**The Enclosed Document Is Provided For Your Convenience.**

# Please Email ALL Questions:

**MailTo:ContractAdministration@TampaGov.net**

**Please Let Us Know If You Plan To Bid**

City of Tampa
Contract Administration Department
306 E. Jackson St. #280A4N
Tampa, FL 33602
(813)274-8456

CITY OF
TAMPA, FLORIDA

NOTICE TO BIDDERS, INSTRUCTIONS TO BIDDERS
PROPOSAL, BID BOND, FORM OF NOTICE OF AWARD,
AGREEMENT, PERFORMANCE BOND AND
SPECIFICATIONS

FOR

## Contract 15-C-00037

# HOWARD F. CURREN DIFFUSED AIR REACTOR IMPROVEMENTS, PHASE 1

City of Tampa
CONTRACT ADMINISTRATION DEPARTMENT
TAMPA MUNICIPAL OFFICE BUILDING
306 E. JACKSON STREET - 4TH FLOOR NORTH
TAMPA, FLORIDA 33602

DECEMBER 2015

CITY OF TAMPA
CONTRACT ADMINISTRATION DEPARTMENT
306 E. Jackson Street 280A4N
Tampa, FL 33602

**********

BID NOTICE MEMO

**********

Bids will be received no later than 1:30 p.m. on the indicated Date(s) for the following Project(s):

**********

CONTRACT NO.: 15-C-00037; Howard F. Curren AWTP Diffused Air Reactor Improvements, Phase I
BID DATE: February 23, 2016 ESTIMATE: $1,800,000 SCOPE: The project comprises furnishing all labor, materials and equipment to remove and replace aeration diffusers, mixers, vegetation, and associated appurtenances within reactor No.1, install internal recycle pump, backflow device, crane davit, and associated piping and appurtenances, install water quality probes (nitrate, ammonium, pH, DO) , PLC, air metering devices, and all associated electrical conduits, panels, and wiring, perform programming to automatically adjust air flow and internal recycle based on probe conditions defined by COT, perform SCADA integration, with all associated work required for a complete project in accordance with the Contract Documents. PRE-BID CONFERENCE: Tuesday, February 09, 2016, 10:00 a.m. at the AWTP Maintenance Building Training Room, 2700 Maritime Drive, Tampa, FL 33619. Attendance is not mandatory, but recommended. Firms must email names and companies represented for all attendees a minimum of 24 hours in advance to Richard.Birchmire@tampagov.net Mariam.Vliet@tampagov.net and Elaine.Tait@tampagov.net to obtain security clearance.

**********

Bids will be opened in the 4th Floor Conference Room, Tampa Municipal Office Building, 306 E. Jackson Street, Tampa, Florida 33602. Pre-Bid Conference is held at the same location unless otherwise indicated. Plans and Specifications and Addenda for this work may be examined at, and downloaded from, www.demandstar.com. Backup files are available at http://www.tampagov.net/contract-administration/programs/construction-project-bidding. Subcontracting opportunities may exist for City certified Small Local Business Enterprises (SLBEs). A copy of the current SLBE directory may be obtained at www.Tampagov.net. Phone (813) 274-8456 for assistance. Email Technical Questions to: contractadministration@tampagov.net .

# CITY OF TAMPA

**Bob Buckhorn, Mayor** | **CONTRACT ADMINISTRATION DEPARTMENT**

Michael W. Chucran, Director

**ADDENDUM NO. 1**

**DATE: December 18, 2015**

Contract 15-C-00037; Howard F. Curren AWTP Diffused Air Reactor Improvements, Phase I

Bidders on the above referenced project are hereby notified that the following addendum is made to the Contract Documents. BIDS TO BE SUBMITTED SHALL CONFORM TO THIS NOTICE.

Item 1: The Bid Date for the above referenced project is hereby changed to February 23, 2016.

Item 2: The pre-bid date is hereby changed to February 9, 2016.

All other provisions of the Contract Documents and Specifications not in conflict with this Addendum shall remain in full force and effect. Questions are to be e-mailed to Contract Administration@tampagov.net.

Jim Greiner

Jim Greiner, P.E., Contract Management Supervisor

**306 E. Jackson Street, 4N • Tampa, Florida 33602 • (813) 274-8456 • FAX: (813) 274-8080**

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# TABLE OF CONTENTS


## BIDDING REQUIREMENTS

Notice to Bidders....N-1
Instructions to Bidders....I-1a thru I-4
Insurance Requirements....INS-1 thru INS-2
SLBE Goal Setting List....GS-1
Goal Contact List Instructions....GCL-1
Sample Solicitation Letter....SL-1

## BID FORMS

Proposal....P-1 thru P-6
Good Faith Efforts Compliance Plan....GFECP
SLBE Solicited....DMI – Solicited
SLBE Utilized....DMI – Utilized
Bid Bond....BB-1

## CONTRACT FORMS

Agreement....A-1 thru A-15
Public Construction Bond....PB-1 thru PB-3

## GENERAL PROVISIONS

General Provisions....G-1 thru G-10
Supplementary General Provisions....SGP-1 thru SGP-6
Special Conditions....SC-1 thru SC-4
Subcontractors Payment Form....DMI - Payments
Project Sign....Sign-1 thru Sign-2

## SPECIFICATION

Section 01010 – Summary of Work....01010-1 thru 01010-2
Section 01020 – Allowances....01020-1 thru 01020-2
Section 01040 – Project Coordination....01040-1 thru 01040-10
Section 01390 – Pre-Construction Audio Video....01390-1 thru 01390-3
Section 01650 – Start-up and Demonstration....01650-1 thru 01650-8
Section 01720 – Project Record Documents....01720-1 thru 01720-3
Section 01730 – Operating and Maintenance Data....01730-1 thru 01730-9
Section 02050 – Demolition and Maintenance of Service During Construction....02050-1 thru 02050-8
Section 03310 – Concrete Work....03310-1 thru 03310-28
Section 03930 – Repair Existing Concrete Structures....03930-1 thru 03930-3
Section 05140 – Structural Aluminum....05140-1 thru 05140-3
Section 05520 – Handrails and Railings....05520-1 thru 05520-7

Section 05531 – Bar Gratings .....05531-1 thru 05531-7
Section 09900 – Painting.....09900-1 thru 09900-19
Section 09905 – Piping, Valve, and Equipment Identification System.....09905-1 thru 09905-7
Section 11209 – Submersible Horizontal Propeller Pumps.....11209-1 thru 11209-7
Section 11225 – Pier Mounted Vertical Turbine Mixers.....11225-1 thru 11225-10
Section 11376 – Fine Bubble Diffused Aeration System.....11376-1 thru11376-25
Section 13600 – Instrumentation General Provisions.....13600-1 thru 13600-31
Section 13610 – Functional Control Descriptions.....13610-1 thru 13610-10
Section 13615 – Process Instrumentation and Controls – Products.....13615-1 thru 13615-20
Section 13620 – Digital Process Control Computers.....13620-1 thru 13620-6
Section 13625 – Process Control Input/Output Modules.....13625-1 thru 13625-5
Section 13630 – Dissolved Oxygen Process Measurement Devices.....13630-1 thru 13630-6
Section 13635 – PH Level Process Measurement Devices.....13635-1 thru 13635-6
Section 13640 – Total Suspended Solids Process Measurement Devices.....13640-1 thru 13640-6
Section 13645 – Dual Ammonium and Nitrate Process Measurement Devices.....13645-1 thru 13645-7
Section 13650 – Ammonium Process Measurement Devices.....13650-1 thru 13650-7
Section 13655 – Nitrate Process Measurement Devices.....13655-1 thru 13655-7
Section 14610 – Manual Davit Crane.....14610-1 thru 14610-4
Section 15000 – Mechanical – General Requirements.....15000-1 thru 1500-12
Section 15044 – Pressure Testing of Piping.....15044-1 thru 15044-3
Section 15050 – Process and Utility Piping, Fittings, Valves, and Accessories.....15050-1 thru 15050-14
Section 15066 – Stainless Steel Pipe and Fittings.....15066-1 thru 15066-7
Section 15126 – Pipe Hangers and Supports.....15126-1 thru 15126-10
Section 16050 – Electrical – General Provisions.....16050-1 thru 16050-6
Section 16110 – Raceways and Fittings.....16110-1 thru 16110-5
Section 16120 – Wires and Cables.....16120-1 thru 16120-4
Section 16130 – Boxes.....16130-1 thru 16130-2
Section 16140 – Wiring Devices.....16140-1 thru 16140-4
Section 16150 – Motors.....16150-1 thru 16150-6
Section 16170 – Safety Switches.....16170-1 thru 16170-2
Section 16450 – Grounding System.....16450-1 thru 16450-3
Section 16485 – Variable Frequency Drives.....16485-9

PLANS 44 Sheets of Drawings

NOTICE TO BIDDERS
CITY OF TAMPA, FLORIDA
Contract 15-C-00037; Howard F. Curren Diffused Air Reactor Improvements, Phase 1

Sealed Proposals will be received by the City of Tampa no later than 1:30 P.M., February 23, 2016, in the 4th Floor Conference Room, Tampa Municipal Office Building, 306 E. Jackson Street, Tampa, Florida, there to be publicly opened and read aloud.

