATION VALVE CARD

Date of Installation \_\_\_\_\_

Contract Drawing Number \_\_\_\_\_

Closest Street Address to Valve or Location of Valve  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Size of Valve (inches) \_\_\_\_\_

Circle Type of Valve:      Gate      Butterfly

GPS Coordinate @ Valve \_\_\_\_\_

Installation Foreman \_\_\_\_\_

Confirm Photos are attached \_\_\_\_\_

## **Isolation Valve Layout**

Provide a brief sketch of the installed configuration. Show depths of the water line and show three ties to the isolation valve:

Depth @ Main (feet) \_\_\_\_\_

---

Contractor Signature

(Rev 2 – 15 Oct 2006)

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Resident Observer Signature

# FIRE HYDRANT CARD

Date of Installation \_\_\_\_\_

Contract Drawing Number \_\_\_\_\_

Closest Street Address to Fire Hydrant or Location of Fire Hydrant  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Length of Hydrant Line (feet) \_\_\_\_\_

List any offset fittings required. \_\_\_\_\_

List Utilities requiring offset fittings \_\_\_\_\_

GPS coordinate @ main \_\_\_\_\_

GPS coordinate @ Hydrant \_\_\_\_\_

Installation Foreman \_\_\_\_\_

Confirm Photos are attached \_\_\_\_\_

## **Fire Hydrant Layout**

Provide a brief sketch of the installed configuration. Indicate lengths, depths of the water line and hydrant, offset fittings, and show three ties to the fire hydrant isolation valve:

Depth @ Main (feet) \_\_\_\_\_

Depth @ hydrant (feet) \_\_\_\_\_

---

Contractor Signature

(Rev 2 – 15 Oct 2006)

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Resident Observer Signature

END OF SECTION

**SECTION 15121**  
**MISCELLANEOUS PIPE FITTINGS AND ACCESSORIES**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. This Section describes requirements for materials and installation of miscellaneous piping specialties, such as quick-connect couplings.

**1.02 RELATED WORK (NOT USED)**

- A. Section 01330, Submittals and Acceptance.
- B. Section 01650, Delivery, Storage, and Handling.
- C. Section 01780, Warranties and Bonds.
- D. Section 01830, Operations and Maintenance Manuals.

**1.03 SUBMITTALS**

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Submit manufacturer's catalog data and descriptive literature showing dimensions and materials of construction by ASTM reference and grade. Show coatings.

**1.04 REFERENCE STANDARDS**

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American Society for Testing and Materials (ASTM)
  - 1. ASTM A36/A36M—Standard Specification for Carbon Structural Steel.
  - 2. ASTM A240/A240M—Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
  - 3. ASTM A513/A513M—Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing.
  - 4. ASTM A536—Standard Specification for Ductile Iron Castings.
  - 5. ASTM A635/A635M—Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-

- Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for.
6. ASTM C219—Standard Terminology Relating to Hydraulic Cement.
  7. ASTM D2000—Standard Classification System for Rubber Products in Automotive Applications.
- B. American Society of Mechanical Engineers (ASME)
1. ASME B16.1—Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250.
  2. ASME B16.5—Pipe Flanges and Flanged Fittings NPS 1/2 through NPS 24 Metric/Inch Standard.
  3. ASME SA36—Carbon Steel Shapes, Plates, and Bars of Structural Quality for Use in Riveted, Bolted, or Welded Construction.
  4. ASME SA675—Carbon Steel Middle Ring or Sleeve.
- C. American Water Works Association (AWWA)
1. AWWA C111/A21.22—Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
  2. AWWA C213—Fusion-Bonded Epoxy Coatings and Linings for Steel Water Pipe and Fittings.
  3. AWWA C219—Bolted Sleeve-Type Couplings for Plain-End Pipe.
- D. American Iron and Steel Institute (AISI)
1. AISI C1012—Hard-Drawn Low-Carbon Steel.

## 1.05 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

## 1.06 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

## 1.07 OPERATIONS AND MAINTENANCE (O&M) MANUALS

- A. O&M Manuals shall be in accordance with General Conditions, Supplementary Conditions, and Section 01830, Operations and Maintenance Manuals.

## PART 2 PRODUCTS

### 2.01 METALLIC QUICK-CONNECT COUPLINGS

- A. Type 6: Quick-connect couplers shall be female-coupler/female-thread type with locking handles. Provide dust plug and security chain with each coupler. Bodies and locking handles shall be Type 316 stainless steel. The gasket shall be Teflon. Couplers shall be CIVACON Kamlok 633-D/634-A, Evertite, or equal.
- B. Type 8: Quick-connect couplers shall be male-adapter/150 lb ASME Flange type. Provide dust cap and security chain with each coupler. Bodies and locking handles shall be Type 316 stainless steel. The gasket shall be Teflon. Adapters shall be CIVACON Kamlock 733 LDS/634-B, Evertite, or equal.
- C. Type 10: Quick-connect couplers shall be male-adapter/hose-shank type. Provide dust cap with each coupler. Bodies and dust caps shall be Type 316 stainless steel. The gasket shall be Teflon. Adapters shall be CIVACON Kamlok 633-E/634-B, Evertite, or equal.

## PART 3 EXECUTION

### 3.01 INSTALLING QUICK-CONNECT COUPLINGS

- A. Attach to piping in accordance with the relevant piping specification.

### 3.02 INSTALLING COUPLINGS

- A. Pipe for use with flexible couplings shall have plain ends as specified in the respective pipe sections in Division 15, Mechanical.
- B. Alloy steel bolts and nut for flanged joints shall be made with high-strength, low-alloy Cor-Ten bolts, nuts, and washers. Cor-Ten for mechanical joints shall be made with mild corrosion resistant alloy steel bolts and nuts. All exposed bolts shall be painted the same color as the pipe. All joints to be wrapped with 8-mil color-coded poly wrap.
- C. Before sleeve-type couplings are installed, the pipe ends shall be cleaned thoroughly for a distance of 8 inches. Soapy water may be used as a gasket lubricant. A follower and gasket, in that order, shall be slipped over each pipe to a distance of about 6 inches from the end, and the middle ring shall be placed on the substantial completion date unless otherwise requested by the Owner.
- D. Mechanical joints shall be made in the standard manner. Valve stems shall be vertical in all cases. Set cast-iron box as shown on the Drawings. Boxes shall have

sufficient bracing to maintain alignment during backfilling. Knobs on cover shall be parallel to pipe. Remove any sand or undesirable fill from valve box after installation. Extend tracing wire outside of valve box extension pipe and enter at valve box.

- E. Thoroughly clean oil, scale, rust, and dirt from the pipe to provide a clean seat for the gasket.
- F. Wipe gaskets clean before installations.
- G. Lubricate flexible couplings and flanged coupling adapter gaskets with soapy water or manufacturer's standard lubricant before installing on the pipe ends.
- H. Install couplings, service saddles, and anchor studs in accordance with the manufacturer's instruction.
- I. Tighten bolts progressively, drawing up bolts on opposite sides a little at a time until all bolts have a uniform tightness.
- J. Use torque-limiting wrenches to tighten bolts to the manufacturer's specified torque values.

END OF SECTION

**SECTION 15122**  
**FLEXIBLE PIPE COUPLINGS**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. This Section presents requirements for materials and installation of flexible pipe couplings.

**1.02 RELATED WORK**

- A. Section 01330, Submittals and Acceptance.
- B. Section 01650, Delivery, Storage, and Handling.
- C. Section 01780, Warranties and Bonds.
- D. Section 01830, Operations and Maintenance Manuals.
- E. Section 09900, Painting and Coating.
- F. Section 15144, Pressure Testing of Piping.

**1.03 SUBMITTALS**

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. The manufacturer's catalog data on flexible pipe couplings. Show the manufacturer's model or figure number for each type of coupling or joint for each type of pipe material for which couplings and joints are used. Show coatings.
- B. The manufacturer's recommended torques to which the coupling bolts shall be tightened for the flexible sleeve-type pipe couplings.
- C. Materials of construction by ASTM reference and grade. Show dimensions.
- D. The number, size, and material of construction of tie rods and lugs for each thrust harness on the project.

**1.04 REFERENCE STANDARDS**

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American Society for Testing and Materials (ASTM)
  - 1. ASTM A240/A240M—Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
  - 2. ASTM D2000—Standard Classification System for Rubber Products in Automotive Applications.
- B. American Water Works Association (AWWA)
  - 1. AWWA C219—Bolted Sleeve-Type Couplings for Plain-End Pipe.
- C. NSF International (NSF)
  - 1. NSF 61—Drinking Water Systems Components – Health Effects.

## 1.05 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

## 1.06 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

## 1.07 OPERATIONS AND MAINTENANCE (O&M) MANUALS

- A. O&M Manuals shall be in accordance with General Conditions, Supplementary Conditions, and Section 01830, Operations and Maintenance Manuals.

## PART 2 PRODUCTS

### 2.01 GENERAL

- A. Each flexible coupling shall be designed for the type, size, and pressure rating of the connecting piping.
- B. All wetted materials shall be suitable for use with the fluid being conveyed.
- C. Wetted materials for flexible coupling used to convey drinking water shall be resistant to free chlorine and chloramine concentrations up to 10 mg/L.

- D. All flexible couplings used in association with drinking water service shall be certified as suitable for contact with drinking water by an accredited certification organization in accordance with NSF 61.

## 2.02 BOLTED-SLEEVE-TYPE COUPLINGS (TYPE C105)

- A. Bolted-sleeve-type couplings shall be designed and manufactured conforming to AWWA C219.
- B. Type C105: Flanged Coupling Adapter:
1. Adapters for ductile iron pipe 12 inches and smaller shall be ductile iron: Dresser Style 127, Smith-Blair Series 912, or equal.
  2. Adapters for ductile-iron pipe larger than 12 inches and steel pipe shall be steel: Dresser Style 128, Smith-Blair Type 913, or equal.
  3. Flange ends shall match the flange of the connecting pipe.

## 2.06 BOLTING FOR FLEXIBLE PIPE COUPLINGS

- A. Bolts and nuts for flexible pipe couplings shall be as specified for the adjacent piping.

## PART 3 EXECUTION

### 3.01 INSTALLING FLEXIBLE PIPE COUPLINGS

- A. Clean oil, scale, rust, and dirt from pipe ends. Clean gaskets in flexible pipe couplings before installation.
- B. Lubricate bolt threads with graphite and oil before installation.
- C. Install threaded nut and bolt thread protection caps after completing the bolt, nut, and gasket installation.

### 3.02 PAINTING AND COATING

- A. Exterior Coating of Buried Flexible Pipe Couplings: Coat buried flexible pipe couplings (including joint harness assemblies) as specified in Section 09900, Painting and Coating, System No. 23. Coat buried bolt threads, tie bolt threads, and nuts according to Section 09900, Painting and Coating, System No. 22.
- B. Exterior Coating of Exposed Flexible Pipe Coupling (Non-Submerged): Coat flexible pipe couplings (including joint harness assemblies) located indoors, in vaults and structures, and above ground with the same coating system as specified

- for the adjacent pipe. If the adjacent pipe is not coated, coat couplings according to Section 09900, Painting and Coating, System No. 12. Apply prime coat at the factory.
- C. Exterior Coating of Exposed Flexible Pipe Coupling (Submerged): Coat flexible pipe couplings (including joint harness assemblies) that will be submerged according to Section 09900, Painting and Coating. Apply prime coat at the factory.
  - D. Line carbon steel and iron-flexible pipe couplings according to Section 09900, Painting and Coating.

### 3.03 HYDROSTATIC TESTING

- A. Hydrostatically test flexible pipe couplings in place with the pipe being tested. Test in accordance with Section 15144, Pressure Testing of Piping.

END OF SECTION

## SECTION 15125 PIPING APPURTEANCES

### PART 1 GENERAL

#### 1.01 SCOPE OF WORK

- A. The Contractor shall furnish all labor, materials, equipment, and incidentals required and install complete and ready for operation all piping appurtenances as shown on the Contract Drawings and as specified in this Section.
- B. All piping appurtenances shall be of the size shown on the Contract Drawings. All equipment of the same type shall be from one manufacturer, unless authorized in writing by the Engineer.
- C. All piping appurtenances shall have the name of the manufacturer and the working pressure for which they are designed cast in raised letters upon the body.
- D. The piping appurtenances shall include, but not be limited to, the following:
  - 1. Pressure Gauge Assembly.
  - 2. Annular Diaphragm Seal and Pressure Gauge Assembly.

#### 1.02 RELATED WORK

- A. Section 01330, Submittals and Acceptance.
- B. Section 01650, Delivery, Storage, and Handling.
- C. Section 01780, Warranties and Bonds.
- D. Section 01830, Operations and Maintenance Manuals.
- E. Section 09900, Painting and Coating.
- F. Section 15055, Piping Systems—General.

#### 1.03 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Product technical submittal data shall contain the following information and data:
  - 1. Acknowledgment that products submitted meet requirements of standards referenced.
  - 2. Manufacturer's installation instructions.

## 1.04 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American Iron and Steel Institute (AISI)
  - 1. AISI Type 304L—Stainless Steel.
  - 2. AISI Type 316—Stainless Steel, Annealed Sheet.
- B. American Society for Testing and Materials (ASTM)
  - 1. ASTM A536—Standard Specification for Ductile Iron Castings.
  - 2. ASTM C285—Standard Test Methods for Sieve Analysis of Wet-Milled and Dry-Milled Porcelain Enamel.
- C. American Society of Mechanical Engineers (ASME)
  - 1. ASME B16.5—Pipe Flanges and Flanged Fittings NPS 1/2 through NPS 24 Metric/Inch Standard.
- D. American Water Works Association (AWWA)
  - 1. AWWA C105/A21.5—Polyethylene Encasement for Ductile-Iron Pipe Systems.
  - 2. AWWA C207—Steel Pipe Flanges for Waterworks Service, Sizes 4-Inch through 144-Inch (100 mm through 3,600 mm).
  - 3. AWWA C210—Liquid-Epoxy Coatings and Linings for Steel Water Pipe and Fittings.
  - 4. AWWA C213—Fusion-Bonded Epoxy Coatings and Linings for Steel Water Pipe and Fittings.
- E. National Sanitation Foundation (NSF)
  - 1. NSF 61—Drinking Water System Components – Health Effects.
- F. Great Lakes Upper Mississippi River Board of State and Provincial Health and Environmental Managers (10 States Standards)
  - 1. Recommended Standards for Wastewater Facilities.

## 1.05 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

## 1.06 DELIVERY, HANDLING, AND STORAGE

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.
- B. All piping appurtenances, unless otherwise directed, shall be loaded and unloaded by lifting, and under no circumstances shall any piping appurtenances be dropped, skidded, or rolled.
- C. Slings, hooks, or tongs used for lifting shall be padded to prevent damage to exterior surface or interior linings of piping appurtenances. If any part of the coating, lining, or components is damaged, the Contractor shall make repairs or replacement at his expense and in a manner satisfactory to the Engineer before attempting to install such piping appurtenances.
- D. Only new piping appurtenances will be allowed for installation and shall be stored to prevent damage and be kept free of dirt, mud, or other debris.

## 1.07 QUALIFICATIONS

- A. All the piping appurtenances shall be products of well-established firms that are fully experienced, reputable, have been selling this product for a minimum of 10 years, and qualified in the manufacture of the particular product furnished. The piping appurtenances shall be designed, constructed, and installed in accordance with the requirements and procedures of applicable AWWA standards and shall comply with these Specifications as applicable.

## 1.08 OPERATIONS AND MAINTENANCE (O&M) MANUALS

- A. O&M Manuals shall be in accordance with General Conditions, Supplementary Conditions, and Section 01830, Operations and Maintenance Manuals.

## PART 2 PRODUCTS

### 2.01 PRESSURE-GAUGE ASSEMBLY

- A. Pressure-gauge assemblies shall be provided at locations listed below or as shown on the Contract Drawings. All pressure-gauge assemblies shall include a pressure

gauge, AISI Type 316 stainless steel, NPT threaded ball valves for isolation and venting, and sensor piping. Sensor piping tubing and fittings shall be Type 316 stainless steel. The pressure gauge shall be constructed of Type 316 stainless-steel wetted parts and Type 304 stainless-steel case and bayonet ring, adjustable pointer, laminated safety-glass window, glycerin liquid-filled case, 1.5% span accuracy, and shall have a 2.5-inch-diameter dial size, minimum. The pressure gauge shall be as manufactured by Onyx Valve, WIKA Instrument Corporation, Type LM 233.54, or approved equal.

- B. The Contractor shall furnish and install pressure-gauge assemblies with pressure-gauge ranges as follows and/or shown on the Contract Drawings.

## 2.02 ANNULAR DIAPHRAGM SEAL AND PRESSURE GAUGE ASSEMBLY

- A. Annular diaphragm seal and pressure gauge assemblies shall be provided at locations listed in this Section, Section 11356, Progressing Cavity Pumps, or as shown on the Contract Drawings. All annular diaphragm-seal pressure gauge assemblies shall include an ethylene-glycol factory liquid-filled pressure-gauge and an annular seal assembly factory calibrated and ready for field installation. The annular seal assembly shall consist of a Buna-N diaphragm annual seal sleeve, carbon steel body, and ASME B16.5 Class 150 full-faced flanges (through bolted configuration). Pressure gauges shall be constructed with a stainless steel case with pressure ranges listed below. Annular diaphragm seal and pressure-gauge assemblies shall be as manufactured by the Red Valve Company, Incorporated, Series 48, Onyx Valve, or approved equal.
- B. The Contractor shall furnish and install annular seal and pressure-gauge assemblies with pressure gauge ranges as follows and/or shown on the Drawings:

| <u>Location</u>                      | <u>Number of Assemblies</u> | <u>Pressure Gauge Range (psi)</u> |
|--------------------------------------|-----------------------------|-----------------------------------|
| Truck-off Loading<br>Pumping Station | 4                           | 30                                |
| Digester Feed<br>Pumping Station     | 4                           | 30                                |

| <u>Location</u>                    | <u>Number of Assemblies</u> | <u>Pressure Gauge Range (psi)</u> |
|------------------------------------|-----------------------------|-----------------------------------|
| Dewatering Feed Pumping Station    | 8                           | 60                                |
| Blended Sludge Grinder Station     | 2                           | 10                                |
| Combined Thickened Grinder Station | 2                           | 10                                |

## 2.03 TOOLS

- A. If required for normal operation and maintenance, special tools shall be supplied with the equipment.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. The Contractor shall install all piping appurtenances as shown on the Contract Drawings.
- B. All piping appurtenances shall be installed in the location shown, unless approved otherwise, true to alignment and rigidly supported. Any damage to the above items shall be repaired to the satisfaction of the Owner and the Engineer.
- C. Install concrete inserts for hangers and supports as soon as forms are erected and before concrete is poured. Before setting these items, the Contractor shall check all plans and figures which have a direct bearing on their location and shall be responsible for the proper location of these piping appurtenances during the construction of the structures.

### 3.02 SHOP PAINTING

- A. Exterior surfaces of ferrous valves and piping appurtenances shall be painted in accordance with Section 09900, Painting and Coating, unless noted or specified otherwise.

### 3.03 INSPECTION AND TESTING

- A. Completed valves and piping appurtenances shall be subjected to hydrostatic pressure test as described in Section 15055, Piping Systems—General, and the detail pipe sections of these Specifications. All leaks in valves and piping

appurtenances shall be repaired and lines retested as approved by the Engineer. Before testing, the valves and pipelines shall be supported and thrust restrained for forces exceeding the test pressure to prevent movement during tests.

END OF SECTION

**SECTION 15144**  
**PRESSURE TESTING OF PIPING**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. This Section specifies the hydrostatic, pneumatic, and leakage testing of pressure piping for pumping stations, wastewater treatment plants, force mains and lift stations.

**1.02 RELATED WORK**

- A. Section 01330, Submittals and Acceptance.
- B. Section 01500, Temporary Facilities and Controls.

**1.03 SUBMITTALS**

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Test bulkhead locations and design calculations, pipe attachment details, and methods to prevent excessive pipe wall stresses.
- B. One electronic PDF and three hard copies of the test records to the Engineer upon completion of the testing.

**1.04 REFERENCE STANDARDS**

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American Water Works Association (AWWA)
  - 1. AWWA C600—Installation of Ductile-Iron Mains and Their Appurtenances.
  - 2. AWWA C605—Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings.

## 1.05 TEST PRESSURES

- A. Test pressures for the various services and types of piping are shown in the Piping Schedule in the Drawings. The Engineer shall provide any pressure requirements that are not included in the Piping Schedule.

## 1.06 TESTING RECORDS

- A. The Contractor shall provide records of each piping installation during the testing. These records shall include the following information:
  1. Date and times of test.
  2. Identification of process, pipeline, or pipeline section tested or retested.
  3. Identification of pipeline material.
  4. Identification of pipe specification.
  5. Test fluid.
  6. Test duration.
- B. Test pressure at low point in process, pipeline, or pipeline section.
- C. Remarks: Leaks identified (type and location), types of repairs, or corrections made.
- D. Certification by Contractor that the leakage rate measured conformed to the Specifications.

## PART 2 PRODUCTS

### 2.01 VENTS AND DRAINS FOR ABOVEGROUND PIPING

- A. The Contractor shall install vents on the high points of aboveground piping, whether shown in the Contract Drawings or not. Install drains on low points of aboveground piping, whether shown in the Contract Drawings or not. Provide a valve at each vent or drain point. Valves shall be 3/4 inch for piping 3 inches and larger and 1/2 inch for piping smaller than 3 inches. Valves shall be ball or gate valves unless otherwise shown on the Contract Drawings. Valves shall be rated for the pressure of the adjacent piping and shall be suitable for use with the adjacent pipe material.

### 2.02 MANUAL AIR-RELEASE VALVES FOR BURIED PIPING

- A. The Contractor shall provide temporary manual air-release valves at test bulkheads for pipeline test. Construct the pipe outlet in the same manner as for a

permanent air valve and, after use, seal with a blind flange, pipe cap, or plug and coat the same as the adjacent pipe.

## 2.03 TEST BULKHEADS

- A. The Contractor shall design and fabricate test bulkheads in accordance with Section VIII of the ASME Boiler and Pressure Vessel Code. Materials shall comply with Part UCS of the code. Design pressure shall be at least 2.0 times the specified test pressure for the section of pipe containing the bulkhead. Limit stresses to 70% of yield strength of the bulkhead material at the bulkhead design pressure. Include air-release and water drainage connections.

## 2.04 TESTING FLUID

- A. The Owner will provide a source of supply from the existing treated water distribution system for the Contractor's use in filling the lines. An air break shall be maintained at all times between the Owner's distribution system and the Contractor's equipment to prevent cross-connection. The line shall be slowly filled with water and the specified test pressure shall be maintained in the pipe for the entire test period by means of a pump furnished by the Contractor. Provide accurate means for measuring the quantity of water required to maintain this pressure. The amount of water required is a measure of the leakage.
- B. Testing fluid shall be potable water unless a pneumatic test is indicated on the Piping Schedule.
- C. For potable water pipelines, obtain and use only potable water for hydrostatic testing.
- D. Submit request for use of water from waterlines of Owner 48 hours in advance.
- E. The Contractor shall provide back flow prevention control for temporary connections to existing water mains.

## 2.05 TESTING EQUIPMENT

- A. The Contractor shall provide calibrated pressure gauges for the range of pressures to be tested, pipes, bulkheads, pumps, compressors, chart recorder, and meters to perform the hydrostatic testing. The Contractor shall provide any necessary assistance required for testing.

## PART 3 EXECUTION

### 3.01 TESTING PREPARATION

- A. Pipes shall be in place, backfilled, and anchored before beginning pressure testing.
- B. The Contractor shall conduct pressure tests on exposed and aboveground piping after the piping has been installed and attached to the pipe supports, hangers, anchors, expansion joints, valves, and meters.
- C. For buried piping, the pipe may be partially backfilled and the joints left exposed for inspection during an initial leakage test. However, perform the final pressure test after completely backfilling and compacting the trench.
- D. Provide any temporary piping needed to carry the test fluid to the piping that is to be tested. After the test has been completed and demonstrated to comply with the Specifications, disconnect and remove temporary piping. Do not remove exposed vent and drain valves at the high and low points in the tested piping; remove any temporary buried valves and cap the associated outlets. Plug taps or connections to the existing piping from which the test fluid was obtained.
- E. Provide temporary drain lines needed to carry testing fluid away from the pipe being tested. Remove such temporary drain lines after completing the pressure testing.
- F. Before starting the test, the Contractor shall notify the Engineer and the Owner's Representative.

### 3.02 CLEANING

- A. Before conducting hydrostatic tests, the Contractor shall flush pipes with water to remove dirt and debris. For pneumatic tests, blow air through the pipes. Maintain a flushing velocity of at least 3 fps for water testing and at least 2,000 fpm for pneumatic testing. Flush pipes for the period given by the formula

$$T = \frac{2L}{3}$$

in which:

T = flushing time (seconds).

L = pipe length (feet).

- B. For pipelines 24 inches or larger in diameter, acceptable alternatives to flushing are use of high-pressure water jet, sweeping, or scrubbing. Water, sediment, dirt, and foreign material accumulated during this cleaning operation shall be discharged, vacuumed, or otherwise removed from the pipe.

### 3.03 LENGTH OF TEST SECTION FOR BURIED PIPING

- A. The maximum length of test section for buried pipe of 12 inches or smaller in diameter is 3,500 feet; for buried pipe larger than 12 inches, 1 mile. Provide intermediate test bulkheads where the pipeline length exceeds these limits.