The proposed work is to include, but not be limited to, furnishing all labor, materials and equipment to remove and replace aeration diffusers, mixers, vegetation, and associated appurtenances within reactor No.1, install internal recycle pump, backflow device, crane davit, and associated piping and appurtenances, install water quality probes (nitrate, ammonium, pH, DO) , PLC, air metering devices, and all associated electrical conduits, panels, and wiring, perform programming to automatically adjust air flow and internal recycle based on probe conditions defined by COT, perform SCADA integration, with all associated work required for a complete project in accordance with the Contract Documents.

The Instructions to Bidders, Proposal, Form of Bid Bond, Agreement, Form of Public Construction Bond, Specifications, Plans and other Contract Documents are posted at DemandStar.com. Backup files may be downloaded from http://www.tampagov.net/contract-administration/programs/construction-project-bidding. One set may be available for reference at the office of the Contract Administration Department, Municipal Office Building, Fourth Floor North, City Hall Plaza, Tampa, Florida 33602.

Each Proposal must be submitted on the Proposal form included in the Specifications and must be accompanied by a certified check or cashier's check on a solvent bank or trust company in compliance with Section 255.051, Florida Statutes, made payable to the City of Tampa, in an amount of not less than five per cent of the total bid, or a Bid Bond, of like amount, on the form set forth in the Contract Documents, as a guarantee that, if the Proposal is accepted, the Bidder will execute the Proposed Contract and furnish a Public Construction Bond within twenty (20) days after receipt of Notice of Award of Contract.

The City of Tampa reserves the right to reject any or all Bids and to waive any informalities in the Bid and/or Bid Bond. Acceptance or rejection of Proposals will be made as soon as practicable after the Proposals are received, but the City reserves the right to hold Proposals for ninety (90) days from the date of Opening.

Bid Protest Procedures: Unless subsequently indicated otherwise, in a revised posting on the Department's web page for Construction Project Bidding, the City of Tampa intends to award the referenced project to the lowest bidder listed in the tabulation posted on or about the date of Bid Opening. A bidder aggrieved by this decision may file a protest not later than 4:30 P.M., five (5) business days from the first posting thereof, pursuant to City of Tampa Code Chapter 2, Article V, Division 3, Section 2-282, Procurement Protest Procedures. Protests not conforming therewith shall not be reviewed.

Communication with City Staff

Pursuant to City of Tampa Ordinance 2010-92, during the solicitation period, including any protest and/or appeal, NO CONTACT initiated by bidders or responders with City officers or employees, other than the individuals specified below is permitted:
Contracts Management Supervisor, Jim Greiner
Contract Officer, Jody Gray
The City's Legal Department staff
The City's Contract Administration Department staff.
Technical Questions and Requests For Information should be directed to the Department via
ContractAdministration@tampagov.net

"A person or affiliate who has been placed on the convicted vendor list following a conviction for a public entity crime may not submit a bid on a contract to provide any goods or services to a public entity, may not submit a bid on a contract with a public entity for the construction or repair of a public building or public work, may not submit bids on leases of real property to a public entity, may not be awarded or perform work as a contractor, supplier, subcontractor, or consultant under a contract with any public entity, and may not transact business with any public entity in excess of the threshold amount provided in Section 287.017, for CATEGORY TWO for a period of 36 months from the date of being placed on the convicted vendor list." Refer to Section 287.133 Florida Statues.

In accordance with the City of Tampa's Equal Business Opportunity Ordinance, a Goal may have been established for subcontracting with Small Local Business Enterprises, SLBEs, certified by the City. A link to the current complete directory of SLBEs is on the Minority Business Development Office Website.

# INSTRUCTIONS TO BIDDERS
## SECTION 1 - SPECIAL INSTRUCTIONS

I-1.01 GENERAL:

The proposed work is the Howard F. Curren Diffused Air Reactor Improvements, Phase 1 in the City of Tampa, as required for a complete project, as shown on the plans and detailed in the specifications. The work is located on land owned or controlled by the City of Tampa.

I-1.02 FORM PREPARATION AND PRESENTATION OF PROPOSALS: Replace the second sentence with the following: Submission of the entire specification book is not required.

I-1.03 ADDENDA – Section I-2.03 is replaced with the following: No interpretation of the meaning of the Plans, Specifications, or other Contract Documents will be made to any Bidder orally.

Every request for such interpretation must be in writing, addressed to the City of Tampa, Contract Administration Department, 306 E. Jackson St., 4th Floor, Tampa, Florida 33602 and then emailed to ContractAdministration@tampagov.net. To be given consideration, such request must be received at least seven (7) days prior to the date fixed for the opening of the Proposals. Any and all such interpretations and any supplemental instructions will be in the form of written addenda which, if issued, will be posted on DemandStar.Com and on the Department's web page, with notice given to all prospective bidders at the respective fax numbers or e-mail addresses furnished, for such purposes. Failure of any Bidder to receive any such addenda shall not relieve said Bidder from any obligation under his Proposal as submitted. All addenda so issued shall become part of the Contract Documents.

I-1.04 SIGNATURE OF BIDDERS: Section I-2.07 is replaced with the following:

Proposals must be signed in ink by the Bidder with signature in full. When firm is a Bidder, the Proposal shall be signed in the name of the firm by one or more partners. When a corporation is a bidder the officer signing shall set out the corporate name in full beneath which he shall sign his name and give the title of his office. The Proposal shall also bear the seal of the corporation attested by its secretary.

If the bidder referred to in Section I-2.07 is a corporation, it must submit; upon request, a copy of its filed Articles of Incorporation. In addition, if the bidder was incorporated in another state, it must establish that it is authorized to do business in the State of Florida. If the bidder is using a fictitious name, it must submit upon request, proof of registration of such name with the Clerk of the Circuit Court of the Country where its principal place of business is. Failure to submit what is required is grounds to reject the bid of that bidder.

I-1.05 TIME FOR COMPLETION:

The work shall be arranged to be completed in accordance with a progress schedule approved by the Construction Engineer.

The time for completion of this project, referred in Article 4.01 of the Agreement, shall be 360 consecutive calendar days. The period for performance shall start from the date indicated in the Notice To Proceed.

I-1.06 LIQUIDATED DAMAGES:

The amount of liquidated damages, referred to in Article 4.06 of the Agreement, for completion of this project shall be $500.00 per calendar day.

I-1.07 BASIS OF AWARD OF CONTRACT:

The basis of award referred to in Item I-2.11 of Instructions to Bidders shall be the greatest amount of work, which can be accomplished within the funds available as budgeted. The award may be made on the basis of the total bid, base bid, alternates(s) if any, unit bids if any, or any combination thereof deemed to be in the best interest of the City.

INSTRUCTIONS TO BIDDERS
SECTION 1 - SPECIAL INSTRUCTIONS

Unless all bids are rejected, the award will be made within 90 days after opening proposals.

I-1.08 GROUND BREAKING CEREMONY:

Arrangement may be made by the City in coordination with the Contractor, for construction to commence with a Ground Breaking Ceremony. Details will be discussed at the pre-construction conference.

I-1.09 INSURANCE:

The insurance required for this project shall be as indicated on Pages beginning with INS-1. Before commencing work, the Contractor shall provide the evidence of the insurance required on a Certificate of Insurance accompanied by evidence of authority to bind the insurance company or companies such as agents license, power of attorney, or letter of authority.

I-1.10 EQUAL BUSINESS OPPORTUNITY PROGRAM / SLBE / REQUIREMENTS

In accordance with the City of Tampa's Equal Business Opportunity Program, a goal of 8.3% has been established for subcontracting with Small Local Business Enterprises, (SLBEs), certified by the City. The goal is based upon the availability of the firms listed on the Subcontract Goal Contract List included herein.

BIDDERS MUST SOLICIT ALL SLBEs ON THAT LIST and provide documentation of emails, faxes, phone calls, letters, or other communication with the firms as a first step to demonstrate Good Faith Efforts to achieve the goal. The list is formatted to facilitate e-mail solicitations to the listed firms by copying and pasting e-mail addresses.

Bidders may explore other opportunities for subcontracting with SLBEs by consulting the current directory of all certified SLBEs posted on the Minority Business Development Office web page.

GOOD FAITH EFFORT COMPLIANCE PLAN REQUIRED - When a Goal has been established, the Bidder must submit, with its bid, completed to the fullest extent possible, a Good Faith Effort Compliance Plan using the form GFECP contained herein. Additional documentation is required whenever an SLBE subcontractor's low quote is not utilized. Supplemental information or documentation concerning the Bidder's Compliance Plan may be required prior to award as requested by the City.

DIVERSITY MANAGEMENT INITIATIVE, DMI, DATA REPORTING FORMS REQUIRED - Bidders must submit, with its bid, "DMI-Solicited" forms listing all subcontractors solicited and "DMI-Utilized" forms listing all subcontractors to be utilized. Supplemental forms, documentation, or information may be submitted at bid time or as requested by the City.

After an award, "DMI-Payments" forms are to be submitted with payment requests to report payments to subcontractors.

Bidders may visit the Minority Business Development Office's web page at TampaGov.net for other information about the SLBE program, FAQ's, and the latest SLBE directory of certified firms.

I-1.11 BID SECURITY:

Surety companies shall have a rating of not less than B+ Class VI as evaluated in the most recently circulated Best Key rating Guide Property-Liability.

INSTRUCTIONS TO BIDDERS
SECTION 1 - SPECIAL INSTRUCTIONS

I-1.12 PUBLIC CONSTRUCTION BOND:

The Bidder who is awarded the Contract will be required to furnish a Public Construction Bond upon the form provided herein, equal to 100 percent of the Contract price, such Bond to be issued and executed by (a) surety company(ies) acceptable to the City of Tampa and licensed to underwrite contracts in the State of Florida. After execution of the Agreement and before commencing work, the Contractor must provide the City a certified copy of the officially recorded Bond.

I-1.13 AGREEMENT
Section 2 – Powers of the City's Representatives
Add the following:
Article 2.05 CITY'S TERMINATION FOR CONVENIENCE:

The City may, at any time, terminate the Contract in whole or in part for the City's convenience and without cause. Termination by the City under this Paragraph shall be by a notice of termination delivered to the Contractor, specify the extent of termination and the effective date.

Upon receipt of a notice of termination, the Contractor shall immediately, in accordance with instructions from the City, proceed with performance of the following duties regardless of delay in determining or adjusting amounts due under this Paragraph:

(a) cease operations as specified in the notice;
(b) place no further orders and enter into no further subcontracts for materials, labor, services or facilities except as necessary to complete continued portions of the Contract;
(c) terminate all subcontracts and orders to the extent they relate to the Work terminated;
(d) proceed to complete the performance of Work not terminated; and
(e) take actions that may be necessary, or that the City may direct, for the protection and preservation of the terminated Work.

The amount to be paid to the Contract by the City because of the termination shall consist of:

(a) for costs related to work performed on the terminated portion of the Work prior to the effective date including termination costs relative to subcontracts that are properly chargeable to the terminated portion of the Work.
(b) the reasonable costs of settlement of the Work terminated, including accounting, legal, clerical and other expenses reasonable necessary for the preparation of termination settlement proposals and supporting data; additional costs of termination and settlement of subcontracts excluding amounts of such settlements; and storage, transportation, and other costs incurred which are reasonably necessary for the preservation, protection or disposition of the terminated Work; and
(c) a fair and reasonable profit on the completed Work unless the Contractor would have sustained a loss on the entire Contract had it been completed.

Allowance shall be made for payments previously made to the Contractor for the terminated portion of the Work, and claims which the City has against the Contractor under the Contract, and for the value of materials supplies, equipment or other items that are part of the costs of the Work to be disposed of by the Contractor.

I-1.14 Section 5 – subcontracts and Assignments, Article 5.01, Page A-7, Last Paragraph:
Change "…twenty-five (25) percent… "to fifty-one (51) percent…"

Section 10-Payments, Article .05 Partial Payments, 1st Paragraph, 1st Sentence:
Change "…fair value of the work done, and may apply for…" to "…fair value of the work done, and shall apply for…"

INSTRUCTIONS TO BIDDERS
SECTION 1 - SPECIAL INSTRUCTIONS

I-1.15 Contractors must utilize the U.S. Department of Homeland Security's E-Verify Systems to verify the employment eligibility of all persons employed during the term of the contract to perform employment duties within the State of Florida and all persons, including subcontractors, assigned by the contractor to perform work pursuant to the contract.

I-1.16 GENERAL PROVISIONS; G-2.02 Copies Furnished to Contractor: Replace the first paragraph with the following:

The Contractor shall acquire for its use copies of the plans and specifications as needed. The documents may be downloaded from the City's web site, at
http://www.tampagov.net/dept_contract_administration/programs_and_services/construction_project_bidding/index.asp

I-1.17 PAYMENT DISPUTE RESOLUTION

Any dispute pertaining to pay requests must be presented to the City pursuant to Executive Order 2003-1.

I-1.18 SCRUTINIZED COMPANIES.

For Contracts $1,000,000 and greater, if the City determines the Contractor submitted a false certification under Section 287.135(5) of the Florida Statutes, or if the Contractor has been placed on the Scrutinized Companies with Activities in the Sudan List or the Scrutinized Companies with Activities in the Iran Petroleum Energy Sector List, the City shall either terminate the Contract after it has given the Contractor notice and an opportunity to demonstrate the City's determination of false certification was in error pursuant to Section 287.135(5)(a) of the Florida Statutes, or maintain the Contract if the conditions of Section 287.135(4) of the Florida Statutes are met.

I-1.19 FLORIDA'S PUBLIC RECORDS LAW

4.33.3 The City of Tampa is a public agency subject to Chapter 119, Florida Statutes. In accordance with Florida Statutes, 119.0701, if applicable, Contractor shall comply with Florida's Public Records Law. Specifically, the Contractor shall:

1. Keep and maintain public records that ordinarily and necessarily would be required by the City in order to perform the service;

2. Provide the public with access to such public records on the same terms and conditions that the City would provide the records and at a cost that does not exceed that provided in Chapter 119, Florida Statutes, or as otherwise provided by law;

3. Ensure that public records that are exempt or that are confidential and exempt from public record requirements are not disclosed except as authorized by law;

4. Meet all requirements for retaining public records and transfer to the City, at no cost, 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. All records stored electronically must be provided to the City in a format that is compatible with the information technology systems of the agency.

4.33.4 The failure of Contractor to comply with the provisions set forth in this Article shall constitute a Default and Breach of this award and the City shall enforce the Default in accordance with the provisions set forth in the DEFAULT/RE-AWARD section of this document.

## SECTION 2
## GENERAL INSTRUCTIONS

I-2.01 BIDDER'S RESPONSIBILITY

Before submitting Proposals, Bidders shall carefully examine the entire site of the proposed work and adjacent premises and the various means of approach and access to the site, and make all necessary investigations to inform themselves thoroughly as to the facilities necessary for delivering, placing and operating the necessary construction equipment, and for delivering and handling materials at the site, and inform themselves thoroughly as to all difficulties involved in the completion of all the work in accordance with the Contract Documents.

Bidders must examine the Plans, Specifications, and other Contract Documents and shall exercise their own judgment as to the nature and amount of the whole of the work to be done, and for the bid prices must assume all risk of variance, by whomsoever made, in any computation or statement of amounts or quantities necessary to complete the work in strict compliance with the Contract Documents.

Elevations of the ground are shown on the Plans and are believed to be reasonably correct, but are not guaranteed to be absolutely so and are presented only as an approximation. Bidders shall satisfy themselves as to the correctness of all elevations.

The City may have acquired, for its own use, certain information relating to the character of materials, earth formations, probable profiles of the ground, conditions below ground, and water surfaces to be encountered at the site of the proposed work. This information, if it exists, is on file at the offices of the Department of Public Works and Bidders will be permitted to see and examine this information for whatever value they consider it worth. However, this information is not guaranteed, and Bidders should satisfy themselves by making borings or test pits, or by such other methods as they may prefer, as to the character, location, and amounts of water, peat, clay, sand, quicksand, gravel, boulders, conglomerate, rock, gas or other material to be encountered or work to be performed.

Various underground and overhead structures and utilities are shown on the plans. The location and dimensions of such structures and utilities, where given, are believed to be reasonably correct, but do not purport to be absolutely so. These structures and utilities are plotted on the Plans for the information of the Bidders, but information so given is not to be construed as a representation or assurance that such structures will be found or encountered as plotted, or that such information is complete or accurate.

I-2.02 FORM, PREPARATION AND PRESENTATION OF PROPOSALS

Each Proposal shall be submitted upon the Proposal Form and in accordance with the instructions included herein. The Proposal Form must not be detached herefrom. All blank spaces for bid prices must be filled in, in both words and figures, with the unit or lump sum prices, or both, for which the Proposal is made. The computed total price for each unit price Contract Item shall be determined by multiplying the estimated quantity of the item, as set forth in the Proposal Form, by the corresponding unit price bid for such item. The resulting product shall be entered in the appropriate blank space under the column headed "Computed Total Price for Item". The lump sum price bid for each lump sum price Contract Item shall also be entered in the column headed "Computed Total Price for Item". If a Proposal contains any omissions, erasures, alterations, additions, or items not called for in the itemized Proposal, or contains irregularities of any kind, such may constitute sufficient cause for rejection of the Proposal. In case of any discrepancy in the unit price or amount bid for any item in the Proposal, the price as expressed in written words will govern. In no case is the Agreement Form to be filled out or signed by the Bidder.

In the case of certain jobs bid Lump Sum a "Schedule of Unit Prices" must be filled out as an attachment to the Lump Sum proposal. These prices may be used as a guide for the negotiation of change orders, at the City's option.