### 3.04 INITIAL PIPELINE FILLING FOR HYDROSTATIC TESTING

- A. The maximum rate of filling shall not cause the water velocity in the pipeline to exceed 1 fps. Filling may be facilitated by removing automatic air valves and releasing air manually.

### 3.05 TESTING NEW PIPE WHICH CONNECTS TO EXISTING PIPE

- A. Before testing new pipelines that are to be connected to existing pipelines, the Contractor shall isolate the new line from the existing line by test bulkheads, spectacle flanges, or blind flanges. After the new line has been successfully tested, remove test bulkheads or flanges and connect to the existing piping.

### 3.06 HYDROSTATIC TESTING OF ABOVEGROUND OR EXPOSED PIPING

- A. Open vents at high points of the piping system to purge air while the pipe is being filled with water. Venting during system filling may also be provided by temporarily loosening flanges.
- B. Subject the piping system to the test pressure indicated on the Piping Schedule in the Contract Drawings. Maintain the test pressure for a minimum of 2 hours. Examine joints, fittings, valves, and connections for leaks. The piping system shall show zero leakage or weeping. Correct leaks and retest until zero leakage is obtained.

### 3.07 HYDROSTATIC TESTING OF BURIED PIPING

- A. Where any section of the piping contains concrete thrust blocks or encasement, the Contractor shall not make the pressure test until at least 10 days after the concrete has been placed. When testing mortar-lined or PVC piping, fill the pipe to be tested with water and allow it to soak for at least 24 hours to absorb water before conducting the pressure test.

- B. Apply and maintain the test pressure by a positive displacement hydraulic force pump.
- C. Maintain the test pressure for the 2 hours by restoring the pressure whenever it falls 5 psi.
- D. After the test pressure is reached, use a meter to measure the additional water added to maintain the pressure. This amount of water is the loss due to leakage in the piping system. The allowable leakage volume is defined by the formulas:

PVC Pipe:

$$L = \frac{ND(P)^{1/2}}{C}$$

in which:

- L = allowable leakage (gallons).
- N = number of rubber-gasketed joints in the pipe tested.
- D = diameter of the pipe (inches).
- P = specified test pressure (psig).
- C = 7,400.

Ductile Iron Pipe:

$$L = \frac{SD(P)^{1/2}}{C}$$

in which:

- L = allowable leakage (gallons).
- S = length of pipe tested (feet).
- D = diameter of the pipe (inches).
- P = specified test pressure (psig).
- C = 133,200.

- E. The leakage test shall be a separate test following the pressure test and shall not be less than 2 hours long. All leaks evident at the surface shall be repaired and leakage eliminated regardless of the total leakage as shown by test. Lines that fail to meet tests shall be repaired and retested as necessary until test requirements are complied with. Defective materials, pipes, valves, and accessories shall be removed and replaced.

- F. The allowable leakage for buried piping having threaded, brazed, or welded (including solvent welded) joints shall be zero.
- G. Submit plan for testing to the Engineer for review at least 10 days before starting the test.
- H. Peening shall not be used to repair pinhole leaks in welded pipes. Any leakage in welded pipes shall be repaired by appropriate welding techniques.
- I. Repair and retest any pipes showing leakage rates greater than that allowed in the criteria above.

### 3.08 REPETITION OF TEST

- A. If the actual leakage exceeds the allowable leakage, locate and correct the faulty work and repeat the test. Restore the work and all damage resulting from the leak and its repair. Eliminate visible leakage.

### 3.09 BULKHEAD AND TEST FACILITY REMOVAL

- A. After a satisfactory test, the Contractor shall remove the testing fluid, remove test bulkheads and other test facilities, and restore the pipe coatings/linings.

END OF SECTION

**SECTION 15155**  
**DUCTILE IRON PIPE AND FITTINGS**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. The Contractor shall provide all materials and incidentals, including piping, fittings, flanged joints, mechanical joints, retainer glands, polyethylene bagging for buried ductile iron piping, fittings, valves, and appurtenances for the ductile iron piping systems required for the work shown on the Contract Drawings, in the Piping Schedule in the Contract Drawings, and described in Section 15060, Pipe Hangers and Supports.

**1.02 RELATED WORK**

- A. Section 01330, Submittals and Acceptance.
- B. Section 01650, Delivery, Storage, and Handling.
- C. Section 01780, Warranties and Bonds.
- D. Section 01830, Operations and Maintenance Manuals.
- E. Section 02240, Dewatering.
- F. Section 02305, Earthwork for Utilities.
- G. Section 09900, Painting and Coating.
- H. Section 15055, Piping Systems—General.
- I. Section 15060, Pipe Hangers and Supports.
- J. Section 15075, Process Equipment, Piping, and Valve Identification.
- K. Section 15144, Pressure Testing of Piping.

**1.03 SUBMITTALS**

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. All ductile iron pipe and fittings to be installed under this Contract shall be inspected and tested at the foundry where the material for this project is manufactured. The Contractor shall submit sworn certificates of such tests and their results.
- B. Shop Drawings, including layout drawings, shall be submitted as specified in Section 15055, Piping Systems—General.
- C. The Contractor shall submit the pipe manufacturer's certification of compliance with the applicable sections of the Specifications.

## 1.04 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

### A. American Society for Testing and Materials (ASTM)

1. ASTM A193/A193M—Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.
2. ASTM A194/A194M—Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure and High Temperature Service, or Both.
3. ASTM A307—Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 psi Tensile Strength.
4. ASTM A536—Standard Specification for Ductile Iron Castings.
5. ASTM A563—Standard Specification for Carbon and Alloy Steel Nuts.
6. ASTM B117—Standard Practice for Operating Salt Spray (Fog) Apparatus.
7. ASTM C150/C150M—Standard Specification for Portland Cement.
8. ASTM C283—Standard Test Methods for Resistance of Porcelain Enameled Utensils to Boiling Acid.
9. ASTM D714—Standard Test Method for Evaluating Degree of Blistering of Paints.
10. ASTM D792—Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
11. ASTM D1238—Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer.
12. ASTM E96/E96M—Standard Test Methods for Water Vapor Transmission of Materials.
13. ASTM G95—Standard Test Method for Cathodic Disbondment Test of Pipeline Coatings (Attached Cell Method).

### B. American Society of Mechanical Engineers (ASME)

1. ASME B1.1—Unified Inch Screw Threads (UN and UNR Thread Form).
2. ASME B16.1—Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250.
3. ASME B16.21—Nonmetallic Flat Gaskets for Pipe Flanges.

- C. American Water Works Association (AWWA)
  - 1. AWWA C104/A21.4—Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
  - 2. AWWA C110/A21.10—Ductile-Iron and Gray-Iron Fittings.
  - 3. AWWA C111/A21.11—Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
  - 4. AWWA C115/A21.15—Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
  - 5. AWWA C150/A21.50—Thickness Design of Ductile-Iron Pipe.
  - 6. AWWA C151/A21.51—Ductile-Iron Pipe, Centrifugally Cast.
  - 7. AWWA C153/A21.53—Ductile-Iron Compact Fittings.
  - 8. AWWA C207—Steel Pipe Flanges for Waterworks Service, Sizes 4-Inch through 144-Inch (100mm through 3,600mm).
  - 9. AWWA C600—Installation of Ductile-Iron Mains and their Appurtenances.
  - 10. AWWA C651—Disinfecting Water Mains.
- D. International Organization for Standardization (ISO)
  - 1. ISO-9001—Quality Management Systems – Requirements.
- E. NSF International (NSF)
  - 1. NSF 61—Drinking Water System Components – Health Effects.

## 1.05 QUALITY ASSURANCE

- A. Source Quality Control:
  - 1. The ductile iron pipe manufacturer shall submit certification that the pipe and fitting products meet all tests required by AWWA C151/A21.51.
  - 2. All materials shall be new and have a manufacturer's certificate verifying compliance to all tests and inspections as required in this Section. The weight, class, and casting period shall be shown on each piece of pipe. The manufacturer's "mark," the year produced, and the word "Ductile" or the letters "DI" shall be cast or stamped on all pipe.

## 1.06 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

## 1.07 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

## 1.08 TESTING REQUIREMENTS

- A. See Section 15144, Pressure Testing of Piping, for testing requirements.

## 1.09 OPERATIONS AND MAINTENANCE (O&M) MANUALS

- A. O&M Manuals shall be in accordance with General Conditions, Supplementary Conditions, and Section 01830, Operations and Maintenance Manuals.

# PART 2 PRODUCTS

## 2.01 GENERAL

- A. All ductile iron piping shall be designed and manufactured in accordance with AWWA C150/A21.50 and AWWA C151/A21.51 for the following minimum operating conditions:

1. The minimum internal design pressure shall be 150 psi with a 100-psig surge allowance, and a safety factor of 2, for a total internal design pressure of 500 psi.
2. The external loads design criteria shall be for the minimum cover indicated on the Drawings at 120 lb per cubic foot soil weight and live load based on one AASHTO H-20 truck load. The thickness design of ductile iron pipe shall be in accordance with AWWA C150/A21.50.
3. The horizontal deflection of cement-mortar-lined ductile iron pipe resulting from external load conditions shall not exceed 3% of the pipe diameter based on the trench design shown on the Drawings.
4. Pressure Class: All ductile iron piping shall meet the following minimum working pressure classes:
  - a. Pipe 4 inches through 12 inches: 350 psi.
  - b. Pipe greater than 12 inches: 250 psi.

## 2.02 JOINTS

- A. Ductile iron fittings shall be furnished with push-on joint, mechanical joints, and flanged joints as shown on the Contract Drawings and specified in this Section:
1. Push-On Joints: Push-on joints shall conform to AWWA C111/A21.11. Gaskets shall be EPDM or approved equal.
  2. Mechanical Joints: All buried ductile iron fittings shall be furnished with mechanical joint ends unless noted otherwise. Mechanical joints shall conform to AWWA C111/A21.11. Glands shall be constructed of ductile iron.
  3. Flanged Joints: Pipe for threaded flange fabrication shall be Special Thickness Class 53 in accordance with AWWA C110/A21.10, AWWA C111/A21.11, and AWWA C115/A21.15. Bolt circle and bolt holes shall match those of ASME B16.1 Class 125 flanges. The flanges shall be rated for a maximum working pressure of 250 psi. Threaded flanges shall be individually fitted and machine tightened on the pipe ends. Flange facing shall be smooth or with shallow serrations in accordance with AWWA C115/A21.15.

## 2.03 FITTINGS

- A. General: Ductile iron pipe fittings shall be the compact type meeting the requirements of AWWA C110/A21.10 and AWWA C153/A21.53 where applicable. Ductile iron, cement lined and seal coated, glass lined, or ceramic epoxy lined. Lining of fitting shall conform to in the Piping Schedule as specified on the Contract Drawings. Fittings shall be manufactured in accordance with AWWA C110/A21.10. Where taps are shown on fittings, tapping bosses shall be provided. At a minimum, fittings shall have the same pressure rating as the connecting pipe.
1. Flanged Joint: AWWA C110/21.10 and ASME B16.1, faced and drilled 125-pound ANSI standard.
  2. Mechanical Joint: AWWA C110/A21.10
    - a. Provide mechanical joint fittings for all buried fittings as shown in the Drawings, unless noted otherwise.
    - b. Provide specified gaskets.

## 2.04 LINING AND COATING

- A. The Contractor shall provide lined ductile iron piping and fittings in accordance with the Piping Schedule in the Contract Drawings. The Contractor shall perform

all field measurements confirming the accuracy of the piping sizes and lengths shown on the Contract Drawings. The Contractor shall notify the Engineer immediately before deviating from or altering the lining of ductile iron piping shown on the approved layout schedule.

- B. Ceramic Epoxy Lined Pipe and Fittings: The Contractor shall notify the Engineer immediately before cutting epoxy-lined ductile iron pipe in the field. The Contractor shall repair the cut end in accordance with the pipe manufacturer's written procedures.
1. General: The lining shall be an amine-cured novalac epoxy containing at least 20% by volume of ceramic quartz pigment. The lining material shall be Protecto 401 Ceramic Epoxy as manufactured by Induron Protective Coatings, Inc. The lining shall be applied by a competent pipe lining specialty firm with a successful history of applying linings to the interior of ductile iron pipe and fittings.
  2. Lining Materials: Lining material shall meet the following requirements and properties:
    - a. A permeability rating of 0.00 when tested according to Method A of ASTM E96/E96M, Procedure A with a test duration of 30 days.
  3. Application: The lining applicator shall apply lining according to the requirements of the Protecto 401 Specification and application methods and procedures.
- C. Cement-Lined Ductile Iron Pipe and Fittings: Interior surfaces of all cement-lined ductile iron pipe, fittings, and specials shall be cleaned and lined in the shop with a standard thickness cement-mortar lining applied in conformity with AWWA C104/A21.4. Every precaution shall be taken to prevent damage to the lining. If lining is damaged or found faulty at delivery site, the Contractor shall repair or replace damaged or unsatisfactory portions with lining conforming to these Specifications at no additional cost to the Owner. Pipe linings for potable water lines shall be NSF 61 approved.
1. All ductile iron pipe and fittings cement-mortar linings shall be surface sealed with an asphaltic seal coating, 1 mil, in accordance with AWWA C104/A21.4.

## 2.05 MANUFACTURERS

- A. Acceptable ductile iron pipe manufacturers include US Pipe, American Ductile Pipe, Griffin Pipe, or approved equal.

## 2.06 BOLTS

- A. General: The Contractor shall provide carbon steel, ASTM A307, Grade A hex head bolts and ASTM A563, Grade A hex head nuts. Threads shall be as specified in ASME B1.1 coarse thread series, Class 2A external and Class 2B internal. Nuts, bolts, and gaskets for flanged fittings and blind flanges shall be designed to withstand the design and test pressure ratings for the pipe.

## 2.07 GASKETS

- A. Gaskets for mechanical joints shall be compatible with sewage pipe service. See Section 15055, Piping System—General, for gasket requirements.
- B. Gaskets for flanged joints shall be 1/8-inch-thick, cloth-inserted rubber conforming to applicable parts of ASME B16.21 and AWWA C207. Gasket material shall be free from corrosive alkali or acid ingredients and suitable for use in sewage and reclaimed water lines. Gaskets shall be full-face type for 125-pound flanges.

## 2.08 RETAINER GLANDS

- A. Retainer glands shall be provided for all buried ductile-iron mechanical joints, fitting, and ductile-iron pipe connections to buried valves. Retainer glands shall be designed for joint retaining through the use of a follower gland and set screw-anchoring devices that impart multiple wedging action against the pipe. The mechanical joint-restraint device shall be UL listed and shall have a working pressure of at least 250 psi with a minimum safety factor of 2.
1. Gland: Manufactured of ductile iron conforming to ASTM A536. Gland dimensions shall match AWWA C111/A21.11 and A21.53.
  2. Restraining Devices: Manufactured of ductile iron heat treated to a minimum hardness of 370 BHN. Restraining devices shall incorporate a set screw/twist-off nut bolt to ensure the proper actuating of the restraining device. The twist-off nut shall be designed to come off at the torque limit desired to anchor the restraining device in place on the pipe.
  3. Joint Deflection: Retainer gland joint deflection shall be limited to manufacturer's recommended maximum deflection angle. Joint deflection shall be applied before the set screws are torqued.

4. Acceptable Manufacturers:

- a. EBAA Iron, Inc. – Megalug 1100 Series.
- b. Or approved equal.

2.09 EXTERNAL PIPE RESTRAINTS

- A. Ductile iron pipe push-on (bell and spigot) joint restraint shall be provided by a restraining harness consisting of a restraint ring, connecting tie-rods, and split-ring assembly installed at all push-on joints. The restraint ring shall consist of wedging components made from 60-42-12 ductile iron conforming to ASTM A536 and wedges heat treated to minimum 370 BHN. Torque limiting twist-off nuts shall be provided on each wedge to ensure proper applied installation torque. The split ring shall be made from 60-42-12 ductile iron conforming to ASTM A536. The connecting rods shall be made of steel conforming to AWWA C111/A12.11. Sizes 4- to 16-inch-diameter restraining harnesses shall have 350-psi maximum working pressure rating and 18- to 36-inch-diameter restraining harnesses shall have 250-psi maximum working pressure rating. All harnesses shall be designed with a 2-to-1 safety factor applied to the maximum working pressure rating.

B. Acceptable Manufacturers:

- 1. EBAA Iron, Inc. – Series 1700.
- 2. Or approved equal.

2.10 INTERNAL PIPE RESTRAINT

A. Acceptable Manufacturers:

1. American Ductile Iron Pipe:

- a. Fastite Joint with Fast-Grip® Gasket.
- b. Flex Ring® Joint.

2. US Pipe:

- a. Field Lok 360® Gasket.
- b. TR Flex® Restrained Joint.

3. Or Engineer-approved equal.

## 2.11 POLYETHYLENE BAGGING

- A. Polyethylene bagging for buried ductile iron pipe, fittings, and valves shall be 8 mils thickness minimum polyethylene, manufactured in accordance with ASTM D1238, Type I, Class C, Grade E1.

## 2.12 COLOR CODING OR MARKING

- A. Color Coding and Marking shall be in accordance with the Pipe Schedule in the Contract Drawings and Section 15075, Process Equipment, Piping, and Valve Identification.

# PART 3 EXECUTION

## 3.01 HANDLING PIPE AND FITTINGS

- A. Care shall be taken in loading, transporting, and unloading to prevent injury to the pipe, fitting, lining, and coating. Pipe and fittings shall not be dropped. All pipe and fittings shall be examined before installation, and no piece that the Engineer finds defective shall be installed. The Contractor shall repair any damage to the pipe and fittings coating and/or lining as directed by the Engineer. If the Engineer determines that the coating and/or lining cannot be repaired, the Contractor shall replace the damaged pipe and fittings at no additional compensation.
- B. All pipe and fittings shall be subjected to a careful inspection immediately before installation.
- C. If any defective pipe is discovered after it has been installed, the Contractor shall remove and replace it with a pipe in satisfactory condition at no additional expense to the Owner.
- D. Ceramic epoxy and glass-lined pipe and fittings shall be handled only from the outside of the pipe and fittings. No forks, chains, straps, hooks, etc. shall be placed inside the pipe and fittings for lifting, positioning, or laying.

## 3.02 PIPE INSTALLATION

- A. The Contractor shall provide and use proper implements, tools, and facilities for the safe and convenient performance of the work. All pipe, fittings, valves, and appurtenances shall be lowered carefully into the trench and at above-grade locations to prevent damage to the pipe, protective coating, lining, and polyethylene bagging. Under no circumstances shall pipeline materials be dropped off or dumped. A trench shall be dewatered before the pipe is installed.

- B. The Contractor shall carefully examine all pipe fittings, valves, and other appurtenances for damage and other defects immediately before installation and before bagging buried ductile-iron pipe. The Contractor shall mark and hold defective materials for inspection by the Engineer, who may prescribe corrective repairs or reject the materials.
- C. The Contractor shall remove all lumps, blisters, and excess coating from the socket and plain ends of push-on joint pipe for buried service. The outside of the plain end and the inside of the bell shall be wiped clean and dry and be free from dirt, sand, grit, or any foreign material before the pipe is laid in trench.
- D. The Contractor shall prevent foreign material from entering the pipe while the pipe is being placed in the trench. During installation, no debris, tools, clothing, or other materials shall be placed in the pipe.
- E. As each length of buried pipe is placed in the trench, the joint shall be assembled and the pipe brought to correct line and grade. The pipe shall be secured in place with approved backfill material.
- F. When pipe is not being laid, the open ends of pipe shall be closed by a watertight plug or other means approved by the Engineer. When practical, the plug shall remain in place until the trench is pumped completely dry. Care shall be taken to prevent pipe flotation should the trench fill with water.
- G. Trench width at the top of pipe, bedding conditions, and backfill placement and compaction shall be such that design loadings on the pipe will not be exceeded.
- H. Joint Assembly: Pipe joints shall be assembled in accordance with the manufacturer's instructions and the requirements of ANSI/AWWA C600.
  - 1. Flanged Joint: Before connecting flanged pipe, the Contractor shall thoroughly clean all faces of the flanges of all oil, grease, and foreign material. The rubber gaskets shall be checked for proper fit and thoroughly cleaned. Care shall be taken to ensure proper sealing of the flange gasket. Bolts shall be tightened so that the pressure on the gasket is uniform. Torque-limiting wrenches shall be used to ensure uniform bearing insofar as possible. If joints leak when the hydrostatic test is applied, the gaskets shall be removed and reset and bolts retightened.
  - 2. Push-On, Restrained Joint, or Mechanical Joint: The Contractor shall joint piping in accordance with the manufacturer's recommendations. Provide all special tools and devices, such as special jacks, chokers, and similar items required for proper installation. Lubricant for the pipe gaskets shall be furnished by the pipe manufacturer, and no substitutes will be permitted under any circumstance.

- I. Pipe Deflection: When it is necessary to deflect pipe from a straight line in either the vertical or horizontal plane or where long radius curves are permitted, the amount of deflection shall not exceed that shown in ANSI/AWWA C600 and that recommended by the retainer gland manufacturer for mechanical joint pipe and fittings.
- J. Pipe Cutting: For inserting valves, fittings, or closure pieces; pipe shall be cut in a neat, workmanlike manner without damaging the pipe or lining. Ductile cast iron may be cut using an abrasive pipe saw, rotary wheel cutter, guillotine pipe saw, milling wheel saw, or oxyacetylene torch. Cut ends and rough edges shall be ground smooth, and for push-on joint connections the cut end shall be beveled.

### 3.03 ABOVE-GROUND PIPE INSTALLATION

- A. The Contractor shall install pipe in horizontal or vertical planes, parallel or perpendicular to building, flooring, and pad surfaces unless otherwise shown. Support pipe and fittings to prevent strain on joints, valves, and equipment. Install flanged joints so that contact faces bear uniformly on the gasket. Tighten bolts in accordance with the pipe manufacturer's recommendations.

### 3.04 SURFACE PREPARATION AND PAINTING

- A. All exposed pipe and fittings shall be painted as specified in Section 09900, Painting and Coating.
- B. All buried steel bolts, nuts, washers, rods, harnesses, clamps, sleeves, and appurtenances shall be painted with System No. 23 as specified in Section 09900, Painting and Coating.

### 3.05 INSPECTION AND TESTING

- A. See Section 15055, Piping Systems—General, and Section 15144, Pressure Testing of Piping.

END OF SECTION

**SECTION 15290**  
**PVC PIPE, 3 INCHES AND SMALLER**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. This Section includes materials, installation, and testing of PVC pipe and fittings sized 3 inches and smaller for use in process piping having a maximum design pressure of 150 psi and having a maximum design temperature of 105°F.

**1.02 RELATED WORK**

- A. Section 01330, Submittals and Acceptance.
- B. Section 01650, Delivery, Storage, and Handling.
- C. Section 01780, Warranties and Bonds.
- D. Section 01830, Operations and Maintenance Manuals.
- E. Section 09900, Painting and Coating.
- F. Section 15055, Piping Systems—General.
- G. Section 15144, Pressure Testing of Piping.

**1.03 SUBMITTALS**

- A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance.
- B. The Contractor shall do the following:
  - 1. Submit materials list showing materials of pipe and fittings with ASTM reference and grade. Submit manufacturer's certification of compliance with referenced standards, e.g., ASTM D1784, D1785, and D2467. Show wall thickness of pipe and fittings. Show fitting dimensions.
  - 2. Submit data sheets for solvent cement and demonstrating compliance with ASTM D2564 and F656.
  - 3. Submit data sheets showing that the pipe and fittings are NSF 61 listed for use in potable water service and that the pipe will bear the NSF logo for potable water use.

**1.04 REFERENCE STANDARDS**

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of

this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. American Society for Testing and Materials (ASTM)

1. ASTM D1784—Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
2. ASTM D1785—Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
3. ASTM D2464—Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
4. ASTM D2467—Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
5. ASTM D2564—Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
6. ASTM D2774—Standard Practice for Underground Installation of Thermoplastic Pressure Piping.
7. ASTM D2855—Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets.
8. ASTM F656—Standard Specification for Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

B. American Society of Mechanical Engineers (ASME)

1. ASME B1.20.1—Pipe Threads, General Purpose (Inch).
2. ASME B16.5—Pipe Flanges and Flanged Fittings NPS 1/2 through NPS 24 Metric/Inch Standard.

C. NSF International (NSF)

1. NSF 61—Drinking Water System Components – Health Effects.

## 1.05 WARRANTIES

A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

## 1.06 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

## 1.07 OPERATIONS AND MAINTENANCE (O&M) MANUALS

- A. O&M Manuals shall be in accordance with General Conditions, Supplementary Conditions, and Section 01830, Operations and Maintenance Manuals.

# PART 2 PRODUCTS

## 2.01 GENERAL

- A. All pipe joints and fittings shall have the same schedule, pressure ratings, thermal resistance, chemical resistance, and other pertinent properties as the pipe being joined or connected. Plastic fittings shall be manufactured of the same resin as used in the manufacture of the pipe being joined.
- B. Each pipe length shall be clearly marked with the manufacturer's name or trademark, applicable ASTM standards, size, pressure rating, and/or schedule.
- C. Provide line-size reducing tees for connecting lateral or instrumentation to pipe systems. Seal threaded fittings with Teflon™ tape or Teflon™ paste. Engage threaded fittings in accordance with ASTM A53.

## 2.02 PIPE

- A. Pipe shall be Schedule 80, Type I, Grade 1 (Class 12454-B), conforming to ASTM D1784 and D1785.

## 2.03 FITTINGS

- A. Fittings shall be Schedule 80 and shall conform to ASTM D2464 for threaded fittings and ASTM D2467 for socket-type fittings.

## 2.04 FLANGES

- A. PVC flanges shall be of the one-piece solid socket design and shall be made of the same material as the pipe. Pressure rating shall be at least 150 psi at a temperature of 73°F. Minimum burst pressure shall be 500 psi. Flanges shall match the dimensions of ASME B16.5, Class 150, steel flanges for outside diameter, bolt circle, and bolt holes. Do not use Van Stone flanges.

## 2.05 UNIONS

- A. Unions shall have socket-type ends, Viton O-rings, and shall be Schedule 80. Material shall be Type I, Grade 1 PVC, per ASTM D1784.

## 2.06 JOINTS

- A. Pipe and fitting joints shall be socket welded except where threaded and flanged joints are required to connect to valves and equipment.

## 2.07 SOLVENT CEMENT IN OTHER THAN CHEMICAL AND CHEMICAL CARRIER WATER SERVICE (NOT USED)

## 2.08 SOLVENT CEMENT IN CHEMICAL AND CHEMICAL CARRIER WATER SERVICE

- A. Solvent cement shall be free of silica. Products: IPS "Weld-On 724" or Oatey "Lo V.O.C. PVC Heavy Duty Gray."

## 2.09 GASKETS FOR FLANGES

- A. See Section 15055, Piping Systems—General.

## 2.10 BOLTS AND NUTS FOR FLANGES

- A. See Section 15055, Piping Systems—General.

## 2.11 LUBRICANT FOR STAINLESS STEEL BOLTS AND NUTS

- A. See Section 15055, Piping Systems—General.

## PART 3 EXECUTION

### 3.01 GENERAL

The Contractor shall adhere to the following:

- A. Do not install PVC pipe when the temperature is below 40°F or above 90°F. Store loose pipes on racks with a maximum support spacing of 3 feet. Provide shade for pipe stored outdoors or installed outdoors until the pipe is filled with water.
- B. Store fittings indoors in their original cartons.

- C. Store solvent cement indoors or, if outdoors, shade from direct sunlight exposure. Do not use solvent cements that have exceeded the shelf life marked on the storage container.
- D. Before installation, check pipe and fittings for cuts, scratches, gouges, buckling, kinking, or splitting on pipe ends. Remove any pipe section containing defects by cutting out the damaged section of pipe.
- E. Do not drag PVC pipe over the ground, drop it onto the ground, or drop objects on it.

### 3.02 SOLVENT-WELDED JOINTS

- A. Before solvent welding, remove fittings and couplings from their cartons and expose them to the air at the same temperature conditions as the pipe for at least 1 hour.
- B. Cut pipe ends square and remove all burrs, chips, and filings before joining pipe or fittings. Bevel solvent-welded pipe ends as recommended by the pipe manufacturer.
- C. Wipe away loose dirt and moisture from the inside and outside of the pipe end and the inside of the fitting before applying solvent cement. Clean the surfaces of both pipes and fittings that are to be solvent welded with a clean cloth moistened with acetone or methylethyl ketone. Do not apply solvent cement to wet surfaces.
- D. The pipe and fitting socket shall have an interference fit. The diametrical clearance between pipe and entrance of the fitting socket shall not exceed 0.04 inch. Check the fit at every joint before applying solvent cement.
- E. Make up solvent-welded joints in accordance with ASTM D2855. Application of cement to both surfaces to be joined and assembly of these surfaces shall produce a continuous bond between them with visual evidence of cement at least flush with the outer end of the fitting bore around the entire circumference.
- F. Allow at least 8 hours of drying time before moving solvent-welded joints or subjecting the joints to any internal or external loads or pressures.
- G. Acceptance criteria for solvent-welded joints shall be as follows:
  - 1. Unfilled Areas in Joint: None permitted.
  - 2. Unbonded Areas in Joint: None permitted.
  - 3. Protrusion of Material into Pipe Bore, Percent of Pipe Wall Thickness: Cement, 50%.

### 3.03 FLANGED JOINTS

- A. Lubricate carbon steel bolt threads with graphite and oil before installation.
- B. Tighten bolts on PVC flanges by tightening the nuts diametrically opposite each other using a torque wrench. Complete tightening shall be accomplished in stages and the final torque values shall be as shown in the following table:

| Pipe Size<br>(inches) | Final Torque<br>(foot-pounds) |
|-----------------------|-------------------------------|
| 1/2 to 1-1/2          | 10 to 15                      |
| 2 to 3                | 20 to 30                      |

### 3.04 INSTALLATION OF STAINLESS STEEL BOLTS AND NUTS

- A. See Section 15055, Piping Systems—General.

### 3.05 THREADED JOINTS

- A. Cut threaded ends on PVC to the dimensions of ASME B1.20.1. Ends shall be square cut. Follow the pipe manufacturer's recommendations regarding pipe hold-down methods, saw cutting blade size, and saw cutting speed.
- B. Pipe or tubing cutters shall be specifically designed for use on PVC pipe. Use cutters manufactured by Reed Manufacturing Company, Ridge Tool Company, or equal.
- C. If a hold-down vise is used when the pipe is cut, insert a rubber sheet between the vise jaws and the pipe to avoid scratching the pipe.
- D. Thread cutting dies shall be clean and sharp and shall not be used to cut materials other than plastic.
- E. Apply Teflon® thread compound or Teflon® tape lubricant to threads before screwing on the fitting.

### 3.06 INSTALLING UNIONS

- A. Provide unions on exposed (above grade and in vaults) piping 3 inches and smaller as follows:
  1. At every change in direction (horizontal and vertical).
  2. Six to 12 inches downstream of valves.

3. Every 40 feet in straight pipe runs.
4. Where shown on the Drawings.

### 3.07 INSTALLING BURIED PIPE

- A. Install in accordance with Section 02305, Earthwork for Utilities, and as follows.
- B. Trench bottom shall be continuous, smooth, and free of rocks. See the details on the Drawings for trench dimensions, pipe bedding, and backfill.
- C. After the pipe has been solvent-welded and the joints have set, snake the pipe in the trench according to the pipe manufacturer's recommendations to allow for thermal expansion and contraction of the pipe.
- D. Do not backfill the pipe trench until the solvent-welded joints have set. Support the pipe uniformly and continuously over its entire length on firm, stable soil. Do not use blocking to change pipe grade or to support pipe in the trench.
- E. Install buried PVC pipe in accordance with ASTM D2774 and the pipe manufacturer's recommendations. Backfill materials in the pipe zone shall be imported sand as specified in Section 02305, Earthwork for Utilities. If water flooding is used, do not add successive layers unless the previous layer is compacted to 90% relative compaction.

### 3.08 INSTALLING ABOVEGROUND OR EXPOSED PIPING

- A. See Section 15055, Piping Systems—General.
- B. Fill empty piping with water, provide temporary shading, or use other means to keep the surface temperature of the pipe below 100°F.

### 3.09 PAINTING AND COATING

- A. Coat piping that is exposed to sunlight as specified Section 09900, Painting and Coating, System No. 51.

### 3.10 PIPE LABELS AND COLOR CODING

- A. Label and color code exposed piping and piping inside concrete pipe trenches with flow stream identification labels and banding in accordance with Section 15075, Process Equipment, Piping, and Valve Identification, and the Piping Schedule on the Drawings.

### 3.11 HYDROSTATIC TESTING

- A. Perform hydrostatic testing for leakage in accordance with Section 15144, Pressure Testing of Piping.

END OF SECTION

**SECTION 15860**  
**ODOR CONTROL SYSTEM EQUIPMENT**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. The Contractor shall furnish and install all equipment and materials necessary to reconnect the existing Odor Control System to the new Sludge Holding Tank Cover. The Contractor shall be responsible for providing additional interconnecting ducting as necessary to meet the new point of connection and all necessary accessories to perform this work.

**1.02 SUBMITTALS**

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Complete Shop Drawings for the all piping and ductwork for review by the Engineer.
- B. Shop Drawings: The following information for approval before equipment is fabricated:
  - 1. Drawings of system showing piping, mounting details, fitting size and location, and sufficient information to allow the Engineer to check clearances, connections, and conformance with the Specifications.
  - 2. Materials of construction of all equipment.
  - 3. Reference list demonstrating minimum qualifications as required in Paragraph 1.04 below.

**1.03 REFERENCES**

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American Society of Testing and Materials (ASTM)
  - 1. ASTM D883—Standard Terminology Relating to Plastics.
  - 2. ASTM D2563—Standard Practice for Classifying Visual Defects in Glass-Reinforced Plastic Laminate Parts.

3. ASTM D2583—Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.
  4. ASTM D3299—Standard Specification for Filament-Wound Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks.
  5. ASTM D4097—Standard Specification for Contact-Molded Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks.
- B. American Society of Mechanical Engineers (ASME)
1. ASME RTP 1—Reinforced Thermoset Plastic Corrosion-Resistant Equipment.
- C. National Bureau of Standards (NBS)
1. NBS PS 15-69—Voluntary Product Standard – Custom Contact-Molded Reinforced-Polyester Chemical-Resistant Process Equipment.
- D. National Fire Protection Association (NFPA)
1. NFPA 820—Standard for Fire Protection in Wastewater Treatment and Collection Facilities.

## 1.04 QUALITY ASSURANCE

- A. Manufacturer: The products furnished under this Section shall be manufactured by a manufacturer who has been regularly engaged in the design and manufacture of the equipment and who has a minimum of 5 years experience in design, fabrication, and testing of biological odor-control systems. The odor-control system manufacturer shall show evidence of at least five identical installations in satisfactory operation in wastewater treatment plant facilities for at least 5 years. Any proposed non-specified manufacturers shall demonstrate to the satisfaction of the Engineer and Owner that the quality of their equipment is equal to that made by those manufacturers specifically named in this Section.
- B. Inspection and Testing Requirements: The Engineer reserves the right to reject delivery of any or all pieces of equipment found upon inspection to have any or all of the following: blisters, chips, crazing, exposed glass, cracks, burned areas, dry spots, foreign matter, surface porosity, sharp discontinuity, or entrapped air at

the surface of the laminate. Any item that does not satisfy the tolerances below shall be rejected:

| Defect              | Inside Surface   | Outside Surface  |
|---------------------|--|--|
| Blister             | None   | Max. dimensions: 1/4 inch diameter by 1/8 inch high; Maximum density: 1 per square foot; Minimum separation: 2 inches apart  |
| Chips               | None   | Maximum dimension of break: 1/4 inch and thickness no greater than 10% of wall thickness; Maximum density: 1 per square foot |
| Crazing             | None   | Maximum length: 1/2 inch; Maximum density: 5 per square foot; Minimum separation: 2 inches                                   |
| Cracks              | None   | None   |
| Exposed Glass       | None   | None   |
| Scratches           | None   | Maximum length: 1 inch; Maximum depth: 0.010 inch  |
| Burned Areas        | None   | None   |
| Surface Porosity    | None   | None   |
| Foreign Matter      | None   | None   |
| Sharp Discontinuity | None   | None   |
| Pits                | Maximum 1/8 inch diameter by 1/32 inch deep; Maximum: 10 per square foot | Maximum 1/8 inch diameter by 1/16 inch deep; Maximum 10 per square foot  |
| Dry Spot            | None   | 2 square inches per square foot  |
| Entrapped Air       | None at the surface 1/16 inches and 10 per square inch maximum           | 1/8 inch and 4 per square inch or 1/16 inch and 10 per square inch within laminate   |

- C. The Engineer reserves the right to be present at the fabricator's facility for visual inspection of equipment to be supplied.
- D. Upon completion of the installation, the material shall be tested for satisfactory operation without excessive vibration, overheating, etc. Compliance shall be based on the equipment manufacturer's specifications and all applicable costs and standards. All equipment must be adjusted and checked for misalignment, clearances, supports, and adherence to safety standards.

## 1.05 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

- B. The manufacturer shall warrantee the material and workmanship, for 1 year from the day of beneficial occupancy. This period shall not extend beyond 18 months after delivery of equipment to the job site.

## 1.06 OPERATION AND MAINTENANCE (O&M) MANUALS

- A. O&M Manuals shall be in accordance with General Conditions, Supplementary Conditions, and Section 01830, Operations and Maintenance Manuals.

## PART 2 PRODUCTS

### 2.01 GENERAL

- A. The manufacturer shall provide the odor-control connection interduct and piping system as specified. The system shall be designed for continuous, automatic operation. The materials shall be designed to withstand a temperature up to 120°F. If required for NFPA 820 compliance, the Contractor shall mount the control panel remotely, at least 3 feet from the airstream.

### 2.02 DESIGN AND PERFORMANCE CRITERIA

- A. Design and Performance Criteria:

1. Criteria: The system shall be capable of removing foul air at a rate no lower than the rate shown on the following table.
2. Foul air removed from the facility will have an average and peak concentration of hydrogen sulfide (H<sub>2</sub>S) and design air flow rate as listed in the following table.

| System I.D.                           | Air Flow Rate,<br>cfm | Ave. Inlet H <sub>2</sub> S<br>Conc. | Peak H <sub>2</sub> S Conc. |
|---------------------------------------|-----------------------|--------------------------------------|-----------------------------|
| Stagnant Conditions<br>Six Mile Creek | 0                     | 900 ppm                              | 1,000 ppm                   |
| Stagnant Conditions<br>Grovewood      | 0                     | 230 ppm                              | 300 ppm                     |
| ZB-8000                               | 1,400 cfm             | 90 ppm                               | 100 ppm                     |

## 2.03 MULTI-STAGE FRP PACKAGED BIOLOGICAL ABSORPTION/ADSORPTION SYSTEM

### A. Material of Construction:

1. The interduct, piping, and accessories shall be contact molded manufactured in accordance with NBS PS 15-69, ASTM D4097 for contact molding unless otherwise noted by the cover manufacturer. Any material of construction other than FRP with premium grade resin will not be allowed.
2. Resin used in the system liner shall be a premium vinyl ester type such as Hетron 922 by Ashland Chemicals, Derakane 411 by Dow Chemical, Vipel F010 by AOC, or approved equal. The resin shall be reinforced with an inner veil of a suitable synthetic organic fiber such as Nexus 111-00010.
3. Reinforcement: Glass-fiber reinforcement used shall be commercial grade corrosion-resistance borosilicate glass.
  - a. All glass-fiber reinforcement shall be Type C, chemical grade, Type E electrical grade.
  - b. Surfacing veil shall be 10-mil Nexus 111-00010 or equal.
  - c. Mat shall be Type "E" (electrical grade) glass, 1 1/2 ounces per square foot with a nominal fiber length of  $1.25 \pm 0.25$  inches, with a silane finish and styrene soluble binder.
  - d. Continuous glass roving used in chopper gun spray-up applications shall be Type "E" grade with chrome or silane coupling agent.
  - e. Alternate layers of mat and woven roving used for reinforcement.
4. Miscellaneous:
  - a. Stainless Steel: Unless otherwise specified, all fasteners and metal attachments, such as anchors, brackets, etc., shall be ANSI 316SS.
  - b. Gaskets: Unless otherwise specified, all gaskets shall be EPDM.

### B. Fabrication:

1. General: Fabrication shall be in accordance with NBS PS 15-69, ASTM D3299, and ASTM D4097. All non-molded surfaces shall be coated with resin incorporating paraffin to facilitate a full cure of the surface. All cut edges, bolt holes, and secondary bonds shall be sealed with a resin coat before the final paraffinated resin coat. All voids shall be filled with a resin paste.

2. Corrosion Liner: The inner surface of all laminates shall be resin rich and reinforced with one NEXUS 111-00010 with a minimum thickness of 10 mils. The interior corrosion layer shall consist of two layers of 1-1/2 ounces per square foot chopped strand mat. If the application is by chopper gun spray up the glass fiber shall be 1/2 to 2 inches long. The total corrosion liner thickness shall be a minimum of 100 mils and have a resin-to-glass ratio of 80/20. All edges of reinforcement to be lapped a minimum of 1 inch.
  3. Structural Laminate: Structural laminates shall consist of alternating layers of 1-1/2 ounces per square foot mat or chopped glass and 24 ounces per square yard woven roving applied to reach a designed thickness. Actual laminate sequences shall be according to the laminate tables shown on fabrication drawings. The exterior surface shall be relatively smooth and shall have no glass fibers exposed. The exterior shall be surface coated with gel coat containing ultraviolet light inhibitors.
- C. Accessories: Air inlet, air outlet, and all connections shown on the Drawings shall be provided by the manufacturer. All external bolts shall be 316SS and designed for the specified loads. Interior fasteners, if applicable, shall be of corrosion-resistant materials such as PVC or FRP.

## 2.04 PIPING

- A. All make-up water and drain piping shall be SCH 80 PVC. The Contractor shall insulate and heat trace all external piping.

## 2.05 ROUND FRP DAMPERS

- A. The Contractor shall furnish and install round FRP single-blade fiberglass dampers at locations shown on plans or as requested by the cover manufacturer. The damper frame shall be of one-piece construction with a resin-rich interior corrosion barrier minimum of 100 mils. A structural lay-up shall consist of alternate layers of chopped strand mat and woven roving to conform to ASME RTP 1 and NBS PS 15-69. The glass-to-resin ratio shall be a minimum of 35% glass to 65% resin. Wall thickness, flange thickness, drilling pattern, and width shall conform to NBS PS 15-69. The exterior surface of the damper shall contain UV inhibitors and a gel-coat color to match the duct system.
- B. The damper blade shall be constructed of the same material as the damper frame and shall have a resin-rich surfacing veil on both sides. Blade stiffeners shall be FRP or FRP encapsulated as required for stiffness.
- C. The axle shall be fiberglass or 316 stainless steel, as required to meet corrosion-resistance requirements for the stagnant air conditions outlined in

Paragraph 2.02A.2. Leakage shall not exceed 3 cfm per square foot at 12 inches wc or 5.25 cfm per square foot at 30 inches wc as required in this Section for isolation. A damper shall be provided with a stainless-steel hand-locking quadrant, gear operators, chain wheel operators, or other actuation devices as required in this Section. All interior metal shall be 316 stainless steel. Gaskets shall be EPDM. Other gasket materials shall be available upon request.

- D. All FRP fabrication shall meet or exceed quality requirements of NBS PS 15-69 and ASME RTP 1. The damper shall be Belco Mfg. Model 201 or approved equal as coordinated with the cover manufacturer.

### PART 3 EXECUTION

#### 3.01 START-UP AND TRAINING

- A. The services of a factory representative may be requested by the Engineer or Owner to ensure proper installation and start-up of the system. The manufacturer shall make any changes to the system that may be necessary to meet the specified performance under inlet conditions as specified.

END OF SECTION

**DIVISION 16**  
**ELECTRICAL**

**SECTION 16050**  
**ELECTRICAL—GENERAL PROVISIONS**

**PART 1 GENERAL**

**1.01 DESCRIPTION**

**A. Scope of Work**

1. Furnish all labor, materials, equipment and incidentals required for a complete electrical system as hereinafter specified and shown on the Drawings, whether or not specifically shown or called for.
2. The work, apparatus and materials which shall be furnished under these Specifications and accompanying Drawings shall include all items listed hereinafter and/or shown on the Drawings. All materials necessary for the complete installation shall be furnished and installed by the Contractor to provide complete power, generator, lighting systems, instrumentation, wiring and control systems as indicated on the Drawings and/or as specified herein whether or not specifically shown or called for. Certain equipment will be furnished as specified in other Section of this specification which will require conduit and wire to complete the installation as required.
3. The Contractor shall furnish and install the necessary cables, transformers, motor control centers, protective devices (surge protection), conductors, exterior electrical system, etc., to serve motor loads, lighting loads and miscellaneous electrical loads as indicated on the Drawings and/or as specified hereinafter.
4. The work shall include complete testing of all equipment and wiring at the completion of the work and making any minor connection changes or adjustments necessary for the proper functioning of the system and equipment. All workmanship shall be of the highest quality; substandard work will be rejected.
5. Provide permitting and acceptance testing.
6. Make all field connections to process instrument panels and other control panels furnished under other Divisions of these Specifications.
7. For process instrumentation furnish and install all conduit, wire and interconnections between primary elements, transmitters, local indicators and receivers. Coordinate wire termination with the instrumentation supplier.
8. It is the intent of these Specifications that the electrical system shall be suitable in every way for the service required. All material, equipment, appliances and all work which may be reasonably implied as being incidental to the work of this Section shall be furnished at no extra cost.

9. Each bidder or his authorized representatives shall, before preparing a bid, visit all areas of the existing building and/or proposed site in which work will take place and be performed to inspect carefully the present installation and conditions. The submission of the bid by this bidder shall be considered evidence that the bidder has visited the project and noted the locations and conditions under which the work will be performed and that the bidder takes full responsibility for a complete knowledge of all factors governing his work.
10. All necessary temporary power requirements are the responsibility of the Contractor and shall be furnished at no extra cost to the Owner.
11. All necessary temporary power, control and instrumentation requirements are the responsibility of the Contractor and shall be furnished at no extra cost to the Owner. Power and controls shall be furnished to all existing equipment at all times.

B. Codes, Inspections and Fees

1. All material and installation shall be in accordance with the latest edition of the National Electrical Code and all applicable national, local and state codes.
2. Pay all fees required for permits, inspections, and connections.

C. Tests

1. Test all systems and repair or replace all defective work. Make all necessary adjustments to the systems and instruct the Owner's personnel in the proper operation of the systems.

D. Interpretation of Drawings

1. The Drawings are not intended to show exact location, quantity or size of conduit runs. All installation of the raceway system shall be as directed by approved shop drawing. Any installation of a raceway system before shop drawing submittal and approval will at the sole risk of the Contractor.
2. All three-phase circuits shall be run in separate conduits unless otherwise shown on the Drawings.
3. Unless otherwise approved by the Engineer, conduit shown exposed shall be installed exposed; conduit shown concealed shall be installed concealed.
4. Where circuits are shown as "home-runs" all necessary fittings and boxes shall be provided for a complete raceway installation.
5. The Contractor shall harmonize the work of the different trades so that interferences between conduits, piping, equipment, architectural and structural work will be avoided. All necessary offsets shall be furnished so as to take up a minimum space and all such offsets, fittings, etc.,

required to accomplish this shall be furnished and installed by the Contractor without additional expense to the Owner. In case interference develops, the Owner's authorized representative is to decide which equipment, piping, etc., must be relocated, regardless of which was installed first.

6. Verify with the Engineer exact locations and mounting heights of lighting fixtures, switches and receptacles prior to installation.
7. The locations of equipment, fixtures, outlets, and similar devices shown on the Drawings are approximate only. Exact locations shall be as approved by the Engineer during construction. Obtain in the field all information relevant to the placing of electrical work and, in case of any interference with other work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the work in an approved manner.
8. Surface mounted panel boxes, junction boxes, conduit, etc., shall be supported by spacers to provide a clearance between wall and equipment.
9. Circuit layouts shown are not intended to show the number of fittings, or other installation details. Furnish all labor and materials necessary to install and place in satisfactory operation all power, lighting, and other electrical systems shown. Additional circuits shall be installed wherever needed to conform to the specific requirements of the equipment.
10. The ratings of motors and other electrically operated devices together with the size shown for their branch circuit conductors and conduits are approximate only and are indicative of the probable power requirements insofar as they can be determined in advance of the purchases of the equipment.
11. All connections to equipment shall be made as shown, specified, required, and directed and in accordance with the approved shop drawings, regardless of the number of conductors shown on the Electrical Drawings.

#### E. Size of Equipment

1. Investigate each space in the building through which equipment must pass to reach its final location. If necessary, the manufacturer shall be required to ship his material in sections sized to permit passing through such restricted areas in the building.
2. The equipment shall be kept upright at all times. When equipment has to be tilted for each of passage through restricted areas during transportation, the manufacturer shall be required to brace the equipment suitably, to insure that the tilting does not impair the functional integrity of the equipment.

F. Component Interconnections

1. Component equipment furnished under this Specification will not be furnished as integrated systems.
2. Analyze all systems components and their shop drawings; identify all terminals and prepare drawings or wiring tables necessary for component interconnection.

G. Record Drawings

1. As the work progresses, legibly record all field changes on a set of project Contract Drawings. When the project is complete furnish a complete set of reproducible "as-built" drawings for the Project Record Documents, Section 01785, Record Documents.

## 1.02 SUBMITTALS

A. Material and Shop Drawings

1. As specified under Section 01330, Submittals and Acceptance, shop drawings shall be submitted for approval of all materials, equipment, apparatus, and other items as required by the Engineer.
2. Shop drawings shall be submitted for the following equipment:
  - a. Motor Control Centers.
  - b. Disconnect Switches.
  - c. Wire and Cable.
  - d. Supporting Devices.
  - e. Variable Frequency Drives.
  - f. Test Data.
  - g. Generator.
3. The manufacturers' name and product designation or catalog numbers shall be submitted for the following material:
  - a. Conduit.
  - b. Receptacles.
  - c. Boxes and Fittings.
  - d. Switches.
  - e. Lamps.
  - f. Control Relays.
4. Prior to submittal by the Contractor, all shop drawings shall be checked for accuracy and contract requirements. Shop drawings shall bear the date

checked and shall be accompanied by a statement that the shop drawings have been examined for conformity to Specifications and Drawings. This statement shall also list all discrepancies with the Specifications and Drawings. Shop drawings not so checked and noted shall be returned.