The proposal must be signed and certified and be presented on the prescribed form in a sealed envelope on/or before the time and at the place stated in the Notice of Bidders, endorsed with the name of the person, firm or corporation presenting it, the date of presentation, and the title of the work for which the Proposal is made.

Unless the apparent low bidder is now engaged in or has recently completed contract work for the City of Tampa, he, if requested, shall furnish to the City, after the opening of bids and prior to award, a summary statement of record of construction experience over the past three (3) years with proper supporting evidence, and, if required by the City, shall also furnish a list of equipment and other facilities pertinent to and available for the proper execution of the proposed work, and a statement of financial resources to the extent necessary to establish ability to carry on the proposed work. The City may make further investigations as considered necessary with respect to responsibility of the Bidder to whom it appears may be awarded the Contract.

If forwarded by mail, the sealed envelope containing the Proposal, endorsed as directed above, must be enclosed in another envelope addressed as specified in the Notice to Bidders and sent by registered mail.

I-2.03 ADDENDA AND INTERPRETATIONS

No interpretation of the meaning of the Plans, Specifications, or other Contract Documents will be made to any Bidder orally.

Every request for such interpretation must be in writing, addressed to the Contract Administration Department, Tampa Municipal Office Building, 4th Floor North, City Hall Plaza, Tampa, Florida 33602. To be given consideration, such request must be received at least seven (7) days prior to the date fixed for the opening of the Proposals. Any and all such interpretations and any supplemental instructions will be in the form of written addenda which, if issued, will be sent by certified mail, with return receipt requested, to all prospective bidders at the respective addresses furnished, for such purposes, not later than three (3) working days prior to the date fixed for the opening of the Proposals, and if requested, a copy will be delivered to the prospective bidder's representative. Failure of any Bidder to receive any such addenda shall not relieve said Bidder from any obligation under his Proposal as submitted. All addenda so issued shall become part of the Contract Documents.

I-2.04 BID SECURITY

Each Proposal must be accompanied by a certified or cashier's check issued by a solvent bank or trust company and payable at sight to the City of Tampa, in compliance with Section 255.051 Florida Statutes, or a Bid Bond upon the form provided herein, in an amount of not less than five percent of the sum of the computed total amount of the Bidder's Proposal as a guarantee that if the Proposal is accepted, the Bidder will execute and fill in the proposed Contract and Public Construction Bond within twenty (20) days after notice of award of the Contract. Certified checks shall have all necessary documentary revenue stamps attached if required by law. Surety on Bid Bonds shall be a duly authorized surety company authorized to do business in the State of Florida, and all such Bonds shall be issued or countersigned by a local resident producing agent, and satisfactory evidence of the authority of the person or persons executing such Bond to Execute the same shall be submitted with the Bond. Bid Bonds shall be issued by a surety company acceptable to the City.

Within ten (10) days after the opening of Proposals, the bid security of all but the three lowest Bidders will be returned. The bid security of the remaining two Bidders whose Proposals are not accepted will be

returned within ten (10) days after the execution of the Contract, or, if no such Contract has been executed, within ninety (90) days after the date of opening Proposals. The bid security of the Bidder whose Proposal is accepted will be returned only after he has duly executed the Contract and furnished the required Public Construction Bond and insurance.

Should it be necessary for the City to retain the bid security and said bid security is in the form of checks, the checks of these Bidders will be returned if replaced by Bid Bonds in an amount equal to the amount of the checks of such Bidders in such form and issued by a surety company acceptable to the City.

A Bidder may withdraw his Proposal before the time fixed for the opening of Proposals, without prejudice to himself, by communicating his purpose, in writing, to the Mayor and City Council, and when his communication is received, the Proposal will be handed to him or his authorized agent unopened. No Bidder may withdraw his Proposal within ninety (90) days after the day of opening Proposals.

The Bidder whose Proposal is accepted shall enter into a written contract, upon the Agreement form included herein, for the performance of the work and furnish the required Public Construction Bond within twenty (20) days after written notice by the City of Award of Contract has been served on such Bidder personally or after receipt of the written notice by registered mail to such Bidder at the address given in his Proposal.

If the Bidder to whom a Contract is awarded refuses or neglects to execute it or fails to furnish the required Public Construction Bond within twenty (20) days after receipt by him of the Notice of Award of Contract, the amount of his bid security shall be forfeited and shall be retained by the City as liquidated damages, and not as a penalty, it being now agreed that said sum is a fair estimate of the amount of damages that the City will sustain in case said Bidder fails to enter into a Contract and furnish the required Public Construction Bond. If a Bid Bond was furnished, the full amount of the Bond shall become due and payable as liquidated damages caused by such failure. The full amount of the bid security shall be forfeited as liquidated damages without consideration of the fact that an award may be less than the full amount of the Bidder's Proposal, excepting that the award shall be within the conditions of said Proposal relating to the basis of consideration for an award. No plea of mistake in the bid or misunderstanding of the conditions of forfeiture shall be available to the Bidder for the recovery of his deposit or as a defense to any action based upon the neglect or refusal to execute a contract.

I-2.05 LAWS AND REGULATIONS
The Bidder who is awarded the Contract must comply with all laws of the State of Florida, and all applicable Ordinances of the City of Tampa respecting labor and compensation and with all other statutes, ordinances, rules and regulations applicable and having the force of law.

I-2.06 PUBLIC CONSTRUCTION BOND
The Bidder who is awarded the Contract will be required to furnish a Public Construction Bond upon the form provided herein, equal to 100 percent of the Contract price, such Bond to be executed by a surety company acceptable to the City of Tampa and licensed to underwrite contracts in the State of Florida. Surety companies shall have a rating of not less than: B+ Class VI as evaluated in the most recently circulated BEST'S KEY RATING GUIDE PROPERTY-LIABILITY.

I-2.07 SIGNATURE AND QUALIFICATIONS OF BIDDERS
Proposals must be signed in ink by the Bidder with signature in full. When a firm is a Bidder, the Proposal shall be signed in the name of the firm by one or more of the partners. When a corporation is a Bidder the officer signing shall set out the corporate name in full beneath which he shall sign his name and give the title of his office. The Proposal shall also bear the seal of the corporation attested by its secretary. Anyone signing the Proposal as agent must file with it legal evidence of his authority to do so.

Bidders who are nonresident corporations shall furnish to the City a duly certified copy of their permit to transact business in the State of Florida, signed by the Secretary of State, within ten days of the notice to do so. Such notice will be given to Bidders who are nonresident corporations, to whom it appears an award will be made, and the copy of the permit must be filed with the City before the award will be made. Failure to promptly submit this evidence of qualification to do business in the State of Florida may be basis for rejection of the Proposal.

I-2.08 REJECTION OF PROPOSALS
The City reserves the right to reject any Proposal if investigation of the Bidder fails to satisfy the City that such Bidder is properly qualified to carry out the obligations and to complete the work contemplated therein. Any or all Proposals will be rejected if there is reason to believe that collusion exists among Bidders. Proposals will be considered irregular and may be rejected if they show serious omissions, alterations in form, additions not called for, conditions or unauthorized alternates, or irregularities of any kind. The City reserves the right to reject any or all Proposals and to waive such technical errors as may be deemed best for the interests of the City.

I-2.09 QUANTITIES ESTIMATED ONLY
The estimate of quantities of the various items of work and materials, if set forth in the Proposal Form, is approximate only and is given solely to be used as a uniform basis for the comparison of Proposals. The quantities actually required to complete the Contract work may be less or more than so estimated, and if awarded a Contract for the work specified, the Contractor agrees that he will not make any claim for damages or for loss of profits because of a difference between the quantities of the various classes of work assumed for comparison of Proposals and quantities of work actually performed. The City further reserves the right to vary the quantities in any amount.

I-2.10 COMPARISON OF PROPOSALS
Except jobs bid on a "One Lump Sum" basis, proposals will be compared on the basis of a total computed price arrived at by taking the sum of the estimated quantity of each time and the corresponding unit price of each item, and including any lump sum prices on individual items.

The computed total prices for individual Contract Items and the total computed price for the entire Contract, as entered by the Bidder in the Proposal Form, are for convenience only and are subject to correction in the tabulation and computation of the Proposals.

I-2.11 BASIS OF AWARD
The Contract will be awarded, if at all, to the lowest responsible Bidder or Bidders, as determined by the City and by the terms and conditions of the Contract Documents. Unless all bids are rejected, the award will be made within ninety (90) days after the opening of Proposals. The successful Bidder will be required to possess, or obtain, a valid City Occupational License.

I-2.12 INSURANCE REQUIRED
The successful Bidder and his subcontractors will be required to procure and pay for insurance covering the work in accordance with the provisions of Article 6.02 of the Agreement as indicated on special instructions pages beginning with INS-1.

I-2.13 NO ASSIGNMENT OF BID
No Bidder shall assign his bid or any rights thereunder.

I-2.14 NONDISCRIMINATION IN EMPLOYMENT
Contracts for work under this Proposal will obligate the contractors and subcontractors not to discriminate in employment practices.