5. The Engineer's check shall be only for conformance with the design concept of the project and compliance with the Specifications and Drawings. The responsibility of, or the necessity of, furnishing materials and workmanship required by the Specifications and Drawings which may not be indicated on the shop drawings is included under the work of this Section.
6. The responsibility for all dimensions to be confirmed and correlated at the job site and for coordination of this work with the work of all other trades is also included under the work of this Section.
7. No material shall be ordered or shop work started until the Engineer's approval of shop drawings has been given.

B. Manufacturer's Services

1. Provide manufacturer's services for testing and start-up of the following equipment:
  - a. Motor Control Centers.
  - b. Variable Frequency Drives.
  - c. 480-volt Switchgear.
2. Manufacturers of the above-listed equipment shall provide an experienced Field Service Engineer to accomplish the following tasks:
  - a. The equipment shall be visually inspected upon completion of installation and prior to energizing to assure that wiring is correct, interconnection complete and the installation is in compliance with the manufacturer's criteria. Documentation shall be reviewed to assure that all Drawings, operation and maintenance manuals, parts list and other data required to check out and sustain equipment operation is available on site. Documentation shall be red-lined to reflect any changes or modifications made during the installation so that the "as-built" equipment configuration will be correctly defined. Spare parts shall be inventoried to assure correct type and quantity.
  - b. The Field Service Engineers shall provide engineering support during the energizing and check out of each major equipment assembly. They shall perform any calibration or adjustment

- required for the equipment to meet the manufacturer's performance specifications.
- c. Upon satisfactory completion of equipment test, they shall provide engineering support of system tests to be performed in accordance with manufacturer's test specifications.
  - d. Three (3) 4-hour training sessions (one for each system) on operation, and two (2) 4-hour training sessions (one for each system) on maintenance and trouble-shooting procedures shall be provided for the Owner's maintenance personnel. All training shall be conducted at a facility provided by the Owner. The maintenance and trouble-shooting sessions shall be conducted with record "as-built" electrical drawings sufficient for a class of eight personnel.
  - e. A final report shall be written and submitted to the Contractor within fourteen days from completion of final system testing. The report shall document the inspection and test activity, define any open problems and recommend remedial action.

## PART 2 PRODUCTS

### 2.01 MATERIALS AND EQUIPMENT

- A. The materials used in all systems shall be new, unused and as hereinafter specified. All materials where not specified shall be of the very best of their respective kinds. Samples of materials or manufacturer's specifications shall be submitted for approval as required by the Engineer.
- B. Materials and equipment used shall be Underwriters Laboratories, Inc., listed.
- C. Electrical equipment shall, at all times during construction, be adequately protected against mechanical injury or damage by water. Electrical equipment shall not be stored out-of-doors. Electrical equipment shall be stored in dry permanent shelters. If any apparatus has been damaged, such damage shall be repaired by the Contractor at his own cost and expense. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and put through such special tests as directed by the Engineer, at the cost and expense of the Contractor, or shall be replaced by the Contractor at his own expense.
- D. Surface mounted raceways and boxes mounted on tanks. Tanks walkways shall be stainless steel as noted on drawings. All fasteners shall be type 316 stainless steel.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Provide and place all sleeves for conduits penetrating floors, walls, partition, etc. Locate all necessary slots for electrical work and form before concrete is poured.
- B. All cutting and patching shall be done in a thoroughly workmanlike manner.

### 3.02 INSPECTION AND TESTING

- A. Test all systems and repair or replace all defective work. Make all necessary adjustments to the systems and instruct the Owner's personnel in the proper operation of the systems.

END OF SECTION

**SECTION 16060**  
**POWER DISTRIBUTION SYSTEM COORDINATION STUDY**

**PART 1 GENERAL**

**1.01 DESCRIPTION**

- A. Scope
  - 1. The Contractor shall provide all labor, materials, equipment, services and incidentals required to perform Power System Studies and distribution system field testing.
- B. The Power System Studies shall include a Short Circuit Study, a Protective Device Evaluation Study, Arc Flash Study and a Protective Device Coordination Study for a completely coordinated Power Distribution System.

**1.02 REFERENCES**

- A. Standards referenced in this Section are listed below:
  - 1. American National Standards Institute, (ANSI)
    - a. ANSI C37.04, Rating Structure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
    - b. ANSI C37.010, Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Basis.
  - 2. Institute of Electrical and Electronics Engineers, (IEEE)
    - a. IEEE 141, Electric Power Distribution in Industrial Plants.
    - b. IEEE 399, Recommended Practice for Industrial and Commercial Power System Analysis.
  - 3. National Electrical Code, (NEC)

## 1.03 QUALITY ASSURANCE

### A. Source Quality Control:

1. Retain the services of a Registered Professional Engineer, to perform the Power System Studies and field services. The Registered Professional Engineer shall be from an independent consulting firm or from the manufacturer of the power distribution equipment.
  2. Coordinate with the Engineer performing the studies and assist him in the collection
  3. All information pertaining to the existing system necessary to perform the studies shall be obtained in advance before performing the studies.
  4. All motor starting and transformer information shall be based upon the equipment installed distribution system. The Field Engineer shall be from the manufacturer of the power distribution equipment.
  5. The Studies shall utilize the existing working SKM model provided by the Owner.
- B. All test equipment and instrument calibration shall be in accordance with the latest edition of the accuracy standard of the U.S. National Institute of Standards and Technology.

## 1.04 SUBMITTALS

### A. Shop Drawings: Submit the following:

1. Copies of calculations and results of the Short Circuit Study, Protective Device Evaluation and Coordination Studies in a report format. The report shall be stamped and signed by the Registered Professional Engineer.
2. Work sequence for the field testing shall be submitted in advance before performing tests. The sequence shall indicate the schedule of work, time frame and downtime for the equipment.
3. Time current curves for all protective devices included within the power system studies.

### B. Reports

1. Field test report shall be submitted.

## PART 2 PRODUCTS

### 2.01 POWER SYSTEM STUDIES

#### A. General

1. Provide a current and complete Short Circuit Study, Protective Device Evaluation Study, and a Protective Device Coordination Study for the Electrical Distribution System.
2. The studies shall include all portions of the high and low voltage electrical distribution system from the normal and alternate sources of power through the low- voltage distribution system. Normal system operating method, alternate operation, and operations which could result in maximum fault conditions shall be thoroughly covered in the study.
3. Problem areas or equipment inadequacies shall be promptly brought to the Engineer's attention.

#### B. Short Circuit Study

1. The Short Circuit Study shall be performed with the aid of a computer program.
2. The study input data shall include the utility company's short circuit, single and three phase contributions, with the X/R ratio, the resistance and reactance components of and all other applicable circuit parameters.
3. Short-circuit momentary duties and interrupting duties shall be calculated on the basis of maximum available fault current at each switchgear bus, switchboard, motor control center, distribution panelboard, pertinent branch circuit panelboards, and other significant locations through the system.
4. The short circuit tabulations shall include symmetrical fault currents, and X/R ratios. For each fault location, the total duty on the bus, as well as the individual contribution from each connected branch, including motor back EMF current contributions shall be listed with its respective X/R ratio.

#### C. Protective Device Evaluation Study

1. A Protective Device Evaluation Study shall be performed to determine the adequacy of circuit breakers, controllers, surge arresters, busways, switches, and fuses by tabulating and comparing the short-circuit ratings of these devices with the available fault currents.
2. Appropriate multiplying factors based upon system X/R ratios and protective device rating standards shall be applied.

#### D. Protective Device Coordination Study

1. A Protective Device Coordination Study shall be performed to select or to check the selections of the power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated voltage and current transformers, and low- voltage breaker trip characteristics and setting.
2. The overcurrent device settings computed in the Protective Device Coordination Study shall provide complete 100 percent selectivity. The system shall be selectively coordinated such that only the device nearest a fault will operate to remove the faulted circuit. System selectively shall be based on both the magnitude and the duration of a fault current.
3. The Protective Device Coordination Study shall include all voltage classes of equipment starting at the utility's incoming line protective device down to and including each of the medium and low voltage equipment. The phase and ground overcurrent and the phase and ground fault protection shall be included, as well as settings for all other adjustable protective devices.
4. The time-current characteristics of the installed protective devices shall be plotted on the appropriate log-log paper. Reasonable coordination intervals and separation of characteristic curves shall be maintained. The coordination plots for phase and ground protective devices shall be provided on a complete system basis. Sufficient curves shall be used to clearly indicate selective coordination achieved through the utility main breaker, power distribution feeder breakers, and the overcurrent devices at each major load center.
5. There shall be a maximum of eight protective devices per plot. Each plot shall be appropriately titled. Plots shall include the following information as required for the circuits shown:
  - a. Representative one-line diagram, legends and types of protective devices selected.
  - b. Power company's relays or fuse characteristics.
  - c. Significant motor starting characteristics.
  - d. Parameters of transformers, ANSI magnetizing inrush and withstand curves.
  - e. Operating bands of low voltage circuit breaker trip curves, and fuse curves.
  - f. Relay taps, time dial and instantaneous trip settings.

- g. Cable damage curves.
  - h. Symmetrical and asymmetrical fault currents.
6. 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, manufacturer, type, range of adjustment, and recommended settings. A tabulation of the recommended power fuse selection shall be provided for all fuses in the system.

#### E. Arc Flash Hazard Study

1. An Arc Flash Hazard Study shall be performed for the electrical distribution system shown on the one-line drawings. The intent of the Arc Flash Hazard Study is to determine hazards that exist at each major piece of electrical equipment shown on the one-line drawing. This includes switchgear, switchboards, panelboards, motor control centers and transformers. The study shall include creation of Arc Flash Hazard Warning Labels listing all items. The Contractor will install the labels. The arc flash hazard study shall consider all operating scenarios during normal conditions alternate operations, emergency power conditions, and any other operations, which could result in maximum arc flash hazard

## 2.02 STUDY REPORT

- A. The results of the Power Distribution System Coordination Study shall be summarized in a final typewritten report. The report shall include the following Sections:
1. Description, purpose, basis, written scope, and a single-line diagram of the Power Distribution System which is included within the scope of the study.
  2. Tabulations of circuit breaker, fuses, and other equipment ratings versus calculated short-circuit duties, and commentary regarding same.
  3. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.
  4. Fault current tabulation including a definition of terms and a guide for interpretation.
  5. Tabulation of appropriate tap settings for relay seal-in units.
  6. Tabulation of equipment survey information.

## PART 3 EXECUTION

### 3.01 FIELD SERVICES

- A. The Registered Professional Engineer shall conduct an equipment survey of devices and information necessary to perform the Power System Studies.
- B. The survey shall include the following information to the extent applicable:
  - 1. Manufacturer, type and size of each power fuse.
  - 2. Manufacturer, type, model and settings for each protective relay, trip unit and circuit breaker.
  - 3. Current transformer ratios for each protective relay.
  - 4. Appropriate data of motors and transformers included with the study.
- C. The Registered Professional Engineer, as part of the field service Work, shall collect all data and coordinate with the equipment vendors to establish the proper settings for the actual devices provided.

### 3.02 FIELD TESTING

- A. Provide field testing of the distribution system in accordance with the manufacturer's recommendations. All field testing shall be performed by the Field Engineer, after the completion and approval of the Power System Studies. The field-testing results shall be documented within a report, with the final settings of all protective devices.
- B. The Field Engineer with necessary tools and equipment shall adjust, set, calibrate and test all protective devices. All protective relays and meters in the medium and low voltage equipment shall be set, adjusted, calibrated and tested in accordance with the manufacturer's 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 lubrication necessary to achieve proper operation shall be considered part of this Contract.
- D. All solid-state trip devices shall be set including all required programming necessary for the protection required. The devices shall be checked and tested for

setting and operation. Circuit breakers and/or contactors associated with the trip devices shall be tested for trip and close function with their protective device.

### 3.03 MAINTENANCE OF OPERATIONS

- A. Since the field-testing work specified may require that certain pieces of equipment be taken out of service, the Contractor shall perform the Work with due regard to maintenance of operations and construction staging in accordance with the requirements of this Section with the Owner's operation. All testing procedures and schedules must be scheduled in advance before any work beginning.

END OF SECTION

**SECTION 16110**  
**RACEWAYS AND FITTINGS**

**PART 1 GENERAL**

**1.01 DESCRIPTION**

**A. Scope of Work**

1. Furnish and install complete raceway systems as shown on the Drawings and as specified herein.

- B. The complete raceway system rigid aluminum above grade and PVC-40 below grade.

**1.02 QUALITY ASSURANCE**

**A. Qualifications**

1. The equipment shall be products of manufacturers who are fully experienced, reputable and qualified in the manufacture of the equipment to be furnished. The system components shall be designed, constructed, delivered and installed in accordance with the best practices and methods.

**B. Standards**

1. Underwriters Laboratories, Inc. (UL).
2. American Society for Testing and Materials, (ASTM).
3. Federal Specifications.

**C. Manufacturers**

1. Non-Metallic Raceways.

- a. Carlon.
- b. Triangle Pipe and Tube Co.
- c. Phillips Petroleum Co.
- d. Indian Head Company.
- e. Or equal.

2. Metallic Raceways:

- a. Youngstown Sheet and Tube Co.
- b. Allied Tube and Conduit Corp.
- c. Wheeling-Pittsburg Steel Corp.
- d. Or equal.

1.03 SUBMITTALS

A. Material and Shop Drawings

- 1. Copies of all materials required to establish compliance with these specifications shall be submitted in accordance with the provisions of the General Conditions. Submittals shall include at least the following:
  - a. Certified shop drawings with performance data and physical characteristics.
  - b. Descriptive literature, bulletins, and/or catalogs of each item of equipment.
  - c. All information required by Section 01330, Submittals and Acceptance.
  - d. A complete total bill of materials for all equipment.
- 2. In the event that it is impossible to conform with certain details of the specifications, describe completely all non-conforming aspects of the Shop Drawing transmittal.

PART 2 PRODUCTS

2.01 GENERAL

- A. The specifications are intended to give a general description of what is required, but do not cover all details which may vary in accordance with the exact requirements of the equipment as offered. They are, however, intended to cover the furnishing, delivery, installation and field testing of all materials, equipment and apparatus as required. Any additional auxiliary equipment necessary for the proper operation of the proposed installation not mentioned in these specifications or shown on the Drawings shall be furnished and installed.
- B. The material covered by these specifications is intended to be standard equipment of proven ability and as manufactured by reputable concerns having experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with best practice and methods and shall operate satisfactorily when installed as shown on the Drawings.

## 2.02 MATERIALS AND EQUIPMENT

### A. Metallic Conduit

1. ALUM conduit shall contain less than 0.1 percent copper and conform to Federal Specification WW-C-540C.

### B. Non-Metallic Conduit and Fittings

1. PVC conduit shall be schedule 80 composed of High Impact PVC (polyvinyl) chloride (C-200 Compound), and shall conform to industry standards, and be UL listed in accordance with Article 347 of National Electrical Code for underground and exposed use. Materials must have tensile strength of 55 PSI, at 70 degrees F, flexural strength of 11,000 PSI, compression strength of 8600 PSI. Manufacturer shall have five years' extruding PVC experience.
2. Liquidtight Flexible Conduit and Fittings shall be for use per Article 351 of the NEC. PVC compounds shall not include fillers. Fittings shall be manufactured from high impact PVC.

### C. Liquidtight, Flexible Non-Metallic Conduit, Couplings, and Fittings

1. Liquidtight, flexible non-metallic conduit shall be all PVC conduit and manufactured by Thomas and Betts Co., K-Flex, Inc., or equal.
2. Fittings used with Liquidtight flexible conduit shall be of the non-metallic type as manufactured by the Thomas and Betts Co., Xtraflex System, K-Flex, Inc., or equal.

### D. Flexible Couplings

1. Flexible Couplings shall be as manufactured by the Thomas and Betts Co., K-Flex, Inc., or equal.

### E. Conduit hubs shall be as manufactured by Myers Electric Products, Inc., Raco, Div., Appleton Electric Co., or equal.

### F. Conduit wall seals shall be Type WSK as manufactured by the O.Z. Electrical Mfg. O., or equal.

### G. Combination expansion-deflection fittings shall be Type XD as manufactured by the Crouse-Hinds Co., or equal.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Installation shall be in strict accordance with the manufacturer's instructions and recommendation, in the location shown on the Drawings.
- B. No conduit smaller than 1/2-inch electrical trade size shall be used, nor any have more than three 90-degree bends in any one run. Pull boxes shall be provided as required or directed. Minimum size floor conduit shall be 3/4-inch.
- C. No wire shall be pulled until the conduit system is complete in all details; in the case of concealed work, until all rough plastering or masonry has been completed; in the case of exposed work, until the conduit system has been completed in every detail.
- D. The ends of all conduit shall be tightly plugged to exclude dust and moisture while the buildings are under construction.
- E. Conduit supports shall be spaced at intervals of 4 feet or less, as required to obtain rigid construction. Conduit straps shall be type as manufactured by "CLIC".
- F. Single conduits shall be supported by means of one-hole non-metallic pipe clamps in combination with one-screw back plates, to raise conduits from the surface. Multiple runs of conduits shall be supported on trapeze type hangers with fiberglass horizontal members and fiberglass treaded hanger rods. The rods shall be not less than 3/8-inch diameter.
- G. Conduit hangers shall be attached to structural steel by means of non-metallic beam or channel clamps. Where attached to concrete surfaces, concrete inserts of the spot type shall be provided.
- H. All conduits on exposed work shall be run at right angles to and parallel with the surrounding wall and shall conform to the form of the ceiling. No diagonal runs will be allowed. Bends in parallel conduit runs shall be concentric. All conduit shall be run perfectly straight and true.
- I. No broken run shall exceed 500 feet in length. This length shall be reduced by 75 feet for each 90-degree elbow.
- J. Conduit terminating in boxes shall have sealing double lock-nuts and insulating bushings.

- K. Conduit terminating in gasketed enclosures shall be terminated with sealing conduit hubs.
- L. Conduit wall seals shall be used for all conduits penetrating walls below grade or other locations shown on the Drawings.
- M. Liquidtight flexible metal conduit shall be used for all motor terminations and other outdoor equipment where vibration is present.
- N. Flexible couplings shall be used in hazardous locations for all motor termination and other equipment where vibration is present.
- O. Expansion fittings shall be installed in the following cases: In each conduit run wherever it crosses an expansion joint in the concrete building structure; in each conduit run which is mechanically attached to separate structures to relieve strain caused by shift on one structure in relation to the other; in straight conduit runs above ground which is more than one hundred feet long and interval between expansion fittings in such a run shall not be greater than 100 feet.
- P. PVC joints shall be solvent welded. Threads will not be permitted on PVC conduit and fittings. Installation of PVC conduit shall be in accordance with manufacturer's recommendations. PVC conduit shall not be used to support fixture or equipment. Field bends shall be made with approved hotbox. Heating with flame and hand-held dryers are prohibited.
- Q. Conduit installations on roofs shall be kept to a bare minimum. Conduit shall be supported above roof at least 6 inches using approved conduit supporting devices. Supports to be fastened to roof using roofing adhesive as approved by roofing contractor.
- R. Cables in vertical raceways shall be supported as per NEC Article 300-19. Provide and install supporting devices for cables, including any necessary accessible pullbox as required regardless if shown on drawings or not. Provide and install access panels as required. Coordinate location of pull box and access panel with the Engineer before installation. This includes empty raceways for future use.
- S. Provide and install pullboxes, junction boxes, fire barrier at fire rated walls, etc., as required by NEC Article 300, whether shown on drawings or not.
- T. Paint all field cut threads and coat all aluminum conduits in contact with concrete per manufacturer's recommendations.

- U. Raceways which do not have conductors furnished under this division of specification shall be left with an approved nylon pullcord in the raceway.
- V. Grounding conductor shall be included in total conduit fill determining conduit sizes, even though not included or shown on drawings. Grounding conductors run with feeders shall be bonded to portions of conduit that are metal by approved ground bushings.
- W. All aluminum conduits in contact with concrete shall be coated with bitumastic paint.

END OF SECTION

**SECTION 16120**  
**WIRES AND CABLES**

**PART 1 GENERAL**

**1.01 DESCRIPTION**

**A. Scope of Work**

1. Furnish, install and test all wire, cable and appurtenances as shown on the Drawings and as hereinafter specified.

**B. General Design**

1. Wire for lighting, and receptacle circuits in the administration building shall be type THHN solid.
2. Wire for all power feeder and motor circuits outside of the administration building shall be type THHN stranded.
3. Single conductor wire for control, indication and metering shall be type THHN No. 14 AWG, stranded.
4. Multi-conductor control cable shall be No. 14 AWG, stranded tinned copper.
5. Wire for process instrumentation shall be No. 16 AWG, stranded tinned copper.
6. Except for control and signal leads, no conductor smaller than No. 12 AWG shall be used.

**1.02 QUALITY ASSURANCE**

**A. Standards**

1. Insulated Cable Engineers Association (ICEA)
2. Underwriters Laboratories, Inc. (UL)
3. American Society for Testing and Materials (ASTM)

**B. Manufacturers**

1. 600-volt wire and cable:
  - a. Hi-Tech Cable Corp.
  - b. Collyer Insulated Wire Co.
  - c. Okonite Co.
  - d. Rome Cable Co.
  - e. American Insulated Wire Corp.
  - f. Triangle PWC, Inc.. Or equal

2. Instrumentation and control cable:

- a. American Insulated Wire Corp.
- b. Rome Cable Corp.
- c. Okonite Co.
- d. Eaton Corp. "Polyset".
- e. Triangle PWC, Inc.
- f. Or Equal.

**1.03 PRODUCT DELIVERY, STORAGE AND HANDLING**

- A. All conductors shall be carefully handled to avoid kinks or damage to the insulation.
- B. All conductors stored outdoors shall be covered.

**PART 2 PRODUCTS**

**2.01 GENERAL**

- A. Wires and cables shall be of annealed, 98 percent conductivity, soft drawn copper conductors.
- B. All conductors shall be stranded except lighting and receptacle circuits.

**2.02 MATERIALS**

A. 600-Volt Wire and Cable

- 1. Type THHN shall be PVC insulation with nylon jacket.

B. Instrumentation and Control Cable

- 1. Process instrumentation wire shall be twisted pair, 600-volt, cross linked polyethylene insulated, aluminum tape shielded, polyvinyl chloride jacketed, type "XLP". Multi-conductor cables with individually shielded twisted pairs shall be installed where indicated.
- 2. Multi-conductor control cable shall be stranded, 600-volt, cross-linked polyethylene insulated with PVC jacket, type "XLP".

C. Terminations and Splices

- 1. Unless otherwise indicated on the plans, no splices may be made in the cables without prior approval of the Engineer. Where splicing is approved,

the splicing material shall be as recommended and approved by the cable manufacturer.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. All conductors shall be carefully handled to avoid kinks or damage to insulation.
- B. Lubricants shall be used to facilitate wire pulling. Lubricants shall be UL listed for use with the insulation specified.
- C. Shielded instrumentation wire shall be installed from terminal to terminal with no splicing at any intermediate point.
- D. Shielded instrumentation wire shall be installed in rigid steel conduit and pull boxes that contain only shielded instrumentation wire. Instrumentation cables shall be separated from control cables in manholes.
- E. Shielding on instrumentation wire shall be grounded at one end only as directed by the supplier of the instrument.
- F. Wire and cable connections to terminals, splices, and taps shall be made with compression connectors. Connections of insulated conductors shall be insulated and covered. All connections shall be made using materials and installation methods in accordance with instructions and recommendations of the manufacturer of the particular item of wire and cable. The conductivity of all completed connections shall not be less than that of the uncut conductor. The insulation resistance of all completed connections of insulated conductors shall be not less than that of the uncut conductor.
- G. All wire and cable shall be continuous and without splices between points of connection to equipment terminals, except a splice will be permitted by the Engineer if the length required between the points of connection exceeds the greatest standard shipping length available from the manufacturer specified or as approved by the Engineer.
- H. Installed, unapproved wire shall be removed and replaced at no additional cost to the Owner.
- I. Steel fish tapes and/or steel pulling cables shall not be used in PVC raceway systems.

- J. Remove debris and moisture from the conduits, boxes, and cabinets before cable installation and mandrel with device of one size smaller than conduit and mandrel with wire brush one size larger than conduit.

### 3.02 TESTS

- A. All 600-volt wire insulation shall be tested with a megohm meter after installation. Tests shall be made at not less than 1,000-VDC. A cable test data form shall be provided for Engineer review.
- B. All service conductors shall be tested as in Paragraph A above. These tests shall be witnessed by the Engineer.

END OF SECTION

## SECTION 16130 BOXES

### PART 1 GENERAL

#### 1.01 DESCRIPTION

##### A. Scope of Work

1. Furnish and install all junction boxes, pull boxes, service entrance boxes and for a complete raceway system as shown on the Drawings and as specified herein.

##### B. General Design

1. Unless otherwise hereinafter specified or shown on the Drawings, all boxes and fasteners shall be type NEMA 4X, 316-stainless steel.
2. All boxes in air conditioning plenums above ceilings shall be pressed steel.
3. All boxes that do not receive devices are to have blank plates installed matching wiring device plates.

#### 1.02 QUALITY ASSURANCE

##### A. Standards

1. Underwriters Laboratories, Inc. (UL)
2. Federal Specifications (FS)
3. American Society for Testing and Material, (ASTM)

##### B. Manufacturers

1. Hoffman, Type CHNFSS.
2. Or Equal.

#### 1.03 SUBMITTALS

##### A. Materials and Shop Drawings

1. See Section 16050, Electrical—General Provisions.

## 1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Boxes and fittings shall be stored indoors protected from damage.