Bidders must, if requested, submit with their initial bid a signed statement as to whether they have previously performed work subject to the President's Executive Order Nos. 11246 and 11375.
Bidders must, if requested, submit a compliance report concerning their employment practices and policies in order to maintain their eligibility to receive the award of the Contract.

Successful Bidders must, if requested, submit a list of all subcontractors who will perform work on the project and written,

signed statement from authorized agents of the labor pools with which they will or may deal for employees on the work together with supporting information to the effect that said labor pools practices and policies are in conformity with Executive Order No. 11246 and that said labor pools will affirmatively cooperate in or offer no hindrance to the recruitment, employment and equal treatment of employees seeking employment and performing work under the Contract, or a certification as to what efforts have been made to secure such statements when such agents or labor pools have failed or refused to furnish them prior to the award of the Contract.

I-2.15 LABOR STANDARDS
The Bidder's attention is directed to the Contract Provisions of the Labor Standards for federally assisted projects which may be attached to and made a part of the Agreement.

I-2.16 NOTICE TO LABOR UNIONS
If applicable, the successful Bidder will be required to provide Labor Unions and other organizations of workers a completed copy of the form entitled "Notice to Labor Unions or Other Organizations of Workers", and such form may be made a part of the Agreement.

I-2.17 NOTICE TO PROSPECTIVE FEDERALLY-ASSISTED CONSTRUCTION CONTRACTORS
A Certification of Nonsegregated Facilities, as required by the May 9, 1967, Order (32 F.R. 7439, May 19, 1967) on Elimination of Segregated Facilities, by the Secretary of Labor, must be submitted to said Secretary prior to the award of a federally-assisted construction and Contract exceeding $10,000 which is not exempt from the provisions of the Equal Opportunity Clause. The form of certification may be bound herein following the form of Bid Bond.

Contractors receiving federally-assisted construction Contract awards exceeding $10,000 which are not exempt from the provisions of the Equal Opportunity Clause will be required to provide for the forwarding of the following notice to prospective subcontractor for supplies and construction contracts where the subcontracts exceed $10,000 and are not exempt from the provisions of the Equal Opportunity Clause:

NOTICE TO PROSPECTIVE SUBCONTRACTORS OF REQUIREMENT
FOR CERTIFICATIONS OF NONSEGREGATED FACILITIES

"A Certification of Nonsegregated Facilities, as required by the May 9, 1967, Order (32 F.R. 7439, May 19, 1967) on Elimination of Segregated Facilities, by the Secretary of Labor, must be submitted prior to the award of a subcontract exceeding $10,000 which is not exempt from the provisions of the Equal Opportunity Clause."

"Contractors receiving subcontract awards exceeding $10,000 which are not exempt from the provisions of the Equal Opportunity Clause will be required to provide from the forwarding of this notice to prospective subcontractors for supplies and construction contracts where the subcontracts exceed $10,000 and are not exempt from the provisions of the Equal Opportunity Clause."

The United States requires a pre-award conference if a proposed construction contract exceeds one million dollars to determine if the the prospective contractor is in compliance with the Equal Employment Opportunity requirements of Executive Order 11246 of September 24, 1965. In such instances, a meeting may be scheduled at which the prospective contractor must specify what affirmative action he has taken or proposed to take to assure equal employment opportunity which must be approved by the United States before award of the contract will be authorized.

Bidders must be prepared to submit an Equal Employment Opportunity (EEO) plan at a pre-award conference. The plan must include bidding opportunities offered by the Bidder to minority subcontractors.

On October 13, 1971, President Nixon issued Executive Order 11246 emphasizing the government's commitment to the promotion of minority business enterprise. Accordingly, the United States is firmly committed to the utilization of available resources to support this important program. U.S. agencies are most interested in realizing minority participation on the subject. Achieving equal employment opportunity compliance is required through Executive Order 11246. WE cannot emphasize too strongly that minority subcontractors be extended subcontractors bidding opportunities as but one step in your affirmative action policy.

Due to the importance of this contract, U.S. Agencies may conduct an EEO Conference prior to the award of the Contract. It is suggested that the responsive Bidder confirm the minority subcontractors he contacted for bids or quotations in his EEO plan submitted at the conference.

I-2.18 EEO AFFIRMATIVE ACTION REQUIREMENTS
By the submission of a Proposal, each Bidder acknowledges that he understands and will agree to be bound by the equal opportunity requirements of Federal regulations which shall be applicable throughout the performance of work under any contract awarded pursuant to solicitation. Each Bidder agrees that if awarded a contract, he will similarly bind contractually each subcontractor. In policies, each Bidder further understands and agrees that if awarded a contract, he must engage in Affirmative Action directed to promoting and ensuring equal employment opportunity in the work force used under the contract (and he must require contractually the same effort of all subcontractors whose subcontracts exceed $100,000). The Bidder understands and agrees that "Affirmative Action" as used herein shall constitute a good faith effort to achieve and maintain minority employment in each trade in the on-site work force used on the project. * * * * * * * END of SECTION * * * * * * *

# CITY OF TAMPA INSURANCE REQUIREMENTS

During the life of the award/contract the Awardee/Contractor shall provide, pay for, and maintain insurance with companies authorized to do business in Florida, with an A.M. Best rating of B+ (or better) Class VII (or higher), or otherwise be acceptable to the City if not rated by A.M. Best. All insurance shall be from responsible companies duly authorized to do business in the State of Florida.

All commercial general liability insurance policies (and Excess or Umbrella Liability Insurance policies, if applicable) shall provide that the City is an additional insured as to the operations of the Awardee/Contractor under the award/contract including the additional insured endorsement, the subrogation wavier endorsement, and the Severability of Interest Provision. In lieu of the additional named insured requirement, if the Awardee/Contractor's company has a declared existing policy which precludes it from including additional insureds, the City may permit the Contractor to purchase an Owners and Contractors Protective Liability policy. Such policy shall be written in the name of the City at the same limit as is required for General Liability coverage. The policy shall be evidenced on an insurance binder which must be effective from the date of issue until such time as a policy is in existence and shall be submitted to the City in the manner described below as applicable to certificates of insurance.

The insurance coverages and limits required must be evidenced by a properly executed Acord 25 Certificate of Insurance form or its equivalent. Each Certificate must be personally manually signed by the Authorized Representative of the insurance company shown in the Certificate with proof that he/she is an authorized representative thereof. Thirty days' written notice must be given to the City of any cancellation, intent not to renew, or reduction in the policy coverages, except in the application of the aggregate liability limits provisions. Should any aggregate limit of liability coverage be reduced, it shall be immediately increased back to the limit required by the contract. The insurance coverages required herein are to be primary to any insurance carried by the City or any self-insurance program thereof.

The following coverages are required:

A. Commercial General Liability Insurance shall be provided on the most current Insurance Services Office (ISO) form or its equivalent. This coverage must be provided to cover liability arising from premises and operations, independent contractors, products and completed operations, personal and advertising injury, contractual liability, and XCU exposures (if applicable). Completed operations liability coverage shall be maintained for a minimum of one-year following completion of work. The amount of Commercial General Liability insurance shall not be less than the amount specified.

(a) $1,000,000 per occurrence and a $2,000,000 general aggregate for projects valued at $2,000,000 or less. General aggregate limit for projects over that price shall equal or exceed the price of the project. An Excess or Umbrella Liability insurance policy can be provided to meet the required limit. Risk Management may be contacted for additional information regarding projects of this nature.

B. Automobile Liability Insurance shall be maintained in accordance with the laws of the State of Florida, as to the ownership, maintenance, and use of all owned, non-owned, leased, or hired vehicles. The amount of Automobile Liability Insurance shall not be less than the amount specified.

(a) $500,000 combined single limit each occurrence bodily injury & property damage- for projects valued at $100,000 and under

(b) $1,000,000 combined single limit each occurrence bodily injury & property damage – for projects valued over $100,000

C. Worker's Compensation and Employer's Liability Insurance shall be provided for all employees engaged in the work under the contract, in accordance with the Florida Statutory Requirements. The amount of the Employer's Liability Insurance shall not be less than:

(a) $500,000 bodily injury by accident and each accident, bodily injury by disease policy limit, and bodily injury by disease each employee – for projects valued at $100,00 and under
(b) $1,000,000 bodily injury by accident and each accident, bodily injury by disease policy limit, and bodily injury by disease each –for projects valued over $100,000

D. Excess Liability Insurance or Umbrella Liability Insurance may compensate for a deficiency in general liability, automobile, or worker's compensation insurance coverage limits. If the Excess or Umbrella policy is being provided as proof of coverage, it must name the City of Tampa as an additional insured **(IF APPLICABLE).**

E. Builder's Risk Insurance, specialized policy designed to cover the property loss exposures that are associated with construction of buildings. The amount of coverage should not be less than the amount of the project. **(IF APPLICABLE).**

F. Installation Floater- a builder's risk type policy that covers specific type of property during its installation, is coverage required for highly valued equipment or materials such as compressors, generators, or other machinery that are not covered by the builder's risk policy **(IF APPLICABLE).**

G. Longshoreman's & Harbor Worker's Compensation Act/Jones Act coverage shall be maintained for work being conducted upon navigable water of the United States. The limit required shall be the same limit as the worker's compensation/employer's liability insurance limit **(IF APPLICABLE).**

H. Professional Liability shall be maintained against claims of negligence, errors, mistakes, or omissions in the performance of the services to be performed and furnished by the Awardee/Contractor or any of its subcontractors when it acts as a DESIGN PROFESSIONAL. The amount of coverage shall be no less than amount specified **(IF APPLICABLE).**

(a) $1,000,000 per incident and general aggregate. Note all claims made policies must provide the date of retroactive coverage.

The City may waive any or all of the above referenced insurance requirements based on the specific nature of goods or services to be provided under the award/contract.

ADDITIONAL INSURED - The City must be included as an additional insured by on the general and (Excess or Umbrella liability policies) if applicable. Alternatively, the Contractor may purchase a separate owners protective liability policy in the name of the City in the specified amount as indicated in the insurance requirements.

CLAIMS MADE POLICIES - If any liability insurance is issued on a claims made form, Contractor agrees to maintain uninterrupted coverage for a minimum of one year following completion and acceptance of the work either through purchase of an extended reporting provision, or through purchase of successive renewals with a retroactive date not later than the beginning of performance of work for the City. The retroactive date must be provided for all claims made policies.

CANCELLATION/NON-RENEWAL - Thirty (30) days written notice must be given to the City of any cancellation, intent to non-renew or material reduction in coverages (except aggregate liability limits). However, ten (10) days notice may be given for non-payment of premium. Notice shall be sent to the City of Tampa Department of Public Works, 306 E. Jackson Street, Tampa, FL 33602.

NUMBER OF POLICIES - General and other liability insurance may be arranged under single policies for the full amounts required or by a combination of underlying policies with the balance provided by an excess or umbrella liability insurance policy.

WAIVER OF SUBROGATION - Contractor waives all rights against City, its agents, officers, directors and employees for recovery of damages to the extent such damage is covered under the automobile or excess liability policies.

SUBCONTRACTORS - It is the Contractor's responsibility to require all subcontractors to maintain adequate insurance coverage.

PRIMARY POLICIES - The Contractor's insurance is primary to the City's insurance or any self insurance program thereof.

RATING - All insurers shall be authorized to do business in Florida, and shall have an A.M. Best rating of B+ (or better), Class VII (or higher), or otherwise be acceptable to the City if not rated by A.M. Best.

DEDUCTIBLES - The Contractor is responsible for all deductibles. In the event of loss which would have been covered but for the presence of a deductible, the City may withhold from payment to Contractor an amount equal to the deductible to cover such loss should full recovery not be obtained under the insurance policy.

INSURANCE ADJUSTMENTS - These insurance requirements may be increased, reduced, or waived at the City's sole option with an appropriate adjustment to the Contract price.

Document updated on 12/22/2009 by RLD (Risk Management)

# *City of Tampa MBD Office*

# *U-WMBE Goal Setting Firms Report*

# *7/27/15*

## ELECTRICAL EQUIPMENT AND SUPPLIES

**B & E Electrical Supply Co.** **Federal Number** 59-3241569
1307 N Albany Ave **Phone** (813) 251-6398 **Minority** African American
Tampa, FL 33607 **Fax** (813) 251-6521 **Contact** Bernard Albury
**E-mail** leo_albury@yahoo.com

**Genesis VII, Inc.** **Federal Number** 59-2952211
1605 White Dr. **Phone** (321) 383-4813 **Minority** African American
Titusville, FL 32780 **Fax** (321) 383-3247 **Contact** Robert Jordan
**E-mail** robert.jordan@genesisvii.com

**Creative Industrial Solutions, LLC** **Federal Number** 20-8479779
5200 NW 43rd Street Suite 102-207 **Phone** (352) 226-8448 **Minority** African American
Orlando, FL 32606 **Fax** (813) 217-5328 **Contact** Kevin Holmes
**E-mail** admin@creativeindustrialsolutions.com

**Milena International, Inc.** **Federal Number** 27-5032416
5004 E. Fowler Ave, Suite C-152 **Phone** (904) 553-3645 **Minority** African American
Tampa, FL 33617 **Fax** (877) 223-6902 **Contact** Raoul Thomas
**E-mail** raoul@milenasupply.com

**MDH Enterprises, Inc.** **Federal Number** 55-0849332
281 E C St. **Phone** (386) 789-2672 **Minority** African American
Orange City, FL 32763 **Fax** (866) 681-5026 **Contact** Matize Hoskins
**E-mail** matize@my-es.com

## ELECTRICAL SERVICES

**Brown & Brown Electric, Inc.** **Federal Number** 59-2283934
6555 N.W. 9th Ave. S-205 **Phone** (954) 938-8986 **Minority** African American
Ft. Lauderdale, FL 33310-5003 **Fax** (954) 938-9272 **Contact** Winston Brown
**E-mail** winston@brownandbrownelectric.com

# *City of Tampa MBD Office*

# *U-WMBE Goal Setting Firms Report*

# *7/27/15*

## ELECTRICAL SERVICES

**Acktel Electric Company, Inc.** **Federal Number** 59-3579225

P.O. Box 52292
Jacksonville, FL 32201-2292

**Phone** (904) 356-1274
**Fax** (904) 356-1374

**Minority** African American
**Contact** Sedley Huey

**E-mail** acktelel@bellsouth.net

**All-In-One Electric, Inc.** **Federal Number** 04-3689273

1201 W Waters Ave.
Tampa, FL 33604

**Phone** (813) 849-6331
**Fax** (813) 514-0473

**Minority** African American
**Contact** Rodney Jones

**E-mail** allinoneelectric@msn.com

**Prime Electric, LLC** **Federal Number** 20-1137443

1229 W. Main St
Leesburg, FL 34748

**Phone** (352) 728-5966
**Fax** (352) 728-5921

**Minority** African American
**Contact** Wylie Hamilton

**E-mail** wylie@primeelectricllc.net

**MDH Enterprises, Inc. Federal Number** 55-0849332

281 E C St.
Orange City, FL 32763

**Phone** (386) 789-2672
**Fax** (866) 681-5026

**Minority** African American
**Contact** Matize Hoskins

**E-mail** matize@my-es.com

## PIPE AND PIPE FITTINGS

**DRD Enterprises, LLC** **Federal Number** 20-4675317

4104 Yellowwood Dr.
Valrico, FL 33594

**Phone** (813) 476-9933
**Fax** (866) 850-1332

**Minority** African American
**Contact** Devon Deenah

**E-mail** ddeenah@drdenterprise.com

**Terrell Industries, Inc.** **Federal Number** 65-0530148

2067 1st Avenue N
St. Petersburg, FL 33713

**Phone** (727) 823-4424
**Fax** (727) 823-3977

**Minority** African American
**Contact** Grady Terrell

**E-mail** gterrell@verizon.net

# *City of Tampa MBD Office*

# *U-WMBE Goal Setting Firms Report*

# *7/27/15*

## TRUCKING & HAULING

**Sabrina's Trucking, LLC** **Federal Number** 59-3284380
P.O. Box 992 **Phone** (813) 629-7210 **Minority** African American
Mango, FL 33550 **Fax** (813) 627-9094 **Contact** Nathaniel Johnson
**E-mail** jtrucker151@aol.com

**Bay Light, LLC d/b/a Professional Property Services** **Federal Number** 59-1341451
10105 11th Street North **Phone** (813) 972-4057 **Minority** African American
Tampa, FL 33612 **Fax** (813) 971-0882 **Contact** Hyacinth Robinson
**E-mail** paulrobinson22@msn.com

**Par Development Partners, Inc.** **Federal Number** 20-5657414
2109 E. Palm Ave., Suite 312 **Phone** (813) 374-2856 **Minority** African American
Tampa, FL 33605 **Fax** (866) 594-2505 **Contact** Yancy Wilson
**E-mail** ydwilson@aol.com

**Charlie Brown's Hauling & Demolition, Inc.** **Federal Number** 20-1874672
P.O. Box 1178 **Phone** (352) 521-0482 **Minority** African American
Dade City, FL 33526 **Fax** (352) 521-5915 **Contact** Charlie Brown
**E-mail** Charliewbrown@aol.com

**On-Point Group, Inc.** **Federal Number** 38-3788119
5608 Puritan Rd **Phone** (813) 927-2808 **Minority** African American
Tampa, FL 33617 **Fax** (813) 374-0993 **Contact** Daphne Jones
**E-mail** d.jones@on-pointgroupinc.com

**Accelerated Waste Solutions of North America, LLC** **Federal Number** 27-1394911
8710 W. Hillsborough Ave., Suite 262 **Phone** (866) 698-2874 **Minority** African American
Tampa, FL 33615 **Fax** (813) 871-0377 **Contact** Fred Tomlin
**Email** cityoftampa@acceleratedwaste.com