## 1.05 WARRANTY AND GUARANTEES

- A. All boxes and fittings shall be warranted against defects or failure for a period of one year from date of acceptance.

# PART 2 PRODUCTS

## 2.01 MATERIALS

- A. Boxes shall be constructed as follows:

1. 14-gauge 316L stainless steel.
2. Continuously welded and ground smooth, no holes or knockouts.
3. Seamless foam in-place gasket, watertight, dust-tight.
4. Stainless steel screws and clamps.

# PART 3 EXECUTION

## 3.01 INSTALLATION

- A. All boxes shall be supported away from surfaces.
- B. All boxes shall be sized per the National Electrical Code (NEC).
- C. All conduit entries into boxes shall not lower or change the NEMA rating of the box.

END OF SECTION

**SECTION 16140**  
**WIRING DEVICES**

**PART 1 GENERAL**

**1.01 DESCRIPTION**

**A. Scope of Work**

1. Furnish and install wiring devices and all necessary accessories and appurtenances required as hereinafter specified and shown on the Drawings.
2. Wiring devices shall include the following:
  - a. Wall Switches.
  - b. Device Plates.
  - c. Plugs.
  - d. Receptacles.
  - e. Lighting Control Time Clocks.
  - f. Lighting Contactors.
  - g. Control Stations.
  - h. Ground Fault Interrupter Receptacles.

**B. Related Work Described Elsewhere**

1. Electrical—General Provisions: Section 16050.
2. Raceways and Fittings: Section 16110.

**1.02 QUALITY ASSURANCE**

**A. Standards**

1. Underwriters Laboratories Inc. (UL).
2. National Electric Manufacturers Association (NEMA).
3. National Electrical Code (NEC).
4. Federal Specification (FS).

**B. Manufacturers**

1. Wall switches, device plates, plugs, and receptacles as follows:
  - a. Arrow-Hart.
  - b. Bryant.
  - c. Hubbell.

- d. Leviton.
  - e. or Equal.
2. Clocks:
- a. Simplex.
  - b. or Equal.
3. Lighting Contactors:
- a. Square-D.
  - b. Cutler-Hammer.
  - c. or Equal.
4. Dimmer Controls:
- a. Leviton.
  - b. Prescolite.
  - c. or Equal.
5. Control Stations:
- a. Hoffman Engineering Co.
  - b. Square-D.
  - c. Crouse-Hinds.
  - d. Or Equal.

## 1.03 SUBMITTALS

### A. Material and Shop Drawings

1. Submit material list and catalog cut-sheets for all items covered under this Section. Indicate type, ratings, material, color, and manufacturer.

## 1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- ### A. All devices covered under this Section shall be stored indoors, protected from damage.

## PART 2 PRODUCTS

### 2.01 MATERIALS

#### A. Switches

1. Wall switches shall be of the indicating, toggle action, flush mounting quiet type. All switches shall conform to FS W-S-896-D.
2. Wall switches shall be of the following types and manufacturer or equal. Any reference to a specific figure number of a specific manufacturer is for establishing a type and quality of product and shall not be considered as proprietary.
  - a. Single-pole – Arrow-Hart, Catalog No. 1991.
  - b. Double-pole – Arrow-Hart, Catalog No. 1992.
  - c. Three-way – Arrow-Hart, Catalog No. 1993.
  - d. Four-way – Arrow-Hart, Catalog No. 1994.
  - e. Single-pole, key-operated – Arrow-Hart Catalog No. 11991-L.
  - f. Momentary contact, two-circuit, center off – Arrow-Hart, Catalog No. 1895.
  - g. Weatherproof cover for Arrow-Hart 2900 series tap action switches – Arrow-Hart Catalog No. 2881-G.

#### B. Receptacles

1. Wall receptacles shall be of the following types and manufacturer or equal.
  - a. Single, 20A, 125V, 1P, 3W; Arrow-Hart, Catalog No 5351.
  - b. Duplex, 20A, 125V, 2P, 3W; Arrow-Hart, Catalog No. 5352.
  - c. Weatherproof, 20A, 125V, 2P, 3W; Arrow-Hart, Catalog No. 5351 and WLRD-1 cover.
  - d. Corrosion-resistant, duplex, 20A, 125V, 2P, 3W; Arrow-Hart, Catalog No. 5351 and WLRD-1 cover.
  - e. 60A, 480V, 3P, 2W; weatherproof receptacle shall be Crouse-Hinds Catalog No. ARE6324 with Crouse-Hinds Catalog No. APJ 6385 plug.
  - f. Ground fault interrupter, duplex, 20A, 125V, 3P, 2W; Arrow-Hart Catalog No. GF5342.
  - g. Stainless steel indoor mounting plate for G.F.I. receptacle; Arrow-Hart Catalog No. 97061.
  - h. Weatherproof cover for G.F.I. receptacle in FS box; Arrow-Hart Catalog No. 4501-FS.
  - i. Clock hanger, 15A, 125V, 2P, 3W; Arrow-Hart Catalog No. 452.

- j. Single, 20A, 125V, 2P, 3W; Arrow-Hart Catalog No. 8510BL; cover: Arrow-Hart Catalog No. 9301C indoor, 7420C weatherproof.
- k. Single, 30A, 125V, 2P, 3W; Arrow-Hart Catalog No. 5716N; cover: Arrow-Hart Catalog No. 9301C indoor, 7420C weatherproof.
- l. Clothes dryer, 30A, 125/250V, 3P, 3W; Arrow-Hart Catalog No. 9344N. Matching cord set shall also be included.

C. Device Plates

- 1. Plates for flush mounted devices shall be of the required number of gangs for the application involved and shall be 302 (18-8) high nickel stainless steel of the same manufacturer as the device.

D. Lighting Contactor

- 1. Lighting contactors shall be of the electrically operated, electrically held type in NEMA 1 enclosures of the number of poles as called for on the Drawings.
- 2. Contactors shall be rated for 25A 600-volt contacts and be similar and equal to Automatic Switch Company bulletin 1255-166 RC.

E. Lighting Control Time Switches

- 1. Time switches for the control of lighting shall have astronomic dials, reserve power and be similar and equal to the following types:
  - a. Where time switch is indicated to be for momentary contact operation it shall be similar and equal to Intermatic Inc. Catalog No. ET-70115-C.
  - b. Where time switch is indicated for SPST maintained control it shall be similar and equal to Intermatic Inc. Catalog No. V-45471-CR.
  - c. Where time switch is indicated for DPST maintained control it shall be similar and equal to Intermatic Inc. Catalog No. V-45471-CR.
  - d. Where time switch is indicated for roadway or equipment, lighting shall be similar or equal to Intermatic Inc. Catalog No. ET-7000 Series.

F. Control Stations

- 1. Control stations for start/stop pushbutton and hand-off-automatic selector switches shall be corrosion resistant, dust-tight, watertight and

weatherproof, NEMA 4X, 600 VAC, UL Standard 508 as manufactured by Crouse-Hinds Series NCS or equal.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Receptacles in process areas and shops shall be mounted 36 inches above the floor unless otherwise noted on the Drawings.
- B. Receptacles in office and other like areas shall be mounted 18 inches above the floor unless otherwise noted on the Drawings.
- C. Use bolt, screws, nuts and other threaded devices having standard threads and heads so they may be installed and replaced without special tools.
- D. Check light switch locations before rough-in to avoid installing a switch behind the door swing.
- E. The Engineer and Owner reserve the right to change any switch or receptacle location within the same room, without added cost before rough-in.
- F. Locate outlets intended for the supply of specific items such as water coolers, copying machines, fans, etc., as recommended by the item manufacturer.

END OF SECTION

## SECTION 16150 MOTORS

### PART 1 GENERAL

#### 1.01 DESCRIPTION

##### A. Scope of Work

1. Furnish and install the motors as hereinafter specified and as called for in other sections of these Specifications.

##### B. Related Work Described Elsewhere

1. Equipment: Division 11.

#### 1.02 QUALIFICATIONS

##### A. Qualifications

1. Motors shall be sufficient in size for the duty to be performed and shall not exceed their full-rated load when the driven equipment is operating at specified capacity. Unless otherwise noted, motors driving pumps shall not be overloaded at any head or discharge condition of the pump.
2. The equipment shall be products of manufacturers who are fully experienced, reputable and qualified in the manufacture of the equipment to be furnished. The system components shall be designed, constructed, delivered and installed in accordance with the best practices and methods.

#### 1.03 SUBMITTALS

- A. The motor manufacturer shall submit to the Engineer: Shop Drawings, Working Drawings and Samples: certified dimension prints showing nameplate data and outline dimensions.
- B. Guarantee: All equipment furnished and installed under this Section shall be guaranteed against defects of workmanship, materials and proper installation for a period of one year from date of acceptance. All such equipment or parts proven defective, due to the above noted causes, shall be replaced in the machines by the Contractor at no expense to the Owner.

### PART 2 PRODUCTS

#### 2.01 GENERAL

- A. The specifications are intended to give a general description of what is required, but do not cover all details which may vary in accordance with the exact

requirements of the equipment as offered. They are, however, intended to cover the furnishing, delivery, installation and field testing of all materials, equipment and apparatus as required. Any additional auxiliary equipment necessary for the proper operation of the proposed installation not mentioned in these specifications, or shown on the Drawings shall be furnished and installed.

- B. The material covered by these specifications is intended to be standard equipment of proven ability and as manufactured by reputable concerns having experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with best practice and methods and shall operate satisfactorily when installed as shown on the Drawings.

## 2.02 MATERIALS AND EQUIPMENT

### A. Rating

1. Unless otherwise noted, motors 200 horsepower and below shall be of the low voltage type. Unless otherwise noted, all motors 1/2 through 200 horsepower shall be rated 230/460 volt, 3-phase, 60 Hertz AC, premium efficient, and motors: below 1/2 horsepower shall be rated 115/230-volt, 1-phase, 60/Hertz AC.
  2. Motor connected to variable frequency drives shall be rated as inverter duty by the motor manufacturer. The motor manufacturer shall submit in writing that the motor is suitable for the drive.
- B. All dripproof and weather protected Type 1 (WP1) motors shall have epoxy encapsulated windings. Small motors not readily available with encapsulated windings may be standard type, except non-encapsulated motors exposed to the outside atmosphere shall be totally enclosed.
- C. All motors shall include space heaters to prevent condensation on the motor windings when the motor is not operating. The space heaters shall be sized by the motor manufacturer; maximum 200 watts; 120 volts.
- D. Squirrel-cage rotors shall be made from high-grade steel laminations adequately fastened together and to the shaft, or shall be cast aluminum or bar-type construction with brazed end rings.

### E. Low Voltage, Three-Phase Motors

1. Motors shall be of the squirrel-cage or wound rotor induction type as noted. Horizontal, vertical solid shaft, vertical hollow shaft, normal thrust and high thrust types shall be furnished as called for on the Drawings and as specified herein. All motors shall be built in accordance with current NEMA, IEEE, ANSI and AFMBA standards where applicable. Motors shall be of the type and quality described by the Specifications, and/or as

shown on the schedule on the Drawings, fully capable of performing in accordance with manufacturer's nameplate rating, and free from defective material and workmanship.

2. Motors shall have normal or high starting torque (as required), low starting current (not to exceed 600 percent full load current), and low slip.
3. Motors shall be of drip proof or weather protected Type 1 or totally enclosed fan cooled construction as called for on the Drawings or specified in other sections of these Specifications, with 1.15 service factor.
4. Motors shall be suitable for operation in moist air with hydrogen sulfide gas present.
5. The output shaft shall be suitable for direct connection or belt drive as required.
6. Motors shall have a Class F non-hygroscopic insulation system. Class F insulation may be used but shall be limited to Class B temperature rise.
7. All motors shall have a final coating of chemical resistant corrosion and fungus protective epoxy fortified enamel finish sprayed over red primer over all interior and exterior surfaces. Stator bore and rotor of all motors shall be epoxy coated.
8. All fittings, bolts, nuts, screws shall be plated to resist corrosion. Bolts and nuts shall have hex heads.
9. All machine surfaces shall be coated with rust inhibitor for each disassembly.
10. Motor terminal boxes shall be cast iron diagonally split, one size larger than the manufacturer's standard (motors above 200 HP only), pipe tapped for conduit and shall be attached to the motor frame with cadmium plated hex head cap screws. The box shall be arranged for rotation so that conduit entry from either sides, or bottom is possible. Gaskets shall be supplied between the box and the motor frame and between halves of the box. Cover shall be installed with cadmium plated hex head cap screws. The box shall come completely assembled to the motor. Motor leads in the conduit box shall have the same insulation class as the windings, shall be sized in accordance with EASA suggested minimum ampacity values using 105 degree C insulated lead wire. The wiring shall be clearly identified every inch or the lead shall have a metal band in accordance with ANSI C6.1, latest revision. Nameplates shall be supplied stating the

above data and permanently attached to the motor. Where the leads exit the motor frame, they shall pass through a tight fitting neoprene rubber seal to prevent foreign material or air passage and to hold the leads in a centered position. Motors shall be provided with a compression type grounding lug, mounted in the conduit box by drilling and tapping into the motor frame or by a double ended cap screw of silicon bronze.

11. Totally enclosed motors shall be provided with condensate drain hole and epoxy coated motor windings to protect against moisture.
12. Nameplates shall be stainless steel. Lifting lugs or "O" type bolts shall be supplied on all frames 254T and larger. Enclosures will have stainless steel screen and motors shall be protected for corrosion, fungus and insects.
13. Low voltage, three-phase motors shall be manufactured by, Baldor, Marathon or Relience Electric.
14. Fractional Horsepower:
  - a. Fractional horsepower motors shall be rigid, welded-steel designed to maintain accurate alignment of motor components and provide adequate protection. End shields shall be reinforced, lightweight die-cast aluminum. Windings shall be of varnish-insulated wire with slot insulation of polyester film, baked-on bonding treatment to make the stator winding strongly resistant to heat, aging, moisture, electrical stresses and other hazards.
  - b. Motor shaft shall be made from high-grade, cold-rolled shaft steel with drive-shaft extensions carefully machined to standard NEMA dimensions for the particular drive connection.
  - c. For light to moderate loading bearings shall be quiet all angle sleeve type with large oil reservoir that prevents leakage and permits motor operation in any position.
  - d. For heavy loading, bearings shall be carefully selected precision ball bearings with extra quality, long-life grease, and large reservoir providing 10 years' normal operation without lubrication.
15. Integral Horsepower:
  - a. Motor frames and end shield shall be cast iron or heavy fabricated steel of such design and proportions as to hold all motor components rigidly in proper position and provide adequate protection for the type of enclosure employed.
  - b. Windings shall be adequately insulated and securely braced to resist failure due to electrical stresses and vibrations.

- c. The shaft shall be made of high-grade machine steel or steel forging of size and design adequate to withstand the load stresses normally encountered in motors of the particular rating. Bearing journals shall be ground and polished.
- d. Rotors shall be made from high-grade steel laminations adequately fastened together, and to the shaft. Rotor squirrel-cage windings shall be cast-aluminum or bar-type construction with brazed end rings.
- e. Motors shall be equipped with vacuum-degassed anti-friction bearings made to AFBMA Standards, and be of ample capacity for the motor rating. The bearing housing shall be large enough to hold sufficient lubricant to minimize the need for frequent lubrication, but facilities shall be provided for adding new lubricant and draining out old lubricant without motor disassembly. The bearing housing shall have long, tight, running fits or rotating seals to protect against the entrance of foreign matter into the bearings, or leakage of lubricant out of the bearing cavity.
- f. Bearings of high thrust motors will be locked for momentary up thrust or 30 percent down thrust. All bearings shall have a minimum B10 life rating of 5 years in accordance with AFBMA life and thrust values.
- g. Vertical hollow-shaft motors will have non-reverse ratchets to prevent backspin.

#### F. Inverter Duty Motors

- 1. In addition to the requirements of 16150-2.02 A. B. C. D. and E., motors intended for use with variable frequency drives shall be inverter duty motors specifically designed for inverter operation, and shall be applied in accordance with NEMA, ANSI, IEEE, AFBMA AND NEC for the duty imposed by the driven and drive equipment. Inverter duty motors shall be specifically certified by the motor manufacturer to be compatible with the variable frequency drive to be used with the motor. Inverter duty motors shall be designed to operate over a frequency range of 0 to 66 Hertz. Motor insulation for all motors operating with variable frequency drives shall be Class H with Class F temperature rise when operated with the inverter continuously at all speed and load conditions throughout the specified operating range. Insulation systems shall be capable of withstanding a change in voltage ( $dV/dT$ ) of 1600 peak volts and rise time greater than 0.1 microseconds without damage per NEMA MG-1 Section IV, Part 31.40.4.2. Motors rated less than 200 horsepower shall be protected with two normally closed thermal protectors in the stator winding and shall be set to open when the temperature reaches 155 degrees C. Motors rated 200 horsepower and greater shall have platinum RTD overtemperature protection. The motor frame shall be cast

- iron. Inverter Duty motors shall be Baldor Inverter Drive Motors, Reliance Electric.
2. Motors shall be suitable for operation in moist air with hydrogen sulfide gas present
  3. Conduit boxes shall be gasketed. Lead wires between motor frame and conduit box shall be gasketed.
  4. Totally enclosed motors shall be provided with condensate drain hole and epoxy coated motor windings to protect against moisture.
  5. Nameplates shall be stainless steel. Lifting lugs or "O" type bolts shall be supplied on all frames 254T and larger. Enclosures will have stainless steel screen and motors shall be protected for corrosion, fungus and insects.

G. Low Voltage, Single Phase Motors

1. Single phase motors shall be split-phase and capacitor-start induction types rated for continuous horsepower at the rpm called for on the Drawings. Motors shall be rated 115/230 volts, 60 Hertz, single phase, open, drip proof, or totally enclosed fan cooled as called for on the Drawings or other sections of these Specifications, with temperature rise in accordance with NEMA Standards for Class B insulation.
2. Totally enclosed fan cooled motors shall be designed for severe duty.
3. Motors shall have corrosion and fungus protective finish on internal and external surfaces. All fittings shall have a corrosion protecting plating.
4. Mechanical characteristics shall be the same as specified for polyphase fractional horsepower motors.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Motor connections: All motors shall be connected to the conduit system by a means of a short section (18-inch maximum) of flexible conduit unless otherwise indicated. For motor connections of No. 6 AWG and smaller wire size, the Contractor shall furnish flexible conduit with an approved grounding conductor inside the flexible section. For motor connections of No. 4 AWG or larger wire size, the Contractor shall install a grounding conductor in the conduit and terminate at the motor control center with an approved grounding clamp.

### 3.02 INSPECTION AND TESTING

- A. The following tests shall be performed on all motors after installation but before putting motors into service.
1. The Contractor shall megger each motor winding before energizing the motor, and, if insulation resistance is found to be low, shall notify the

Engineer and shall not energize the motor. The following table gives minimum acceptance insulation resistance in megohms at various temperatures and for various voltages with readings being taken after 1 minute of megger test run.

| Winding Temp (F°) | 115V. | 230V. | 460V. |
|-------------------|-------|-------|-------|
| 37                | 60    | 108   | 210   |
| 50                | 32    | 60    | 120   |
| 68                | 13    | 26    | 50    |
| 86                | 5.6   | 11    | 21    |
| 104               | 2.4   | 4.5   | 8.8   |
| 122               | 1     | 2     | 3.7   |
| 140               | .50   | .85   | 1.6   |

2. The Contractor shall check all motors for correct clearances and alignment and for current lubrication, and shall lubricate if required in accordance with manufacturer's instructions. The Contractor shall check direction of rotation of all motors and reverse connections if necessary.

END OF SECTION

**SECTION 16160  
PANELBOARDS**

**PART 1 GENERAL**

**1.01 DESCRIPTION**

A. Scope of Work

1. Furnish all labor, materials, equipment and incidentals required and install all panelboards as hereinafter specified and as shown on the Drawings.

**1.02 QUALITY ASSURANCE**

A. Standards

1. Panelboards shall be in accordance with the Underwriter Laboratories, Inc. "Standard for Panelboards" and "Standard for Cabinets and Boxes" and shall be so labeled where procedures exist. Panelboards shall also comply with NEMA Standard for Panelboards and the National Electrical Code.

B. Manufacturer (NEMA 1 and NEMA4X)

1. 120/240V, single-phase, three-wire, and 120/208V three-phase, four-wire panelboards shall be as manufactured by the General Electric, Square D Co., or Cutler/Hammer.
2. 480V, three-phase, three-wire panelboards shall be as manufactured by the, Square D Co., I-Line, or Cutler/Hammer or General Electric.

C. Manufacturer (NEMA 3 and 12)

1. NEMA 3 and 12 panelboards shall be type NLP as manufactured by the Crouse-Hinds Company or equal.

**1.03 SUBMITTALS**

A. Materials and Shop Drawings

1. See Section 16050, Electrical—General Provisions.

## PART 2 PRODUCTS

### 2.01 RATING

- A. Panelboard ratings shall be as shown on the Drawings. All panelboards shall be rated for the intended voltage.

### 2.02 CONSTRUCTION AREA (NEMA 1)

#### A. Interiors

- 1. All interiors shall be completely factory assembled with circuit breakers, wire connectors, etc. All wire connectors, except screw terminals, shall be of the anti-turn solderless type and all shall be suitable for copper or aluminum wire of the sizes indicated.
- 2. Interiors shall be so designed that circuit breakers can be replaced without disturbing adjacent units and without removing the main bus connectors and shall be so designed that circuits may be changed without machining, drilling or tapping.
- 3. Branch circuits shall be arranged using double row construction except when narrow column panels are indicated. Branch circuits shall be numbered by the manufacturer.
- 4. A nameplate shall be provided listing panel type, number of circuit breakers, ratings and source.

#### B. Buses

- 1. Bus bars for the mains shall be of tin-plated copper. Full size neutral bars shall be included. Bus bar taps for panels with single pole circuit devices shall be arranged for sequence phasing of the branch circuit devices. Bussing shall be braced throughout to conform to industry standard practice governing short circuit stresses in panelboards. Phase bussing shall be full height without reduction. Cross connectors shall be copper.
- 2. Neutral bussing shall have a suitable lug for each outgoing feeder requiring a neutral connection.
- 3. Spaces for future circuit breakers shall be bussed for the maximum device that can be fitted into them.

#### C. Boxes

- 1. Recessed boxes shall be made from galvanized code gauge steel without multiple knockouts. Surface mounted boxes shall be painted to match the trim. Boxes shall be of sufficient size to provide a minimum gutter space of 4 inches on all sides.

2. Surface mounted boxes shall have an internal and external finish as hereinafter specified in Paragraph D4.
3. At least four interior mounting studs shall be provided.
4. All conduit entrances shall be field punched.

D. Trim

1. Hinged doors covering all circuit breaker handles shall be included in all panel trims.
2. Doors shall have semi flush type cylinder lock and catch, except that doors over 48 inches in height shall have a vault handle and three-point catch, complete with lock, arranged to fasten door at top, bottom and center. Door hinges shall be concealed. Two keys shall be supplied for each lock. All locks shall be keyed alike; directory frame and card having a transparent cover shall be furnished on each door.
3. The trims shall be fabricated from code gauge sheet steel.
4. All exterior and interior steel surfaces of the panelboard shall be properly cleaned and finished with ANSI Z55.1, No. 61 light gray paint over a rust-inhibiting phosphatized coating. The finish paint shall be of a type to which field applied paint will adhere.
5. Trims for flush panels shall overlap the box by at least 3/4 inch all around. Surface trims shall have the same width and height as the box. Trims shall be fastened with quarter turn clamps.

## 2.03 CONSTRUCTION (NEMA 4X)

A. Interiors and Buses

1. Interiors and buses shall be as hereinbefore specified for NEMA 1 construction.
2. Interior trim shall be complete. No exposed wiring allowed.

B. Boxes and Covers

1. Boxes and covers shall be made from 316 stainless steel.
2. Boxes and covers shall be hinged together and gasketed. All metallic parts on exterior shall be stainless steel.
3. Conduit openings shall be sealed with lock rings or sealing washers.
4. Polycarbonate or plastic enclosures or boxes are unacceptable.

## 2.04 CIRCUIT BREAKERS

- A. Panelboards shall be equipped with circuit breakers with frame size and trip settings as shown on the Drawings.

- B. Circuit breakers shall be molded case, bolt-in type, for NEMA 1 and plug-in for NEMA 4X.
- C. Circuit breakers used in 120/240 and 120/208V panelboards shall have an interrupting capacity of not less than 10,000 amperes, RMS symmetrical.
- D. Three pole breakers used in 480V panelboards shall have an interrupting capacity of not less than 25,000 amperes, RMS symmetrical.
- E. GFCI
  - 1. GFCI (ground fault circuit interrupter) shall be provided for circuits where indicated on the Drawings. GFCI units shall be one-pole, 120-volt, molded case, bolt-on breakers, incorporating a solid state ground fault interrupter circuit insulated and isolated from the breaker mechanism. The unit shall be U.L. listed Class A Group I device (5 milliamp sensitivity, 25 millisecond trip time), and in interrupting capacity of 10,000 amperes RMS.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Boxes for surface mounted panelboards shall be mounted so there is at least 1/2-inch air space between the box and the wall.
- B. Unless otherwise noted on the Drawings, top of cabinets shall be mounted 6 feet 0 inch above the floor, properly aligned and adequately supported independently of the connecting raceways.
- C. All wiring in panelboards shall be neatly formed, grouped, laced and identified to provide a neat and orderly appearance. A typewritten directory card identifying all circuits shall be placed in the card holder inside the front cover.

END OF SECTION

**SECTION 16170**  
**SAFETY SWITCHES**

**PART 1 GENERAL**

**1.01 DESCRIPTION**

**A. Scope of Work**

1. Furnish and install all motor and circuit disconnects as hereinafter specified and as shown on the drawing.

**B. General Design**

1. All switches shall be heavy duty and have stainless steel NEMA 4X enclosures and be horsepower rated.
2. All switches shall have metal nameplates, front cover mounted, that contain a permanent load, switch-type, catalog number and HP ratings, handle whose position is easily recognizable and is padlockable in the "off" position, visible blades, reinforced fuse clips, nonreversible, positive, quick make-quick break mechanism, switch assembly plus operating handle as an integral part of the enclosure base.
3. Switches shall have defeatable door interlocks that prevent the door from opening when the operating handle is in the "on" position. All switches shall have line terminal shields.
4. All current carrying parts shall be copper.
5. Auxiliary contacts rated 10 ampere at 240 volts shall be provided, for motor space heater interlock and position indication.

**1.02 QUALITY ASSURANCE**

**A. Standards**

1. National Electrical Manufacturer's Association (NEMA)
2. Underwriter's Laboratories (UL)
3. Federal Specifications (FS)
4. National Electrical Code (NEC)

**B. Manufacturer**

1. Switches shall be as manufactured by Square D Co. Class 9422, Cutler-Hammer, or equal.

## 1.03 SUBMITTALS

### A. Materials and Shop Drawings

1. See Section 16050, Electrical—General Provisions.

## 1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. All switches shall be stored indoors protected from damage.

## 1.05 WARRANTY AND GUARANTEES

- A. All switches shall be warranted against defect, rusting or failure for a period of 1 year from date of acceptance.

## PART 2 PRODUCTS

### 2.01 MATERIALS AND EQUIPMENT

- A. Where a six-pole weatherproof disconnect are called for on the drawings; the Contractor shall provide two 600-Volt, three-pole non-fusible switch in a single NEMA 4X stainless steel enclosure with a single operating handle mechanically interlocked to both disconnects.
- B. All parts exposed to the weather or in hose down areas shall be stainless steel.
- C. Short circuit rating – 10,000 RMS symmetrical amperes for non-fused switches.
- D. Line and load lugs shall be front removable and suitable for copper, 60/75 degree C wire through 200A sizes, 75 degree C wire for 400-800A sizes.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. All switches shall be mounted as shown on the drawings.
- B. Location of disconnect switches shall be per the NEC and shall be verified with the Engineer before installation.
- C. All mounting appurtenances shall be 316 stainless steel including fasteners.

END OF SECTION

**SECTION 16370**  
**VARIABLE-SPEED DRIVES**

**PART 1 GENERAL**

**1.01 DESCRIPTION**

**A. Scope of Work**

1. Furnish and install variable speed drives including all appurtenances required as shown on the drawing and specified herein.
2. All equipment and accessories shall have approved manufacturer's shop drawings prior to installation and shall be tested in conformance with these Performance Specifications prior to acceptance and final payment by the Owner.

**B. Related Work Described Elsewhere**

1. Equipment: Division 11.

**1.02 QUALITY ASSURANCE**

**A. Variable-speed drives shall be sufficient size for the duty to be performed and shall not exceed their full-rated capacity when the driven equipment is operating as specified. Variable-speed drives driving pumps shall not be overloaded under any operating condition of the pump.**

**B. Standards**

1. National Electrical Manufacturers Association (NEMA)
2. Institute of Electrical and Electronics Engineers, Inc. (IEEE)
3. American National Standards Institute (ANSI)
4. National Electric Code (NEC)

**C. The variable frequency control shall operate satisfactorily when connected to a bus supplying other solid state power conversion equipment which may be causing up to 10% total harmonic voltage distortion and commutation ASDs shall meet requirements as outlined in the latest edition of IEEE-519 for total harmonic voltage and current distortion. Individual or simultaneous operation of the ASDs shall not add more than 5% total harmonic voltage distortion to the normal bus, nor more than 10% while operating from standby generator. The point of common coupling shall be the secondary side of the service transformer. Twelve-pulse (minimum) harmonic rectifier technology is required to meet these requirements, it is the responsibility of the ASD manufacturer to provide this harmonic technology within the ASD enclosure.**

- D. The controller shall be subject to, but not limited to, the following quality assurance controls, procedures and tests:
1. Power transistors, SCR's and diodes shall be tested to ensure correct function and highest reliability.
  2. All printed circuit boards shall be tested at 50 degree C for 50 hours. The ASD manufacturer shall provide certification that the tests have been completed.
  3. Every controller will be functionally tested with a motor to ensure that if the drive is started up according to the instruction manual provided, the unit will run properly.
  4. The ASD systems shall be fabricated by the same ASD manufacturer, items must not be fabricated in whole or in part by parties other than the ASD manufacturer. Third-party distributor or packager modifications to a standard product will not be allowed.
  5. The ASD shall be fully designed and manufactured in the United States of America.

E. Approved Manufacturers:

1. Yaskawa.

### 1.03 DRIVE MANUFACTURE'S RESPONSIBILITIES

- A. The ASD manufacturer shall be responsible for the installation, testing and start-up of each drive.
- B. The ASD manufacturer shall be responsible for the coordination of the drive with thier respective motor specified in other sections of the Project Specifications.
- C. The ASD manufacturer shall be, at no additional cost to the Owner, responsible for mitigating any harmonic, and/or all RF and/or EMI and/or any electrical type noise created by the drive which adversely affect the proper operation of any and all electronic and/or electrical power and/or mechanical devices on this project.
- D. The ASD manufacturer shall provide input and/or output filters and/or any other accessories on each drive to mitigate all electrical and mechanical noise to a limit which is not detrimental to the motor winding irregardless of the motor lead length and/or type of conduit or charecteristics to this installation.
- E. The ASD manufacturer shall be responsible for all additionnal cost related to the installation of the drive that is above and beyond the scope of work shown on the drawings and specification.

- F. The ASD manufacturer shall pay for all engineering fees and Owner costs related to the services required by the Consultant and Owner to assist in the mitigation of ASD-related problems.

#### 1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. The equipment shall be maintained in an upright position at all times. Lifting shall be only at the floor sills or the top mounted lifting angles.
- B. The equipment shall be protected against damage at all times. Any damage to the paint shall be carefully repaired using touch-up paint furnished by the ASD Manufacturer.
- C. Each box or package shall be properly marked to show its net weight in addition to its contents.

### PART 2 PRODUCTS

#### 2.01 VARIABLE FREQUENCY ADJUSTABLE SPEED DRIVES (VARIABLE TORQUE, PWM)

- A. General:
  - 1. The variable frequency drive (ASD) motor controller shall convert 460-Volt, three-phase, 60 Hertz utility power to adjustable voltage (0-460V) and frequency (0-60 Hz.) three-phase, AC power for stepless motor speed control with a capability of 10:1 speed range. All general options and modifications shall mount within the standard adjustable frequency controller enclosure.
  - 2. The adjustable frequency controller shall be a space vector sine-coded Pulse-Width Modulated (PWM) design. Modulation methods which incorporate "gear-changing" techniques are not acceptable. Distributor or packager modifications to a third-party standard product will not be allowed. All drives shall be manufactured by a single manufacturer, and shall be of the same technology.
  - 3. The controller(s) shall be suitable for use with any standard configuration squirrel-cage induction motor(s) having a 1.05 or better service factor, or with existing standard squirrel-cage induction motor(s) with nameplate data as shown on the plans. At any time in the future, it shall be possible to substitute any standard motor (equivalent horsepower, voltage and RPM) in the field.
  - 4. The Contractor shall be responsible for the erection, installation and start up on the equipment covered by this Specification.
  - 5. Complete drawings shall be furnished for approval before proceeding with manufacture and shall consist of master wiring diagrams, elementary or

control schematics including coordination with other electrical control devices operating in conjunction with the Adjustable Frequency Drive, and suitable outline drawings with sufficient details for locating conduit stub-ups and field wiring.

6. The Adjustable Frequency Drive manufacturer shall maintain and staff engineering service and repair shops throughout the United States, including the State of Florida, trained to do start up service, emergency service calls, repair work, service contracts and training of customer personnel.

## B. Construction

1. Each Adjustable Frequency Drives shall consist of a 460V, twelve-pulse minimum rectifier and adjustable frequency inverter with features, functions and options as specified.
2. The controller shall produce an adjustable AC voltage/frequency output. It shall have an output voltage regulator to maintain correct output V/Hz. despite incoming voltage variations.
3. The controller shall have a continuous output current rating of 100% of motor nameplate current.
4. The ASD shall be of the Pulse-Width Modulated type and shall employ a 12-pulse (minimum) dual full-wave diode bridge converters to convert incoming fixed voltage/frequency to a fixed DC voltage, all components for 12-pulse converters must be integral to ASD enclosure and require no additional installation costs. The Pulse Width Modulation strategy shall be of the space vector type implemented in a microprocessor which generates a sine-coded output voltage.
5. The inverter output shall be generated by Insulated Gate Bipolar Transistors (IGBT) which shall be controlled by six identical base driver circuits. The ASD shall not induce excessive power losses in the motor. The worst case RMS motor line current measured at rated speed, torque and voltage shall not exceed 1.05 times the rated RMS motor current for pure sine wave operation.
6. The Adjustable Frequency Drives shall be rated for the HP, full load amperes and rpm of the motor. They shall be designed to provide continuous speed adjustment of three-phase motors. The adjustable frequency output voltage shall provide constant volts-per-Hertz excitation to the motor terminals up to 60 Hertz.

7. Controllers shall be rated for an ambient temperature of 0 to 40°C, an altitude of up to 3,300 feet above sea level, and humidity of 0 to 95% non-condensing.
8. Controller enclosures shall be NEMA Type I floor-mounted, force ventilated above 25 HP. The inverters shall have complete front accessibility with easily removable assemblies.
9. The door of each power unit shall include a "POWER ON light, a ASD fault light, a ASD run light, stop push-button, start push-button, a fault reset push-button, a "HAND-OFF-AUTOMATIC" selector switch, and a manual speed control potentiometer.
10. The ASD shall be software programmable to provide automatic restart after any individual trip condition resulting from either overcurrent, overvoltage, undervoltage, or overtemperature. For safety, the drive shall shut down and require manual reset and restart if the automatic reset/restart function is not successful within a maximum of three attempts within a short time period.
11. A speed droop feature shall be included which reduces the speed of the drive on transient overloads. The drive is to return to set speed after transient is removed. If the acceleration or deceleration rates are too rapid for the moment of inertia of the load, the drive is to automatically compensate to prevent drive trip.
12. Automatic restart after drive trip or utility failure. Software selectable if not desired.
13. Process signal inverter. Software selectable to allow speed of drive to vary inversely with input signal.
14. Proportional and integral setpoint process controller with menu driven selection and programming via door-mounted keypad.
15. Pick up a spinning load. The ASD shall be able to determine the motor speed and resume control of a motor which is spinning in either direction without tripping.
16. A door-mounted membrane keypad with integral 2-line, 24-character LCD display shall be furnished, capable of controlling the ASD and setting drive parameters, and shall include the following features:

17. The digital display must present all diagnostic message and parameter values in English engineering units when accessed, without the use of codes.
18. The keypad module shall contain a "self-test" software program which can be activated to verify proper keypad operations.
19. The digital keypad shall allow the operator to enter exact numerical settings in English engineering units. A plain English user menu shall be provided in software as a guide to parameter setting, (rather than codes). Drive parameters shall be factory set in EEPROM and resettable in the field through the keypad. Six (6) levels of password security shall be available to protect drive parameters from unauthorized personnel. The EEPROM stored drive variables must be able to be transferred to new boards to reprogram spare boards.
  - a. Normally the digital display shall simultaneously display:
    - (1) Speed demand in percent.
    - (2) Output current in amperes.
    - (3) Frequency in hertz.
    - (4) Control Mode: Manual/Automatic.
    - (5) Total three-phase KW or output volts.
20. The controller shall include the following protective features:
  - a. Single phase fault or 3-phase short circuit on ASD output terminals without damage to any power component.
  - b. Static instantaneous overcurrent and overvoltage trip with inverse overcurrent protection.
  - c. Static overspeed (overfrequency) protection.
  - d. Line or fuse loss and undervoltage protection.
  - e. Power unit overtemperature protection.
  - f. Electronic motor overload protection.
  - g. Responsive action to motor winding temperature detectors or thermostatic switches.
  - h. LED status indicators on regulator, printed circuit board face plates.
  - i. Isolated operator controls.
  - j. Input line fuses.
  - k. Be insensitive to incoming power phase sequence.
  - l. Have desaturation circuit to drive inverter section transistor base current to zero in event of controller fault.
  - m. Have DC bus discharge circuit for protection of operator and service personnel with an indicator lamp.

- n. Input line noise suppression with line reactor.
  - o. Output dv/dt filter for motor long leads.
21. The following system configuring settings shall be provided, without exception, field adjustable through the keypad/display unit or via the serial communication port only.
- a. Motor Nameplate Data:
    - (1) Motor frequency.
    - (2) Number of poles.
    - (3) Full load speed.
    - (4) Motor volts.
    - (5) Motor full load amps.
    - (6) Motor KW.
    - (7) Current min.
    - (8) Current max.
  - b. ASD Limits:
    - (1) Independent accel/decel rates.
    - (2) No load boost.
    - (3) Vmin, Vmax, V/Hz.
    - (4) Full load boost.
    - (5) Overload trip curve select (Inverse or Constant).
    - (6) Min./max. speed (frequency).
    - (7) Auto reset for load or voltage trip select.
    - (8) Slip compensation.
    - (9) Catch-A Spinning-Load select.
    - (10) Overload trip time set.
  - c. ASD Parameters:
    - (1) Voltage loop gain.
    - (2) Voltage loop stability.
    - (3) Current loop stability.
  - d. Controller Adjustments:
    - (1) PID control enable/disable.
    - (2) Setpoint select.
    - (3) Proportional band select.
    - (4) Reset time select.
    - (5) Rate time select.
    - (6) Input signal scaling.

- (7) Input signal select (4-20mA/0-5 Volts).
  - (8) Auto start functions: On/Off, Delay On/off, Level Select On/Off.
  - (9) Speed Profile: Entry, Exit, Point Select.
  - (10) Min., Max. Speed Select.
22. The ASD shall include a comprehensive microprocessor based digital diagnostic system which monitors its own control functions and displays faults and operating conditions. microprocessor systems must be products of the same manufacturer as the ASD.
23. A "FAULT LOG" shall record, store, display and print upon demand, the following for the 10 most recent events:
- a. ASD mode (Auto/Manual).
  - b. Elapsed time (since previous fault).
  - c. Type of fault.
24. The fault log record shall be accessible via a RS232 serial link as well as line by line on the keypad display.
25. The following factory installed modifications shall be furnished with the controller:
- a. Input circuit breaker, interlocked with the enclosure door, with through-the-door handle to provide positive disconnect of incoming AC power. The circuit breaker shall be rated for 65,000 AIC.
  - b. Door-mounted meters or keypad display shall be provided on all units as follows:
    - (1) Analog or digital ammeter (0% - 110%).
    - (2) Analog or digital speed/frequency meter (0 - 110% speed as well as Hz.).
    - (3) Analog or digital voltmeter (0 - 600 VAC).
    - (4) Analog or digital KW meter(0 - 110%).
    - (5) 5-digit elapsed time meter.
    - (6) HAND-OFF-REMOTE Selector Switch.
  - c. The drive is to be provided with isolated 4-20mA DC output signals proportional to speed and current for remote monitoring of the ASD.

- d. Relay output auxiliary contacts to indicate the position of all selector switches, drive failures and drive status.
- e. Ethernet/IP Interface.
- f. Provide 120VAC and logic for motor space heater control.
- g. Provide control of remote seal water solenoids.
- h. Provide for motor t-stat shut down.

## PART 3 EXECUTION

### 3.01 SYSTEM OPERATION

- A. With the ASD H-O-R switch in the "HAND" position and the remote H-O-A in the HAND position, the drive shall be controlled by the manual speed potentiometer or keypad located on the drive door.
- B. With the ASD H-O-R switch in the "OFF" position and the remote H-O-A in the OFF position, the drive shall not start under any condition.
- C. With the ASD H-O-R switch in the "REMOTE" position and the remote H-O-A in the AUTO position, the drive shall be controlled via the Ethernet/IP interface.

### 3.02 INSTALLATION

- A. Field wiring shall be per manufacturer's recommendation.
- B. The manufacturer shall include in his bid 1 normal work day per drive of a qualified service engineer's time. This time will be used to ensure proper connection and functioning of the equipment prior to startup and to train Owner personnel in the use of the equipment.
- C. The manufacturer shall provide one spare for each type of plug-in type PC card. These spares will be color-coded or otherwise keyed to its original counterpart. In addition to the cards, the manufacturer shall provide two spares per drive all expendable items such as fuses, pilot lamps, etc.

### 3.03 INSPECTION AND TESTING

- A. The drive manufacturer shall test the drive controller with a motor load prior to shipment.
- B. The drive manufacturer shall furnish a certified field test report demonstrating installed compliance for voltage and current distortion at the required point of

common coupling under both utility power and generator power. The test shall report shall be sealed by a Florida-registered Professional Electrical Engineer.

- C. A copy of all tests and checks performed in the field, complete with meter readings and recordings, where applicable, shall be submitted to the Owner.

END OF SECTION

**SECTION 16402**  
**UNDERGROUND SYSTEM**

**PART 1 GENERAL**

**1.01 DESCRIPTION**

- A. Scope of Work
  - 1. Furnish and install a complete underground system of ducts, manholes and handholes all as hereinafter specified and shown on the Drawings.
- B. Related Work Described Elsewhere
  - 1. Excavation and backfilling is included in Division 2.
  - 2. All concrete and reinforcing steel shall be included under Division 3.
  - 3. Conduit for ducts shall be as specified under Section 16110, Raceways and Fittings.
  - 4. Ground rods and other grounding materials and methods shall be as specified under other sections of Division 16.

**PART 2 PRODUCTS**

**2.01 MATERIALS**

- A. Ducts shall be encased in concrete as indicated on the plans.
- B. Cable racks, supports, pulling-in irons, manhole steps, and hardware shall be galvanized steel manufactured by Cope or equal.
- C. Precast manholes and handholes shall be heavy duty type, designed for a Class H20 wheel load. Precast manholes and handholes shall be as manufactured by Brooks Products Co.
- D. Handhole covers and frames shall be as shown on the Drawings.
- E. Fireproofing tape shall be Irvington No. 7700 or be an approved equal product.

**PART 3 EXECUTION**

**3.01 INSTALLATION**

- A. Ducts shall be installed to drain away from buildings; ducts between manholes or handholes shall drain toward the manholes or handholes. Duct slopes shall not be less than 3 inches per 100 feet.

- B. Duct banks shall be reinforced as shown on the Drawings.
- C. Duct lines shall be laid in trenches on a clean backfill bedding not less than 6 inches thick and well graded.
- D. Plastic spacers shall be used to hold ducts in place. Spacers shall provide not less than 2-inch clearance between ducts.
- E. The minimum cover for duct lines shall be 24 inches unless otherwise permitted by the Engineer.
- F. Duct entrances to buildings and structures shall be made with steel conduit not less than 10 feet long.
- G. PVC duct termination at manholes shall be with PVC end bells. Steel conduits shall be terminated with insulated, grounding-type bushings.
- H. Where bends in ducts are required, long radius elbows, sweeps and offsets shall be used.
- I. All ducts shall be rodded and a mandrel drawn through followed by a swab to clean out any obstructions which may cause cable abrasions. The mandrel shall be 12 inches in length and the diameter 1/2 inch less than the inside diameter of the duct.
- J. Spare ducts shall be plugged and sealed watertight at all manholes, buildings and structures.
- K. Ducts in use shall be sealed watertight at all manholes, buildings and structures.
- L. Pulling-in irons shall be installed opposite all duct entrances to manholes, equal to Cope Catalog No. 311-9.
- M. Cable racks shall be similar and equal to Cope Catalog 324-T, cut to length for one, two, three or four vertical tiers of cables. Racks shall be mounted with 1/2-inch by 4-inch expansion bolts on manhole walls. Arms similar and equal to Cope Catalog No. 325-T4, 325-T75 and/or 325-T10 for one, two and/or three cables, respectively, shall be furnished and installed with Catalog No. 326-T22 porcelain insulators for support of cables. Lock clips shall be furnished and installed to secure hooks in position.
- N. Cables shall be trained in manholes and supported on racks and hooks at intervals not greater than 3 feet - 0 inches and supports shall be installed on each side of all splices. Furnish inserts on all manhole walls for mounting future racks as well as

racks required for present installation. Branch circuit conductors shall not be run in manholes.

- O. Fireproofing shall be furnished for all 5-KV cables in manholes. Each individual 5-KV cable shall be wrapped with an arc-proofing tape. The tape shall be applied in accordance with the manufacturer's recommendations. The wrapping shall extend into the end bells.
- P. Aluminum rigid conduit shall be used for risers.
- Q. All risers from underground shall be given a heavy coat of bitumastic paint from a point 1 foot - 0 inches below grade to a point not less than 6 inches above grade or surface of slab.
- R. All joints shall be made so as to prevent the passage of concrete inside the conduit to form obstructions or cause cable abrasions.
- S. Manhole covers in streets shall finish flush with finished paving and in other areas shall finish 3 inches above crown of adjacent roadway. Floor elevations of manholes shall be so set that the center line of the lowest conduit entering will be not less than 1 foot above the floor and center line of the highest conduit entering will be not less than 1 foot below the roof slab.
- T. Concrete monuments shall be provided at each stubbed conduit location. Monuments shall be as shown on the Drawings and shall be installed in the same manner outlined for manhole covers.
- U. A #6 bare copper wire (stranded) shall be installed in each 4-inch PVC conduit.
- V. A 5/8-inch by 10-foot copper clad ground rod shall be driven in the bottom of each manhole. All bond wires and galvanized steel conduits shall be bonded to the ground rod.

END OF SECTION

**SECTION 16450**  
**GROUNDING SYSTEM**

**PART 1 GENERAL**

**1.01 DESCRIPTION**

**A. Scope of Work**

1. Furnish and install a complete grounding system in strict accordance with Article 250 of the National Electrical Code and as hereinafter specified and shown on the Drawings.

**B. Related Work Described Elsewhere**

1. Conduit: Section 16110, Raceways and Fittings.
2. Wire: Section 16120, Wires and Cables.

**1.02 QUALITY ASSURANCE**

**A. Qualifications:**

1. The equipment shall be products of manufacturers who are fully experienced, reputable and qualified in the manufacture of the equipment to be furnished. The system components shall be designed, constructed, delivered and installed in accordance with the best practices and methods.

**1.03 SUBMITTALS**

**A. Material and Shop Drawings:**

1. Copies of all materials required to establish compliance with these specifications shall be submitted in accordance with the provisions of the General Conditions. Submittals shall include at least the following:
  - a. Certified shop drawings with performance data and physical characteristics.
  - b. Descriptive literature, bulletins, and/or catalogs of each item of equipment.
  - c. All information required by Section 01330, Submittals and Acceptance.
  - d. Complete wiring diagrams and schematics of all power and control systems showing wiring requirements between system and connections to work of other sections.

## 1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver a complete system ready to install as job progress requires.

## PART 2 PRODUCTS

### 2.01 GENERAL

- A. The specifications are intended to give a general description of what is required, but do not cover all details which may vary in accordance with the exact requirements of the equipment as offered. They are, however, intended to cover the furnishings, delivery, installation and field testing of all materials, equipment and apparatus as required. Any additional auxiliary equipment necessary for the proper operation of the proposed installation not mentioned in these specifications, or shown on the Drawings shall be furnished and installed.
- B. The material covered by these specifications is intended to be standard equipment of proven ability and as manufactured by reputable concerns having experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with best practice and methods and shall operate satisfactorily when installed as shown on the Drawings.

### 2.02 MATERIALS AND EQUIPMENT

- A. Ground rods: Ground rods shall be copper clad steel 3/4-inch-x-20-foot, minimum depth. Ground rods shall be copperweld or equal.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. The 480 volt switchgear ground bus shall be grounded to a ground loop system. The protecting conduits shall be bonded to the grounding conductor at both ends.
- B. All steel building columns shall be bonded together and connected to the building ground grid.
- C. Motors shall be grounded as hereinafter specified.
- D. Lighting transformer neutrals shall be grounded to the nearest grounding electrode.
- E. Grounding electrodes shall be driven as required. Where rock is encountered, grounding plates may be used in lieu of grounding rods.

- F. All equipment enclosures, motor and transformer frames, conduits systems, cable armor, exposed structural steel and similar items shall be grounded.
- G. Exposed connections shall be made by means of approved grounding clamps. Exposed connections between different metals shall be sealed with No-Oxide Paint Grade A or equal. All buried connections shall be made by welding process such as Cadweld or equal.
- H. For reasons of mechanical strength, grounding conductors shall be No. 10 AWG minimum copper, minimum size.
- I. All underground conductors shall be laid slack and where exposed to mechanical injury, shall be protected by pipes or other substantial guards. If guards are iron pipe or other magnetic material, conductors shall be electrically connected to both ends of the guard.
- J. The Contractor shall exercise care to ensure good ground continuity, in particular between the conduit system and equipment frames and enclosures. Where necessary, jumper wires shall be installed.