# *City of Tampa MBD Office*

# SLBE Goal Setting Firms Report

***as of 7/27/2015***

## ELECTRICAL EQUIPMENT AND SUPPLIES

**B & E Electrical Supply Co.** **Federal Number** 59-3241569

1307 N Albany Ave
Tampa, FL 33607

**Phone** (813) 251-6398
**Fax** (813) 251-6521
**E-mail** leo_albury@yahoo.com

**Minority** Small Business
**Contact** Bernard Albury

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**Icon Supply, Inc** **Federal Number** 59-3243571

P.O. Box 272423
Tampa, FL 33688-2423

**Phone** (813) 936-2030
**Fax** (813) 936-9268
**E-mail** ICONUSA@tampabay.rr.com

**Minority** Small Business
**Contact** Norma Tempest

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**Integrated Design of Central Florida** **Federal Number** 59-2203868

180 Scarlet Blvd.
Oldsmar, FL 34677

**Phone** (316) 209-8342
**Fax** (813) 925-0299
**E-mail** wallyses@aol.com

**Minority** Small Business
**Contact** Walter Wiseman

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**Milena International, Inc.** **Federal Number** 27-5032416

5004 E. Fowler Ave, Suite C-152
Tampa, FL 33617

**Phone** (904) 553-3645
**Fax** (877) 223-6902
**E-mail** raoul@milenasupply.com

**Minority** Small Business
**Contact** Raoul Thomas

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## ELECTRICAL SERVICES

**Apollo Construction & Engineering Services, Inc.** **Federal Number** 59-2811166

P.O. Box 5848
Sun City Center, FL 33571-5848

**Phone** (813) 645-4926
**Fax** (813) 645-3351
**E-mail** tkamprath@apollo-construction.com

**Minority** Small Business
**Contact** Thomas Kamprath

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**Gaylord / Miller Electric Corp** **Federal Number** 59-1631953

602 North Oregon Avenue
Tampa, FL 33606

**Phone** (813) 254-4681
**Fax** (813) 254-9473
**E-mail** james.gmelectric@verizon.net

**Minority** Small Business
**Contact** James A. Tepper

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# *City of Tampa MBD Office*

# SLBE Goal Setting Firms Report

***as of 7/27/2015***

## ELECTRICAL SERVICES

**All-In-One Electric, Inc.** **Federal Number** 04-3689273

1201 W Waters Ave.
Tampa, FL 33604

**Phone** (813) 849-6331 **Minority** Small Business
**Fax** (813) 514-0473 **Contact** Rodney Jones
**E-mail** allinoneelectric@msn.com

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**JDP Electric, Inc.** **Federal Number** 59-3511620

6600 N. Florida Avenue
Tampa, FL 33604

**Phone** (813) 234-4004 **Minority** Small Business
**Fax** (813) 236-0394 **Contact** Jeffrey Priede
**E-mail** jdpinc@tampabay.rr.com

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**Mandy Electric, Inc.** **Federal Number** 59-2914874

9353 E. Fowler Ave.
Thonotosassa, FL 33592

**Phone** (813) 264-9234 **Minority** Small Business
**Fax** (813) 333-9701 **Contact** Armando Hernandez
**E-mail** lhernandez@mandyselectric.com

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**Crevello Electric, Inc.** **Federal Number** 59-3559003

3305 N. Stanley Rd.
Plant City, FL 33565

**Phone** (813) 986-6106 **Minority** Small Business
**Fax** (813) 986-9633 **Contact** Bill Crevello
**E-mail** crevelloelectric@gmail.com

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**Best Price Electric Service, LLC** **Federal Number** 27-1211988

P.O. Box 6516
Seffner, FL 33583

**Phone** (813) 927-1668 **Minority** Small Business
**Fax** (813) 409-3154 **Contact** Frank Fleites
**E-mail** BestPriceElectricServ@hotmail.com

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**Manatee Electric, Inc.** **Federal Number** 59-3454485

845 Thompson Road
Lithia, FL Fl

**Phone** (813) 645-7000 **Minority** Small Business
**Fax** (813) 654-7568 **Contact** John Babuka
**E-mail** john@reliableelectricusa.com

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**Aguila Electrical Services, Inc.** **Federal Number** 20-0818128

5708 N 56TH ST
Tampa, FL 33610

**Phone** (813) 368-9323 **Minority** Small Business
**Fax** (813) 884-4092 **Contact** Jael Aguila
**E-mail** sales@aguilaelectrical.com

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# *City of Tampa MBD Office*

# SLBE Goal Setting Firms Report

***as of 7/27/2015***

## ELECTRICAL SERVICES

**A American Electrical Contractor, Inc.** **Federal Number** 59-2603773

9170 126th Avenue N
Largo, FL 33773

**Phone** (727) 588-0126
**Fax** (727) 588-9170
**E-mail** mark.aaec@yahoo.com

**Minority** Small Business
**Contact** Mark Comerford

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**Rhythms Electric Corporation** **Federal Number** 27-3150153

433 37th Ave NE
St. Petersburg, FL 33704

**Phone** (727) 460-8779
**Fax**
**E-mail** rhythmselectric@me.com

**Minority** Small Business
**Contact** Mathew Krchmar

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**TAMCO Electric, Inc.** **Federal Number** 59-1396630

4022 W South Avenue
Tampa, FL 33614

**Phone** (813) 986-3472
**Fax** (813) 986-5979
**E-mail** atrujill@tampabay.rr.com

**Minority** Small Business
**Contact** Steven Moates

---

## PIPE AND PIPE FITTINGS

**2 Meyer Corp.** **Federal Number** 56-2384669

6308 Lake Sunrise Dr.
Apollo Beach, FL 33572

**Phone** (813) 645-3150
**Fax** (813) 645-5634
**E-mail** Renatonjr@aol.com

**Minority** Small Business
**Contact** Melissa Gugliotti

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**DRD Enterprises, LLC** **Federal Number** 20-4675317

4104 Yellowwood Dr.
Valrico, FL 33594

**Phone** (813) 476-9933
**Fax** (866) 850-1332
**E-mail** ddeenah@drdenterprise.com

**Minority** Small Business
**Contact** Devon Deenah

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**Mar Supply Co.** **Federal Number** 27-0206845

1660 63rd Avenue East
Bradenton, FL 34203

**Phone** (941) 286-3240
**Fax** (941) 761-6500
**E-mail** info@marsupplyco.com

**Minority** Small Business
**Contact** Raul Corona

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### PIPE AND PIPE FITTINGS

**Terrell Industries, Inc.** **Federal Number** 65-0530148

2067 1st Avenue N
St. Petersburg, FL 33713

**Phone** (727) 823-4424
**Fax** (727) 823-3977
**E-mail** gterrell@verizon.net

**Minority** Small Business
**Contact** Grady Terrell

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### TRUCKING & HAULING

**Sabrina's Trucking, LLC** **Federal Number** 59-3284380

P.O. Box 992
Mango, FL 33550

**Phone** (813) 629-7210
**Fax** (813) 627-9094
**E-mail** jtrucker151@aol.com

**Minority** Small Business
**Contact** Nathaniel Johnson

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**Sunrise Utility Construction, Inc.** **Federal Number** 59-3034012

P.O. Box 272293
Tampa, FL 33688-2293

**Phone** (813) 949-3749
**Fax** (813) 949-0408
**E-mail** LMNBOSS@AOL.COM

**Minority** Small Business
**Contact** Lisa Nehrboss

---

**Bay Light, LLC d/b/a Professional Property Services** **Federal Number** 59-1341451

10105 11th Street North
Tampa, FL 33612

**Phone** (813) 972-4057
**Fax** (813) 971-0882
**E-mail** paulrobinson22@msn.com

**Minority** Small Business
**Contact** Hyacinth Robinson

---

**Par Development Partners, Inc.** **Federal Number** 20-5657414

2109 E. Palm Ave., Suite 312
Tampa, FL 33605

**Phone** (813) 374-2856
**Fax** (866) 594-2505
**E-mail** ydwilson@aol.com

**Minority** Small Business
**Contact** Yancy Wilson

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**Charlie Brown's Hauling & Demolition, Inc.** **Federal Number** 20-1874672

P.O. Box 1178
Dade City, FL 33526

**Phone** (352) 521-0482
**Fax** (352) 521-5915
**E-mail** Charliewbrown@aol.com

**Minority** Small Business
**Contact** Charlie Brown

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# *City of Tampa MBD Office*

# SLBE Goal Setting Firms Report

***as of 7/27/2015***

## TRUCKING & HAULING

**On-Point Group, Inc.** **Federal Number** 38-3788119

5608 Puritan Rd
Tampa, FL 33617

**Phone** (813) 927-2808
**Fax** (813) 374-0993
**E-mail** d.jones@on-pointgroupinc.com

**Minority** Small Business
**Contact** Daphne Jones

---

**Accelerated Waste Solutions of North America, LLC** **Federal Number** 27-1394911

8710 W. Hillsborough Ave., Suite 262
Tampa, FL 33615

**Phone** (866) 698-2874
**Fax** (813) 871-0377
**E-mail** cityoftampa@acceleratedwaste.com

**Minority** Small Business
**Contact** Fred Tomlin

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**TNT Environmental, LLC** **Federal Number** 26-3864129