### 3.02 INSPECTION AND TESTING

- A. The Contractor shall obtain the services of an NETA recognized testing firm to measure the ground resistance of the system. All test equipment shall be provided by the Contractor and approved by the Engineer. Dry season resistance of the system shall not exceed 5 ohms. If such resistance cannot be obtained with the system as shown, the Contractor shall provide additional grounding as directed by the Engineer, without additional payment.

END OF SECTION

**SECTION 16500  
LIGHTING SYSTEM**

**PART 1 GENERAL**

**1.01 DESCRIPTION**

**A. Scope of Work:**

1. Furnish and install complete lighting systems including panelboards, transformers, lighting fixtures, receptacles, switches, contractors, clocks and all necessary accessories and appurtenances required as hereinafter specified and shown on the Drawings.

**B. Related Work Described Elsewhere**

1. Panelboards: Section 16160, Panelboards.
2. Conduit: Section 16110, Raceways and Fittings.
3. Wire: Section 16120, Wires and Cables.

**1.02 QUALITY ASSURANCE**

**A. Qualifications:**

1. The equipment shall be a product of manufacturers who are fully experienced, reputable and qualified in the manufacture of the equipment to be furnished. The system components shall be designed, constructed, delivered and installed in accordance with the best practices and methods.
2. The system shall be furnished by a single manufacturer who shall be responsible for the coordination of the system design and who shall assume complete responsibility for the proper operation of the system including equipment supplied but not of his manufacture.

**B. Standards:**

1. All lighting fixtures shall be in accordance with the National Electrical Code and shall be constructed in accordance with the latest edition of the Underwriters Laboratories "Standards for Safety, Electrical Lighting Fixtures". All lighting fixtures shall be Underwriters Laboratories labeled.

## 1.03 SUBMITTALS

### A. Material and Shop Drawings:

1. Copies of all materials to establish compliance with these specifications shall be submitted in accordance with the provisions of the General Conditions. Submittals shall include at least the following:
  - a. Certified shop drawings with performance data and physical characteristics.
  - b. Descriptive literature, bulletins, and/or catalogs of each item of equipment.
  - c. A complete total bill of materials for all equipment.
  - d. Complete wiring diagrams and schematics of all power and control systems showing wiring requirements between system and connections to work of other sections.
2. If it is impossible to conform with certain details of the specifications, describe completely all non-conforming aspects of the Shop Drawing transmittal.

## PART 2 PRODUCTS

### 2.01 GENERAL

- A. The specifications are intended to give a general description of what is required, but do not cover all details which may vary in accordance with the exact requirements of the equipment as offered. They are, however, intended to cover the furnishing, delivery, installation and field-testing of all materials, equipment and apparatus as required. Any additional auxiliary equipment necessary for the proper operation of the proposed installation not mentioned in these specifications or shown on the Drawings shall be furnished and installed.
- B. The material covered by these specifications is intended to be standard equipment of proven ability and as manufactured by reputable concerns having experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with best practice and methods and shall operate satisfactorily when installed as shown on the Drawings.

### 2.02 MATERIALS AND EQUIPMENT

#### A. Lighting Fixtures:

1. Lighting fixture types shall be as shown on the "Lighting Fixture Schedule" on the Drawings. The catalog numbers listed are given as a

guide to the design and quality of fixture desired. Equivalent designs and equal quality fixtures of other manufacturers will be acceptable.

B. Lamps:

1. LED type, all as indicated on the "Fixture Schedule".

C. Flexible Fixture Hangers:

1. Flexible fixture hangers used in nonhazardous areas shall be Type ARB and flexible fixture supports used in hazardous areas shall be Type ECHF as manufactured by the Crouse-Hinds Company or equal.
2. FRP channel shall be used to span for mounting of fixtures when required by fixture location or as indicated on the Drawings.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Each fixture shall be a complete finished unit with all components, mounting and/or hanging devices necessary, for the proper installation of the particular fixture in its designation location and shall be completely wired ready for connection to the branch circuit wires at the outlet.
- B. When fixtures are noted to be installed flush, they shall be complete with the proper accessories for installing in the particular ceiling involved. All flush mounted fixtures shall be supported from the structure and shall not be dependent on the hung ceilings for their support.
- C. Flexible fixture hangers shall be used for all pendant mounted fixtures.
- D. Conduit run in areas with hung ceilings shall be installed in the space above the hung ceiling as close to the structure as possible. Conduit shall be supported from the structure.

### 3.02 REPLACEMENT

- A. Lamps used during the building construction, before 2 weeks from completion of the work, shall be removed and replaced with new lamps.

### 3.03 CLEANING UP

- A. All fixtures shall be left in a clean condition, free of dirt and defects, before acceptance by the Engineer.

END OF SECTION

**SECTION 16921**  
**480-VOLT MOTOR CONTROL CENTERS**

**PART 1 GENERAL**

**1.01 DESCRIPTION**

**A. Scope of Work**

1. Furnish, install, and test the motor control centers as hereinafter specified and as shown on the Drawings.

**1.02 QUALITY ASSURANCE**

**A. Standards**

1. The motor control centers shall be the product of a manufacturer who shall also be the manufacturer of all the circuit breakers, fused switches and motor starters included in the motor control centers.
2. All units and sections shall be UL labeled when possible. Motor control centers containing service entrance equipment shall be UL labeled "Suitable For Use As Service Equipment".
3. Motor control centers shall be built and tested in accordance with:
  - a. National Electrical Manufacturers (NEMA)
  - b. American National Standards Institute (ANSI)
  - c. Underwriters Laboratories, Inc. (UL)

**B. Equipment Manufacturer**

1. The motor control centers shall be 8000 series General Electric to match existing.

**1.03 SUBMITTALS**

- A.** Complete master wiring diagrams and elementary or control schematics, including coordination with other electrical control devices operating in conjunction with the motor control centers and suitable outline drawings shall be furnished for approval before proceeding with manufacture. Due to the complexity of the control functions, it is imperative the above drawings be clear and carefully prepared to facilitate interconnections with other equipment. Standard preprinted sheets or drawings simply marked to indicate applicability to this Contract will not be acceptable.

- B. Submittals shall include a bill-of-material listing conductor material and insulation type as well as other hardware and equipment to be furnished.
- C. Where it is not explicitly shown and completely obvious from the outline drawings, the following items shall be verified in a written statement accompanying the shop drawings:
  - 1. Type of terminal blocks used and that the removal of plug-in compartments can be performed without disconnecting or removing wires.
  - 2. Tin plating of bus.
  - 3. Insulation and isolation of vertical bus.
  - 4. UL approval.

## PART 2 PRODUCTS

### 2.01 RATING

- A. The motor control centers shall be designed for 480-volt, three-phase, three-wire, 60 Hz service and shall have short-circuit rating of not less than 65,000 amperes RMS, symmetrical.

### 2.02 CONSTRUCTION

- A. Structure
  - 1. The motor control centers shall be a standard metal-enclosed, free-standing, deadfront structure, not more than 90-inches in height, and fabricated from formed sheet steel of not less than No. 14 gauge thickness. The enclosure shall be NEMA 1. The motor control centers shall consist of vertical sections of equal height and 20 inches deep containing individual plug-in compartments. Compartments shall be isolated from each other by separate horizontal steel plates or by steel plates without openings that are a part of the compartment itself.
  - 2. Plug-in compartments shall totally isolate enclosed equipment. All unused openings to the adjacent vertical wiring space shall be plugged. All openings used for wiring shall have insulating grommets.
  - 3. Vertical sections shall be mounted on steel channel sills continuous on four sides, or with steel channel sills on two sides and end cover plates. Each compartment shall be provided with a hinged door of pan construction on the front and a door opening of sufficient size to permit ready removal of any of the equipment in the compartment. Interlocks shall be provided to prevent opening the compartment door when the disconnect device in the compartment is in the closed position. An interlock bypass device shall be furnished. Means of locking the

disconnect device in the "Off" position shall be provided. Disconnect device operating mechanism shall not be attached to the compartment door.

4. All sections shall have the same structural features with provisions for the addition of similar sections at either end. Each compartment shall meet NEMA Standards for the control equipment installed and units of similar size shall be interchangeable.
5. Each section shall be provided with a horizontal wiring space which shall line up with a similar space in the adjacent section or sections, with openings between so that wires may be pulled the entire length of the control centers. There shall also be provided in each section a vertical wiring space with separate full height door.
6. The motor control centers shall be designed for against-the-wall mounting. All wiring, bus joints and other mechanical parts requiring tightening or other maintenance shall be accessible from the front or top.
7. The motor control centers shall have engraved laminated nameplates screwed to the doors of each individual compartment and wiring diagrams pasted inside each door. Compartments containing motor starters shall each have an overload heater selection table pasted inside the door.
8. The motor control centers shall provide equipment of type, capacity, trip ratings for the loads shown on the Drawings or otherwise specified.
9. Construction shall be NEMA Class 11, Type B or C. Insofar as possible, all devices and components used shall be of one manufacturer. The motor control centers shall be furnished as a completely factory assembled unit where transportation facilities and installation requirements permit.
10. The motor control centers shall be finished with ANSI Z55.1, No. 61 light gray enamel over a rust resistant primer.
11. The insulation level of the complete motor control assembly shall be such that it will meet the field tests required under PART 3.

## B. Buses

1. All buses shall be tin-plated copper. A continuous main horizontal bus shall be furnished. Main buses shall be rated as shown on the Drawings but shall be not less than 600 amperes.
2. Each vertical section shall have a full height vertical bus rated not less than 300 amperes. Vertical buses shall be insulated and isolated with glass polyester or equivalent continuous insulation. Taped buses will not be acceptable. Unused stab openings shall be plugged. Lower ends of vertical buses shall be insulated.
3. A 1/4-inch-x-2-inch ground bus shall be furnished the entire length of the motor control centers.
4. Buses shall be braced for 65,000 amperes RMS, symmetrical, short circuit current.

5. All buses except neutral and ground buses shall be completely isolated by steel plates or insulating material.

C. Wiring

1. All wiring shall be copper.
2. Compartment wiring shall be to compartment mounted, plug-in terminal blocks that allow compartment to be withdrawn without having to remove wires from fixed terminal blocks.
3. Power wiring shall be black. Control wiring shall be red. Wiring energized from sources other than the starter control power transformer shall be yellow. All wiring shall be identified at each termination.

D. Signage

1. Each motor control center shall be furnished with a sign marked "DANGER - HIGH VOLTAGE". Letters shall be not less than 1-inch high, 114-inch stroke. Signs shall be laminated plastic, engraved red letters with a white background. Signs shall include voltage (i.e. 480v, 120v, etc.) and be fastened to with stainless steel screws and epoxy cement.
2. All compartments with voltages from sources outside of the compartment, not disconnected by the motor circuit protector, shall have a sign on the compartment door marked "CAUTION - THIS UNIT CONTAINS A VOLTAGE FROM A SOURCE OUTSIDE OF THIS UNIT". Letters shall be black on a high visibility yellow background. Background shall be laminated plastic approximately 3 inches x 5 inches.

## 2.03 COMPONENTS

A. Combination Motor Starters

1. All motor starters shall be a combination motor circuit protector and contactor, three-pole, 60 Hz, 600-volt, magnetically operated, of the types shown on the Drawings. NEMA sizes shall be as required for the horsepower shown on the Drawings but shall be not less than NEMA Size 1.
2. All motor starters shall have a 120-volt operating coil, overload relay in each phase and control power transformer.
3. All motor starters shall have 1-N.O. and 1-N.C. auxiliary contacts. Additional auxiliary contacts shall be furnished where shown on the Drawings or as required by the control scheme.

4. Full voltage, non-reversing starters, NEMA Size 4 and smaller shall be of plug-in type design with stab-on connectors engaging the vertical buses. Larger units shall be of fixed design.
5. Reduced-voltage starters shall be solid state type with isolation contactor and surge protection.
  - a. Construction:
    - (1) The power section shall be three phase, 60-hertz, and rated for the HP, current, and voltage as shown on the drawings. It shall consist of three sets of back-to-back phase-controlled power semi-conductors. Maximum current-limit shall be 500% for standard units.
    - (2) Resistor/Capacitor snubber networks shall be used to prevent false firing of SCR's due to dv/dt characteristics of the electrical system.
    - (3) Fan cooled units shall be supplied with thermal sensors on the heat sink to trip the control protective logic for over temperature condition. Thermal sensors shall be rated 90-degree C maximum.
    - (4) The one-piece logic board shall be mounted for easy testing, service and replacement.
    - (5) Three-phase current sensing via current transformers for closed loop control to insure motor stability shall be provided.
    - (6) A contactor shall be placed on the line side of the starter to automatically isolate the solid-state starter from the line when starter is not energized.
  - b. The logic circuitry shall include as a minimum:
    - (1) Short circuit electronic trip overcurrent protection. Time not to exceed 1/2 cycle.
    - (2) Inverse time running overcurrent protection.
    - (3) Auxiliary trip circuitry.
    - (4) Gate firing circuit lockout protection on trip.
    - (5) Fault relay lockout protection.
    - (6) 250% - 500% current limit adjustment.
    - (7) Minimum and maximum voltage adjustments.
    - (8) Voltage stability adjustment.
    - (9) Adjustable ramp time (0.5 to 30 seconds).
    - (10) HAND-OFF-REMOTE selector switch.

- c. The logic board shall include, as standard, current and voltage sensing circuitry that continually monitor motor load and regulate motor voltage to minimize motor kWh energy consumption.
  - d. External interface circuitry shall include 120-volt relay logic interface capability.
  - e. Tripped functions shall be designed to be cleared by removing power from the solid-state logic board.
  - f. The solid-state logic shall provide phase sequence protection.
  - g. Two ground lugs shall be furnished, one for incoming and one for outgoing ground connections.
  - h. Power terminations shall consist of pressure type terminals for top or bottom entrance.
  - i. Testing:
    - (1) The manufacturer shall supply certified test results, upon request, to confirm that the controller has been tested to substantiate designs according to applicable ANSI and NEMA Standards. The tests shall verify not only the performance of the unit and integrated assembly, but also the suitability of the enclosure venting, rigidity and bus bracing. In addition, the unit shall be factory tested in accordance with ANSI standards.
    - (2) Manufacturer shall be prepared to show proper evidence of having tested for noise immunity on both input and output power connections. Noise testing shall be performed in accordance with NEMA ICA 2-230.40.
6. Overload relays shall be adjustable and manually reset by push button in compartment door. Replaceable individual overload relay heaters of the proper size shall be installed in each phase.
  7. Control power transformers shall be sized for additional load where required. Transformer secondary shall be equipped with time-delay fuses.
  8. Motor circuit protectors shall be molded case with adjustable magnetic trip only. They shall be specifically designed for use with magnetic motor starters. Motor circuit protectors shall have auxiliary disconnect contacts when used with starters having external control circuits.

B. Circuit Breakers

1. Circuit breakers shall be thermal-magnetic, molded case, 480-volt, with not less than 65,000 amperes, RMS interrupting capacity. All circuit breakers with 225 amperes frame and larger shall have interchangeable trips. Circuit breakers shall have auxiliary disconnect contacts when used with starters having external control circuits.

C. Control Stations

1. Control stations shall be standard size, heavy-duty, oiltight.

D. Indicating Lights

1. Indicating lights shall be standard size, heavy duty, low voltage transformer operated as manufactured by Square-D type SK-Class 9001 or equal.

E. Running Time Meters

1. Running time meters shall be 3-1/2-inch-square case; non-reset, 99,999.9 hour range; Type 236 as manufactured by the General Electric Co., or equal.
2. Voltmeters, amp meters, and watt meters shall be 4-1/4-inch square, 250-degree scale, plus or minus 1-percent accuracy switchboard instruments; General Electric Co.'s Type AB-40, or equal.
3. A four-position selector switch shall be furnished and installed for selection of three phases and off.

F. Instrument Transformers

1. Instrument transformers shall be indoor, 600-volt, butyl-rubber molded, metering class designed in accordance with ANSI and NEMA standards.

G. Surge Protection

1. Surge protection equipment shall be a three-phase surge capacitor and three-phase lightning arrester. The lightning arrestor shall be General Electric Company's M.O.V. type, Catalog No. 9L15ECC001, or equal. Surge capacitor shall be General Electric Company Catalog No. 9L18BBB301, or equal.

H. Control Relays

1. Control relays shall be heavy-duty, machine tool type with suitable rated convertible contacts. Time delay relays shall be pneumatic, adjustable.
2. Relays shall be CR2810 and CR2920 as manufactured by General Electric Co., or equal.

I. Nameplates

1. Unit nameplates shall be black and white laminated plastic having engraved letters approximately 3/16-inch high extending through the black face into the white layer. Nameplates shall identify equipment controlled or circuit designation as applicable.

2.04 SPARE PARTS

A. The following spare parts shall be furnished:

1. One box of power fuses of each size furnished.
2. One set of starter contacts for each NEMA size installed.
3. One starter coil for each NEMA size installed.
4. One box of pilot lights.

PART 3 EXECUTION

3.01 INSTALLATION

- A. The motor control center housings shall be bolted to angle iron sills imbedded in the concrete on the two longest sides. The sills shall be the full length of the motor control center housing and shall be installed level in all directions.
- B. Field installed interior wiring shall be neatly grouped by circuit and bound by plastic tie wraps. Circuit groups shall be supported such that circuit termination are not stressed.
- C. The motor control centers shall be maintained in an upright position at all times. Lifting shall be only at the floor sills or the top mounted lifting angle.
- D. The motor control centers shall be protected against damage at all times. Any damage to the paint shall be carefully repaired using touch-up paint furnished by motor control centers manufacturer.

### 3.02 TESTS AND CHECKS

- A. The following minimum tests and checks shall be made after the assembly of the motor control centers, but before the termination of any field wiring.
  1. Megger terminals and buses after disconnecting devices sensitive to megger voltage.
  2. A 1,000 VDC megger shall be used for these tests.
  3. The first test shall be made with main circuit breaker closed and all remaining breakers open. A second test shall be made with all circuit breakers closed.
  4. The test results shall be recorded and forwarded to the Engineer for his review. Minimum megger readings shall be 100 megohms in both tests.
  5. Test failures will be the Contractors responsibility to correct at no charge to the Owner.
- B. The following shall be done before energizing the motor control centers:
  1. Remove all current transformer shunts after completing the secondary circuit.
  2. Install overload relay heaters based on actual motor nameplate current. If capacitors are installed between starter and motor, use overload relay heaters based on measured motor current.
  3. Check all mechanical interlocks for proper operation.
  4. Vacuum clean all interior equipment.

END OF SECTION

# **SECTION V**

## **CONTRACT DOCUMENTS**

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Bond No.: \_\_\_\_\_

**PUBLIC CONSTRUCTION BOND**

(1)

This bond is given to comply with § 255.05, Florida Statutes, and any action instituted by a claimant under this bond for payment must be in accordance with the notice and time limitation provisions in subsections (2) and (10).

Pursuant to § 255.05(1)(b), Florida Statutes, “**Before commencing the work** or before recommencing the work after a default or abandonment, **the contractor shall provide to the public entity a certified copy of the recorded bond**. Notwithstanding the terms of the contract or any other law governing prompt payment for construction services, the public entity may not make a payment to the contractor until the contractor has complied with this paragraph.”

| <b><u>CONTRACTOR</u></b>     | <b><u>SURETY</u></b>         | <b><u>OWNER</u></b>   |
|------------------------------|------------------------------|---|
| [name]                       | [name]                       | City of Clearwater<br>Engineering<br>100 S. Myrtle Avenue<br>Clearwater, FL 33756<br>(727) 562-4750 |
| [principal business address] | [principal business address] |   |
| [phone number]               | [phone number]               |   |

**PROJECT NAME:** MS WRF BLEND TANK MIXER

**PROJECT NO.:** 18-0057-UT

**PROJECT DESCRIPTION:** The work generally includes, but is not limited to, the following:

1. Demolish the following within the extents of the Existing Sludge Holding Tank: FRP Cover, Stairs, Supports, Structural Walkway, Aeration Piping, Existing Piping (as shown in the Contract Drawings).
2. Remove Grit, Sludge, and Rags remaining in existing Sludge Holding Tank and dispose off-site in accordance with FDEP regulations.
3. Temporarily remove, store, and protect FRP Odor Control Duct for reconnection to new Sludge Holding Tank Cover.
4. Install new Sludge Holding Tank Stairs and Walkway.
5. Drain, clean, and coat the interior (walls and floor) and exterior (walls) of the existing Sludge Holding Tank.
6. Demolish the existing Pump Station Pad and replace with structure elevated beyond the 100-year flood plain.

7. Install LED Light Pole systems and modify the existing Light Poles to be LED as specified on the Drawings near the Sludge Holding Tank.
8. Install a New Mixer in the Sludge Holding Tank.
9. Install a New Aluminum Cover with Access ladders and Harness Tie-Off Points from walkway on the Sludge Holding Tank.
10. Install New Truck Off-Loading and Recirculation Pump Station (as shown in the contract Drawings) southeast of the Sludge Holding Tank.
11. Remove and replace Dewatering Feed Pump Station Pumps and Piping located at the Sludge Holding Tank.
12. Remove concrete sidewalk and pad (as shown in the Contract Drawings), leaving appropriate base and support for stair landing and stair column supports.
13. Remove and replace process and drain piping to Sludge Holding Tank (as shown in the Contract Drawings).
14. Incorporate Electrical, Arc Flash Requirements, Instrumentation & Controls (I&C) and Supervisory Control and Data Acquisition (SCADA) Integration for proposed improvements.

BY THIS BOND, We, \_\_\_\_\_, as Contractor, and \_\_\_\_\_, a corporation, as Surety, are bound to the City of Clearwater, Florida, herein called Owner, in the sum of \$[x,xxx,xxx.xx], for payment of which we bind ourselves, our heirs, personal representatives, successors, and assigns, jointly and severally.

THE CONDITION OF THIS BOND is that if Contractor:

1. Performs the contract dated \_\_\_\_\_, between Contractor and Owner for construction of MS WRF Blend Tank Mixer, the contract documents being made a part of this bond by reference (which include the Advertisement for Bids, Proposal, Contract, Surety Bond, Instructions to Bidders, General Conditions, Plans, Technical Specifications and Appendix, and such alterations as may be made in said Plans and Specifications as therein provided for), at the times and in the manner prescribed in the contract; and
2. Promptly makes payments to all claimants, as defined in Section 255.05(1), Florida Statutes, supplying Contractor with labor, materials, or supplies, used directly or indirectly by Contractor in the prosecution of the work provided for in the contract; and

Bond No.: \_\_\_\_\_

**PUBLIC CONSTRUCTION BOND**  
**(2)**

3. Pays Owner all losses, damages, expenses, costs, and attorney's fees, including appellate proceedings, that Owner sustains because of a default by Contractor under the contract; and
4. To the limits of § 725.06(2), Florida Statutes, shall indemnify and hold harmless Owner, their officers and employees, from liabilities, damages, losses and costs, including, but not limited to, reasonable attorney's fees, to the extent caused by the negligence, recklessness, or intentional wrongful misconduct of Contractor and persons employed or utilized by Contractor in the performance of the construction contract; and
5. Performs the guarantee of all work and materials furnished under the contract for the time specified in the contract, then this bond is void; otherwise it remains in full force.
6. Any action instituted by a claimant under this bond for payment must be in accordance with the notice and time limitation provisions in Section 255.05(2), Florida Statutes.
7. Any changes in or under the contract documents and compliance or noncompliance with any formalities connected with the contract or the changes does not affect Surety's obligation under this bond, and Surety does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the contract or to the work or to the specifications.

**IN TESTIMONY WHEREOF**, witness the hands and seals of the parties hereto this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_.

*(If sole Ownership or Partnership, two (2) Witnesses required).*

*(If Corporation, Secretary only will attest and affix seal).*

**[TYPE LEGAL NAME OF CONTRACTOR]**

By: \_\_\_\_\_  
 Title: \_\_\_\_\_  
 Print Name: \_\_\_\_\_

**WITNESS:**

\_\_\_\_\_  
 Corporate Secretary or Witness  
 Print Name: \_\_\_\_\_

*(affix corporate seal)*

\_\_\_\_\_  
 Print Name: \_\_\_\_\_

\_\_\_\_\_  
*(Corporate Surety)*

By: \_\_\_\_\_  
 ATTORNEY-IN-FACT  
 Print Name: \_\_\_\_\_

*(affix corporate seal)*

*(Power of Attorney must be attached)*

**CONTRACT**  
(1)

This **CONTRACT** made and entered into this \_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_ by and between the City of Clearwater, Florida, a municipal corporation, hereinafter designated as the "City", and \_\_\_\_\_, of the City of \_\_\_\_\_ County of \_\_\_\_\_ and State of Florida, hereinafter designated as the "Contractor".

[Or, if out of state:]

This **CONTRACT** made and entered into this \_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_ by and between the City of Clearwater, Florida, a municipal corporation, hereinafter designated as the "City", and \_\_\_\_\_, a/an \_\_\_\_\_(State) Corporation authorized to do business in the State of Florida, of the City of \_\_\_\_\_ County of \_\_\_\_\_ and State of \_\_\_\_\_, hereinafter designated as the "Contractor".

**WITNESSETH:**

That the parties to this contract each in consideration of the undertakings, promises and agreements on the part of the other herein contained, do hereby undertake, promise and agree as follows:

The Contractor, and his or its successors, assigns, executors or administrators, in consideration of the sums of money as herein after set forth to be paid by the City and to the Contractor, shall and will at their own cost and expense perform all labor, furnish all materials, tools and equipment for the following:

**PROJECT NAME: MS WRF BLEND TANK MIXER**

**PROJECT NO.: 18-0057-UT**

**in the amount of \$\_\_\_\_\_**

In accordance with such proposal and technical supplemental specifications and such other special provisions and drawings, if any, which will be submitted by the City, together with any advertisement, instructions to bidders, general conditions, technical specifications, proposal and bond, which may be hereto attached, and any drawings if any, which may be herein referred to, are hereby made a part of this contract, and all of said work to be performed and completed by the contractor and its successors and assigns shall be fully completed in a good and workmanlike manner to the satisfaction of the City.

If the Contractor should fail to comply with any of the terms, conditions, provisions or stipulations as contained herein within the time specified for completion of the work to be performed by the Contractor, then the City, may at its option, avail itself of any or all remedies provided on its behalf and shall have the right to proceed to complete such work as Contractor is obligated to perform in accordance with the provisions as contained herein.

## **CONTRACT**

(2)

**THE CONTRACTOR AND HIS OR ITS SUCCESSORS AND ASSIGNS DOES HEREBY AGREE TO ASSUME THE DEFENSE OF ANY LEGAL ACTION WHICH MAY BE BROUGHT AGAINST THE CITY AS A RESULT OF THE CONTRACTOR'S ACTIVITIES ARISING OUT OF THIS CONTRACT AND FURTHERMORE, IN CONSIDERATION OF THE TERMS, STIPULATIONS AND CONDITIONS AS CONTAINED HEREIN, AGREES TO HOLD THE CITY FREE AND HARMLESS FROM ANY AND ALL CLAIMS FOR DAMAGES, COSTS OF SUITS, JUDGMENTS OR DECREES RESULTING FROM ANY CLAIMS MADE UNDER THIS CONTRACT AGAINST THE CITY OR THE CONTRACTOR OR THE CONTRACTOR'S SUB CONTRACTORS, AGENTS, SERVANTS OR EMPLOYEES RESULTING FROM ACTIVITIES BY THE AFOREMENTIONED CONTRACTOR, SUB CONTRACTOR, AGENT SERVANTS OR EMPLOYEES, TO THE LIMITS OF § 725.06(2).**

In addition to the foregoing provisions, the Contractor agrees to conform to the following requirements:

In connection with the performance of work under this contract, the Contractor agrees not to discriminate against any employee or applicant for employment because of race, sex, religion, color, or national origin. The aforesaid provision shall include, but not be limited to, the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; lay off or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post hereafter in conspicuous places, available for employees or applicants for employment, notices to be provided by the contracting officer setting forth the provisions of the non-discrimination clause.

The Contractor further agrees to insert the foregoing provisions in all contracts hereunder, including contracts or agreements with labor unions and/or worker's representatives, except sub-contractors for standard commercial supplies or raw materials.

It is mutually agreed between the parties hereto that time is of the essence of this contract, and in the event that the work to be performed by the Contractor is not completed within the time stipulated herein, it is then further agreed that the City may deduct from such sums or compensation as may be due to the Contractor the sum of **\$1,000.00 per day** for each day that the work to be performed by the Contractor remains incomplete beyond the time limit specified herein, which sum of **\$1,000.00 per day** shall only and solely represent damages which the City has sustained by reason of the failure of the Contractor to complete the work within the time stipulated, it being further agreed that this sum is not to be construed as a penalty but is only to be construed as liquidated damages for failure of the Contractor to complete and perform all work within the time period as specified in this contract.

It is further mutually agreed between the City and the Contractor that if, any time after the execution of this contract and the public construction bond which is attached hereto for the faithful performance of the terms and conditions as contained herein by the Contractor, that the City shall at any time deem the surety or sureties upon such public construction bond to be unsatisfactory or if, for any reason, the said bond ceases to be adequate in amount to cover the performance of the work the Contractor shall, at his or its own expense, within ten (10) days after receipt of written notice from the City to do so, furnish an additional bond or bonds in such term and amounts and with such surety or sureties as shall be satisfactory to the City. If such an event occurs, no further payment shall be made to the Contractor under the terms and provisions of this contract until such new or additional security bond guaranteeing the faithful performance of the work under the terms hereof shall be completed and furnished to the City in a form satisfactory to it.

**CONTRACT**

(3)

In addition to all other contract requirements as provided by law, the contractor executing this agreement agrees to comply with public records law.

IF THE CONTRACTOR HAS QUESTIONS REGARDING THE APPLICATION OF CHAPTER 119, FLORIDA STATUTES, THE CONTRACTORS DUTY TO PROVIDE PUBLIC RECORDS RELATING TO THIS CONTRACT. CONTACT THE CUSTODIAN OF PUBLIC RECORDS AT 727-562-4092, [Rosemarie.Call@myclearwater.com](mailto:Rosemarie.Call@myclearwater.com), 600 Cleveland St. Clearwater, FL 33756

The contractor's agreement to comply with public records law applies specifically to:

- a) Keep and maintain public records required by the City of Clearwater (hereinafter “public agency”) to perform the service being provided by the contractor hereunder.
- b) Upon request from the public agency’s custodian of public records, provide the public agency with a copy of the requested records or allow the records to be inspected or copied within a reasonable time at a cost that does not exceed the cost provided for in Chapter 119, Florida Statutes, as may be amended from time to time, or as otherwise provided by law.
- c) Ensure that the public records that are exempt or confidential and exempt from public records disclosure requirements are not disclosed except as authorized by law for the duration of the contract term and following completion of the contract if the contractor does not transfer the records to the public agency.
- d) Upon completion of the contract, transfer, at no cost, to the public agency all public records in possession of the contractor or keep and maintain public records required by the public agency to perform the service. If the contractor transfers all public records to the public agency upon completion of the contract, the contractor shall destroy any duplicate public records that are exempt or confidential and exempt from public records disclosure requirements. If the contractor keeps and maintains public records upon completion of the contract, the contractor shall meet all applicable requirements for retaining public records. All records stored electronically must be provided to the public agency, upon request from the public agency’s custodian of public records, in a format that is compatible with the information technology systems of the public agency.
- e) A request to inspect or copy public records relating to a public agency’s contract for services must be made directly to the public agency. If the public agency does not possess the requested records, the public agency shall immediately notify the contractor of the request and the contractor must provide the records to the public agency or allow the records to be inspected or copied within a reasonable time.
- f) The contractor hereby acknowledges and agrees that if the contractor does not comply with the public agency’s request for records, the public agency shall enforce the contract provisions in accordance with the contract.
- g) A contractor who fails to provide the public records to the public agency within a reasonable time may be subject to penalties under Section 119.10, Florida Statutes.
- h) If a civil action is filed against a contractor to compel production of public records relating to a public agency’s contract for services, the court shall assess and award against the contractor the reasonable costs of enforcement, including reasonable attorney fees, if:
  1. The court determines that the contractor unlawfully refused to comply with the public records request within a reasonable time; and

## **CONTRACT**

(4)

2. At least 8 business days before filing the action, the plaintiff provided written notice of the public records request, including a statement that the contractor has not complied with the request, to the public agency and to the contractor.
- i) A notice complies with subparagraph (h)2. if it is sent to the public agency's custodian of public records and to the contractor at the contractor's address listed on its contract with the public agency or to the contractor's registered agent. Such notices must be sent by common carrier delivery service or by registered, Global Express Guaranteed, or certified mail, with postage or shipping paid by the sender and with evidence of delivery, which may be in an electronic format.
  - j) A contractor who complies with a public records request within 8 business days after the notice is sent is not liable for the reasonable costs of enforcement.

**IN WITNESS WHEREOF**, the parties to the agreement have hereunto set their hands and seals and have executed this Agreement, the day and year first above written.

**CITY OF CLEARWATER  
IN PINELLAS COUNTY, FLORIDA**

By: \_\_\_\_\_ (SEAL)  
 William B. Horne, II  
 City Manager

Attest:

Countersigned: \_\_\_\_\_  
 Rosemarie Call  
 City Clerk

By: \_\_\_\_\_  
 Frank Hibbard  
 Mayor

Approved as to form:  
 \_\_\_\_\_  
 Owen Kohler  
 Assistant City Attorney

Contractor must indicate whether:

Corporation,  Partnership,  Company, or  Individual

\_\_\_\_\_  
 (Contractor)

By: \_\_\_\_\_ (SEAL)  
 Print Name: \_\_\_\_\_  
 Title: \_\_\_\_\_

The person signing shall, in his own handwriting, sign the Principal's name, his own name, and his title; where the person is signing for a Corporation, he must, by Affidavit, show his authority to bind the Corporation – **provide Affidavit**.

## **CONSENT OF SURETY TO FINAL PAYMENT**

TO OWNER: City of Clearwater      PROJECT NAME: MS WRF BLEND TANK MIXER  
Engineering                            PROJECT NO.: 18-0057-UT  
Department  
100 S. Myrtle Ave.      CONTRACT DATE: [REDACTED]  
Clearwater, FL 33756      BOND NO.: [REDACTED], recorded in O.R. Book [REDACTED],  
Page [REDACTED], of the Public Records of Pinellas County, Florida.

CONTRACTOR: [REDACTED]

Pursuant to § 255.05(11), Florida Statutes, and in accordance with the provisions of the Contract between the Owner and the Contractor as indicated above, the:

[insert name of Surety]  
[address]  
[address] ,SURETY,

on bond of

[insert name of Contractor]  
[address]  
[address] ,CONTRACTOR,

hereby approves of the final payment to the Contractor, and agrees that final payment to the Contractor shall not relieve Surety of any of its obligations to

City of Clearwater  
Engineering  
100 S. Myrtle Ave.  
Clearwater, FL 33756 ,OWNER,

as set forth in said Surety's bond.

IN WITNESS WHEREOF, the Surety has hereunto set its hand this \_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_

\_\_\_\_\_  
(Surety)

\_\_\_\_\_  
(Signature of authorized representative)

\_\_\_\_\_  
(Printed name and title)

Attest:  
(Seal):

**PROPOSAL/BID BOND**

(Not to be filled out if a certified check is submitted)

**KNOWN ALL MEN BY THESE PRESENTS:** That we, the undersigned, \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ as Contractor, and \_\_\_\_\_  
\_\_\_\_\_ as Surety, whose address is \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_, are held and firmly bound unto the City  
of Clearwater, Florida, in the sum of \_\_\_\_\_ Dollars  
(\$\_\_\_\_\_) (being a minimum of 10% of Contractor's total bid amount) for the payment of which,  
well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors,  
administrators, successors and assigns.

The condition of the above obligation is such that if the attached Proposal of \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ as Contractor, and \_\_\_\_\_ as Surety, for  
work specified as: \_\_\_\_\_

all as stipulated in said Proposal, by doing all work incidental thereto, in accordance with the plans and  
specifications provided herefor, all within Pinellas County, is accepted and the contract awarded to the  
above named bidder, and the said bidder shall within ten days after notice of said award enter into a contract,  
in writing, and furnish the required Public Construction Bond with surety or sureties to be approved by the  
City Manager, this obligation shall be void, otherwise the same shall be in full force and virtue by law and  
the full amount of this Proposal/Bid Bond will be paid to the City as stipulated or liquidated damages.

Principal must indicate whether:

Corporation,  Partnership,  Company, or  Individual

Signed this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_.

\_\_\_\_\_  
Contractor

\_\_\_\_\_  
Principal

By: \_\_\_\_\_  
Title  
\_\_\_\_\_  
\_\_\_\_\_

\_\_\_\_\_  
Surety

The person signing shall, in his own handwriting, sign the Principal's name, his own name, and his title;  
where the person is signing for a Corporation, he must, by Affidavit, show his authority to bind the  
Corporation – **provide Affidavit**.

## AFFIDAVIT

(To be filled in and executed if the bidder is a corporation)

**STATE OF FLORIDA**

**COUNTY OF** \_\_\_\_\_)

\_\_\_\_\_, being duly sworn, deposes and says that he/she is  
Secretary of \_\_\_\_\_  
a corporation organized and existing under and by virtue of the laws of the State of Florida, and having its  
principal office at:

(Street & Number)      (City)      (County)      (State)

Affiant further says that he is familiar with the records, minute books and by-laws of

(Name of Corporation)

Affiant further says that \_\_\_\_\_ is \_\_\_\_\_  
(Officer's Name) (Title)

of the corporation, is duly authorized to sign the Proposal for \_\_\_\_\_

or said corporation by virtue of \_\_\_\_\_  
(state whether a provision of by laws or a Resolution of  
Board of Directors. If by Resolution give date of adoption).

Affiant

Sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_.

---

Notary Public

Type/print/stamp name of Notary

**Title or rank, and Serial No., if any**

**NON-COLLUSION AFFIDAVIT**

**STATE OF FLORIDA**                      )  
**COUNTY OF \_\_\_\_\_)**

\_\_\_\_\_, being, first duly sworn, deposes and says that he is  
of \_\_\_\_\_, the party making the foregoing Proposal or Bid; that such Bid is genuine and not collusive or sham; that said bidder is not financially interested in or otherwise affiliated in a business way with any other bidder on the same contract; that said bidder has not colluded, conspired, connived, or agreed, directly or indirectly, with any bidders or person, to put in a sham bid or that such other person shall refrain from bidding, and has not in any manner, directly or indirectly, sought by agreement or collusion, or communication or conference, with any person, to fix the bid price or affiant or any other bidder, or to fix any overhead, profit or cost element of said bid price, or that of any other bidder, or to secure any advantage against the City of Clearwater, Florida, or any person or persons interested in the proposed contract; and that all statements contained in said proposal or bid are true; and further, that such bidder has not directly or indirectly submitted this bid, or the contents thereof, or divulged information or data relative thereto to any association or to any member or agent thereof.

---

Affiant

Sworn to and subscribed before me this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_.

---

Notary Public

**PROPOSAL**

(1)

**TO THE CITY OF CLEARWATER, FLORIDA, for**

**MS WRF BLEND TANK MIXER (#18-0057-UT)**

and doing such other work incidental thereto, all in accordance with the contract documents, marked

**MS WRF BLEND TANK MIXER (#18-0057-UT)**

Every bidder must take notice of the fact that even though his proposal be accepted and the documents signed by the bidder to whom an award is made and by those officials authorized to do so on behalf of the City of Clearwater, Florida, that no such award or signing shall be considered a binding contract without a certificate from the Finance Director that funds are available to cover the cost of the work to be done, or without the approval of the City Attorney as to the form and legality of the contract and all the pertinent documents relating thereto having been approved by said City Attorney; and such bidder is hereby charged with this notice.

The signer of the Proposal, as bidder, also declares that the only person, persons, company or parties interested in this Proposal, are named in this Proposal, that he has carefully examined the Advertisement, Instructions to Bidders, Contract Specifications, Plans, Supplemental Specifications, General Conditions, Special Provisions, and Public Construction Bond, that he or his representative has made such investigation as is necessary to determine the character and extent of the work and he proposes and agrees that if the Proposal be accepted, he will contract with the City of Clearwater, Florida, in the form of contract; hereto annexed, to provide the necessary labor, materials, machinery, equipment, tools or apparatus, do all the work required to complete the contract within the time mentioned in the General Conditions and according to the requirements of the City of Clearwater, Florida, as herein and hereinafter set forth, and furnish the required surety bonds for the following prices to wit:

If the foregoing Proposal shall be accepted by the City of Clearwater, Florida, and the undersigned shall fail to execute a satisfactory contract as stated in the Advertisement herein attached, then the City may, at its option determine that the undersigned has abandoned the contract, and thereupon this Proposal shall be null and void, and the certified check or bond accompanying this Proposal, shall be forfeited to become the property of the City of Clearwater, Florida, and the full amount of said check shall be retained by the City, or if the Proposal Bond be given, the full amount of such bond shall be paid to the City as stipulated or liquidated damages; otherwise, the bond or certified check accompanying this Proposal, or the amount of said check, shall be returned to the undersigned as specified herein.

**PROPOSAL**  
(2)

Attached hereto is a bond or certified check on \_\_\_\_\_  
\_\_\_\_\_, Bank, for the sum of \_\_\_\_\_  
\_\_\_\_\_ (\$\_\_\_\_\_)  
(being a minimum of 10% of Contractor's total bid amount).

The full names and residences of all persons and parties interested in the foregoing bid are as follows:

(If corporation, give the names and addresses of the President and Secretary. If firm or partnership, the names and addresses of the members or partners. The Bidder shall list not only his name but also the name of any person with whom bidder has any type of agreement whereby such person's improvements, enrichment, employment or possible benefit, whether sub-contractor, materialman, agent, supplier, or employer is contingent upon the award of the contract to the bidder).

NAMES: \_\_\_\_\_ ADDRESSES: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Signature of Bidder: \_\_\_\_\_

The person signing shall, in his own handwriting, sign the Principal's name, his own name and his title. Where the person signing for a corporation is other than the President or Vice President, he must, by affidavit, show his authority, to bind the corporation.

Principal: \_\_\_\_\_

By: \_\_\_\_\_ Title: \_\_\_\_\_

Company Legal Name: \_\_\_\_\_

Doing Business As (if different than above): \_\_\_\_\_

Business Address of Bidder: \_\_\_\_\_

City and State: \_\_\_\_\_ Zip Code \_\_\_\_\_

Phone: \_\_\_\_\_ Email Address: \_\_\_\_\_

Dated at \_\_\_\_\_, this \_\_\_\_\_ day of \_\_\_\_\_, A.D., 20\_\_.

**CITY OF CLEARWATER**  
**ADDENDUM SHEET**

**PROJECT: MS WRF BLEND TANK MIXER (#18-0057-UT)**

Acknowledgment is hereby made of the following addenda received since issuance of Plans and Specifications.

Addendum No. \_\_\_\_\_ Date: \_\_\_\_\_

\_\_\_\_\_  
(Name of Bidder)

\_\_\_\_\_  
(Signature of Officer)

\_\_\_\_\_  
(Title of Officer)

\_\_\_\_\_  
(Date)

**PROJECT: MS WRF BLEND TANK MIXER (#18-0057-UT)**

CONTRACTOR: \_\_\_\_\_

BIDDER'S GRAND TOTAL: \$\_\_\_\_\_ (Numbers)

BIDDER'S GRAND TOTAL: \_\_\_\_\_

\_\_\_\_\_ (Words)

**Bidder's Proposal****MS WRF Blend Tank Mixer #18-0057-UT**

CONTRACTOR:

BIDDER'S GRAND TOTAL: \$(Numbers)

BIDDER'S GRAND TOTAL: \$(Words)

| ITEM NO.                             | DESCRIPTION OF BASE BID ITEMS   | UNIT | EST. QTY. | UNIT PRICE | TOTAL |
|--------------------------------------|---|------|-----------|------------|-------|
| <b>MS WRF Blend Tank Mixer</b>       |   |      |           |            |       |
| 1                                    | Mobilization, Demobilization, and General Conditions (Not to exceed 5% of the Base Bid) | LS   | 1         |            | \$ -  |
| 2                                    | Remove Contents of Existing Sludge Hlding Tank  | CY   | 300       |            | \$ -  |
| 3                                    | Demolition  | LS   | 1         |            | \$ -  |
| 4                                    | Existing Odor control Piping, Stairs, and Sludge Holding Tank Walkway Replacement       | LS   | 1         |            | \$ -  |
| 5                                    | Clean and Coat the Interior and Exterior of the Existing Sludge Holding Tank            | LS   | 1         |            | \$ -  |
| 6                                    | Sludge Holding Tank and Pump Station Equipment and Rehabilitation                       | LS   | 1         |            | \$ -  |
| 7                                    | Record Drawings   | LS   | 1         |            | \$ -  |
| <b>Subtotal</b>                      |   |      |           |            |       |
| 8                                    | 10 % Contingency  | LS   | 1         | \$ -       | \$ -  |
| <b>Total MS WRF Blend Tank Mixer</b> |   |      |           |            |       |
|                                      |   |      |           |            |       |
|                                      | <b>Bidder's Grand Total</b>   |      |           |            | \$ -  |

**THE BIDDER'S GRAND TOTAL ABOVE IS HIS TOTAL BID BASED ON HIS UNIT PRICES AND LUMP SUM PRICES AND THE ESTIMATED QUANTITIES REQUIRED FOR EACH SECTION. THIS FIGURE IS FOR INFORMATION ONLY AT THE TIME OF OPENING BIDS. THE CITY WILL MAKE THE TABULATION FROM THE UNIT PRICES AND LUMP SUM PRICE BID. IF THERE IS AN ERROR IN THE TOTAL BY THE BIDDER, IT SHALL BE CHANGED AS ONLY THE UNIT PRICES AND LUMP SUM PRICE SHALL GOVERN.**

**THE CONTRACTOR SHALL PROVIDE COPIES OF A CURRENT CONTRACTOR LICENSE/REGISTRATION WITH THE STATE OF FLORIDA AND PINELLAS COUNTY IN THE BID RESPONSE.**

**SCRUTINIZED COMPANIES AND BUSINESS OPERATIONS WITH  
CUBA AND SYRIA CERTIFICATION FORM**

***PER SECTION III, ITEM 25, IF YOUR BID IS \$1,000,000 OR MORE, THIS FORM MUST BE  
COMPLETED AND SUBMITTED WITH THE BID PROPOSAL. FAILURE TO SUBMIT THIS  
FORM AS REQUIRED, MAY DEEM YOUR SUBMITTAL NONRESPONSIVE.***

The affiant, by virtue of the signature below, certifies that:

1. The vendor, company, individual, principal, subsidiary, affiliate, or owner is aware of the requirements of section 287.135, Florida Statutes, regarding companies on the Scrutinized Companies with Activities in Sudan List, the Scrutinized Companies with Activities in the Iran Petroleum Energy Sector List, or engaging in business operations in Cuba and Syria; and
2. The vendor, company, individual, principal, subsidiary, affiliate, or owner is eligible to participate in this solicitation and is not listed on either the Scrutinized Companies with Activities in Sudan List, the Scrutinized Companies with Activities in the Iran Petroleum Sector List, or engaged in business operations in Cuba and Syria; and
3. Business Operations means, for purposes specifically related to Cuba or Syria, engaging in commerce in any form in Cuba or Syria, including, but not limited to, acquiring, developing, maintaining, owning, selling, possessing, leasing or operating equipment, facilities, personnel, products, services, personal property, real property, military equipment, or any other apparatus of business or commerce; and
4. If awarded the Contract (or Agreement), the vendor, company, individual, principal, subsidiary, affiliate, or owner will immediately notify the City of Clearwater in writing, no later than five (5) calendar days after any of its principals are placed on the Scrutinized Companies with Activities in Sudan List, the Scrutinized Companies with Activities in the Iran Petroleum Sector List, or engages in business operations in Cuba and Syria.

---

Authorized Signature

---

Printed Name

---

Title

---

Name of Entity/Corporation

**STATE OF** \_\_\_\_\_

**COUNTY OF** \_\_\_\_\_

The foregoing instrument was acknowledged before me on this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, by \_\_\_\_\_ (name of person whose signature is being notarized) as the \_\_\_\_\_ (title) of \_\_\_\_\_ (name of corporation/entity), personally known to me as described herein \_\_\_\_\_, or produced a \_\_\_\_\_ (type of identification) as identification, and who did/did not take an oath.

---

Notary Public

---

Printed Name

My Commission Expires: \_\_\_\_\_  
NOTARY SEAL ABOVE

**SCRUTINIZED COMPANIES THAT BOYCOTT ISRAEL LIST**  
**CERTIFICATION FORM**

***PER SECTION III, ITEM 25, THIS FORM MUST BE COMPLETED AND SUBMITTED WITH THE BID PROPOSAL. FAILURE TO SUBMIT THIS FORM AS REQUIRED, MAY DEEM YOUR SUBMITTAL NONRESPONSIVE.***

The affiant, by virtue of the signature below, certifies that:

1. The vendor, company, individual, principal, subsidiary, affiliate, or owner is aware of the requirements of section 287.135, Florida Statutes, regarding companies on the Scrutinized Companies that Boycott Israel List, or engaged in a boycott of Israel; and
2. The vendor, company, individual, principal, subsidiary, affiliate, or owner is eligible to participate in this solicitation and is not listed on the Scrutinized Companies that Boycott Israel List, or engaged in a boycott of Israel; and
3. “Boycott Israel” or “boycott of Israel” means refusing to deal, terminating business activities, or taking other actions to limit commercial relations with Israel, or persons or entities doing business in Israel or in Israeli-controlled territories, in a discriminatory manner. A statement by a company that it is participating in a boycott of Israel, or that it has initiated a boycott in response to a request for a boycott of Israel or in compliance with, or in furtherance of, calls for a boycott of Israel, may be considered as evidence that a company is participating in a boycott of Israel; and
4. If awarded the Contract (or Agreement), the vendor, company, individual, principal, subsidiary, affiliate, or owner will immediately notify the City of Clearwater in writing, no later than five (5) calendar days after any of its principals are placed on the Scrutinized Companies that Boycott Israel List, or engaged in a boycott of Israel.

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Authorized Signature

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Printed Name

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Title

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Name of Entity/Corporation

**STATE OF** \_\_\_\_\_

**COUNTY OF** \_\_\_\_\_

The foregoing instrument was acknowledged before me on this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, by \_\_\_\_\_ (name of person whose signature is being notarized) as the \_\_\_\_\_ (title) of \_\_\_\_\_ (name of corporation/entity), personally known to me as described herein \_\_\_\_\_, or produced a \_\_\_\_\_ (type of identification) as identification, and who did/did not take an oath.

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Notary Public

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Printed Name

My Commission Expires: \_\_\_\_\_  
NOTARY SEAL ABOVE