17852 Pine Knoll Drive
Dade City, FL 33523

**Phone** (352) 567-1822
**Fax** (352) 567-5817
**E-mail** tntenvironmental@gmail.com

**Minority** Small Business
**Contact** Christopher Leibereid

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**J M J Hauling, Inc.** **Federal Number** 32-0270935

13810 Golf Course Road
Parrish, FL 34219

**Phone** (917) 544-9741
**Fax** (941) 721-6932
**E-mail** mvachu@tampabay.rr.com

**Minority** Small Business
**Contact** Bachu Maniram

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**Ortzak Technology, LLC** **Federal Number** 45-4837502

13014 N. Dale Mabry Hwy, Suite 623
Tampa, FL 33618

**Phone** (813) 961-6023
**Fax** (813) 961-6023
**E-mail** dcastro@ortzak.com

**Minority** Small Business
**Contact** Daniel Castro

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**OGONZALEZ TRUCKING INC** **Federal Number** 20-2502525

4108 DELLBROOK DR
Tampa, FL 33624

**Phone** (813) 961-8158
**Fax** (813) 961-8158
**E-mail** SOGARA4@VERIZON.NET

**Minority** Small Business
**Contact** OMAR GONZALEZ

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# *City of Tampa MBD Office*

## SLBE Goal Setting Firms Report

***as of 7/27/2015***

**SLBE Contract Goal**

| Goal |
| --- |
| 8.3% |

Subcontract Goal Contact List: SLBEs and Underutilized WMBEs
(**The Underutilized WMBE Industry Category for Subcontracts is Construction - BBE Certified)

Project 15-C-00037 (HFC AWTP Dissolved Aeration Reactor Improvements, Phase 1)

| # Of Firms | Company Name | Federal Number | Address | Phone Number | SLBE/WMBE CLASS | City, State, Zip Code | Fax Number | Contact Name | Contact Email |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 Meyer Corp. | 56-2384669 | 6308 Lake Sunrise Dr. | (813) 645-3150 | Small Business | Apollo Beach, FL 33572 | (813) 645-5634 | Melissa Gugliotti | Renatonjr@aol.com |
| 2 | A American Electrical Contractor, Inc. | 59-2603773 | 9170 126th Avenue N | (727) 588-0126 | Small Business | Largo, FL 33773 | (727) 588-9170 | Mark Comerford | mark.aaec@yahoo.com |
| 3 | Accelerated Waste Solutions of North America, LLC | 27-1394911 | 8710 W. Hillsborough Ave., Suite 262 | (866) 698-2874 | **SLBE/BBE** | Tampa, FL 33615 | (813) 871-0377 | Fred Tomlin | cityoftampa@acceleratedwaste.com |
| 4 | Acktel Electric Company, Inc. | 59-3579225 | P.O. Box 52292 | (904) 356-1274 | **African American** | Jacksonville, FL 32201-2292 | (904) 356-1374 | Sedley Huey | acktelel@bellsouth.net |
| 5 | Aguila Electrical Services, Inc. | 20-0818128 | 5708 N 56TH ST | (813) 368-9323 | Small Business | Tampa, FL 33610 | (813) 884-4092 | Jael Aguila | sales@aguilaelectrical.com |
| 6 | All-In-One Electric, Inc. | 04-3689273 | 1201 W Waters Ave. | (813) 849-6331 | **SLBE/BBE** | Tampa, FL 33604 | (813) 514-0473 | Rodney Jones | allinoneelectric@msn.com |
| 7 | Apollo Construction & Engineering Services, Inc. | 59-2811166 | P.O. Box 5848 | (813) 645-4926 | Small Business | Sun City Center, FL 33571-5848 | (813) 645-3351 | Thomas Kamprath | tkamprath@apollo-construction.com |
| 8 | B & E Electrical Supply Co. | 59-3241569 | 1307 N Albany Ave | (813) 251-6398 | **SLBE/BBE** | Tampa, FL 33607 | (813) 251-6521 | Bernard Albury | leo_albury@yahoo.com |
| 9 | Bay Light, LLC d/b/a Professional Property Services | 59-1341451 | 10105 11th Street North | (813) 972-4057 | **SLBE/BBE** | Tampa, FL 33612 | (813) 971-0882 | Hyacinth Robinson | paulrobinson22@msn.com |
| 10 | Best Price Electric Service, LLC | 27-1211988 | P.O. Box 6516 | (813) 927-1668 | Small Business | Seffner, FL 33583 | (813) 409-3154 | Frank Fleites | BestPriceElectricServ@hotmail.com |
| 11 | Brown & Brown Electric, Inc. | 59-2283934 | 6555 N.W. 9th Ave. S-205 | (954) 938-8986 | **African American** | Ft. Lauderdale, FL 33310-5003 | (954) 938-9272 | Winston Brown | winston@brownandbrownelectric.com |

**African American/Black Business Enterprises (BBE) may count toward the subcontract goal. Refer to MBD Form 70-Procurement Guidelines**

**Report Date: July 27, 2015**

Subcontract Goal Contact List: SLBEs and Underutilized WMBEs
(**The Underutilized WMBE Industry Category for Subcontracts is Construction - BBE Certified)

Project 15-C-00037 (HFC AWTP Dissolved Aeration Reactor Improvements, Phase 1)

| # Of Firms | Company Name | Federal Number | Address | Phone Number | SLBE/WMBE CLASS | City, State, Zip Code | Fax Number | Contact Name | Contact Email |
|---|---|---|---|---|---|---|---|---|---|
| 12 | Charlie Brown's Hauling & Demolition, Inc. | 20-1874672 | P.O. Box 1178 | (352) 521-0482 | **SLBE/BBE** | Dade City, FL 33526 | (352) 521-5915 | Charlie Brown | Charliewbrown@aol.com |
| 13 | Creative Industrial Solutions, LLC | 20-8479779 | 5200 NW 43rd Street Suite 102-207 | (352) 226-8448 | **African American** | Orlando, FL 32606 | (813) 217-5328 | Kevin Holmes | admin@creativeindustrialsolutions.com |
| 14 | Crevello Electric, Inc. | 59-3559003 | 3305 N. Stanley Rd. | (813) 986-6106 | Small Business | Plant City, FL 33565 | (813) 986-9633 | Bill Crevello | crevelloelectric@gmail.com |
| 15 | DRD Enterprises, LLC | 20-4675317 | 4104 Yellowwood Dr. | (813) 476-9933 | **SLBE/BBE** | Valrico, FL 33594 | (866) 850-1332 | Devon Deenah | ddeenah@drdenterprise.com |
| 16 | Gaylord / Miller Electric Corp | 59-1631953 | 602 North Oregon Avenue | (813) 254-4681 | Small Business | Tampa, FL 33606 | (813) 254-9473 | James A. Tepper | james.gmelectric@verizon.net |
| 17 | Genesis VII, Inc. | 59-2952211 | 1605 White Dr. | (321) 383-4813 | **African American** | Titusville, FL 32780 | (321) 383-3247 | Robert Jordan | robert.jordan@genesisvii.com |
| 18 | Icon Supply, Inc | 59-3243571 | P.O. Box 272423 | (813) 936-2030 | Small Business | Tampa, FL 33688-2423 | (813) 936-9268 | Norma Tempest | ICONUSA@tampabay.rr.com |
| 19 | Integrated Design of Central Florida | 59-2203868 | 180 Scarlet Blvd. | (316) 209-8342 | Small Business | Oldsmar, FL 34677 | (813) 925-0299 | Walter Wiseman | wallyses@aol.com |
| 20 | J M J Hauling, Inc. | 32-0270935 | 13810 Golf Course Road | (917) 544-9741 | Small Business | Parrish, FL 34219 | (941) 721-6932 | Bachu Maniram | mvachu@tampabay.rr.com |
| 21 | JDP Electric, Inc. | 59-3511620 | 6600 N. Florida Avenue | (813) 234-4004 | Small Business | Tampa, FL 33604 | (813) 236-0394 | Jeffrey Priede | jdpinc@tampabay.rr.com |
| 22 | Manatee Electric, Inc. | 59-3454485 | 845 Thompson Road | (813) 645-7000 | Small Business | Lithia, FL Fl | (813) 654-7568 | John Babuka | john@reliableelectricusa.com |

**African American/Black Business Enterprises (BBE) may count toward the subcontract goal. Refer to MBD Form 70-Procurement Guidelines**

**Report Date: July 27, 2015**

Subcontract Goal Contact List: SLBEs and Underutilized WMBEs
(**The Underutilized WMBE Industry Category for Subcontracts is Construction - BBE Certified)

Project 15-C-00037 (HFC AWTP Dissolved Aeration Reactor Improvements, Phase 1)

| # Of Firms | Company Name | Federal Number | Address | Phone Number | SLBE/WMBE CLASS | City, State, Zip Code | Fax Number | Contact Name | Contact Email |
|---|---|---|---|---|---|---|---|---|---|
| 23 | Mandy Electric, Inc. | 59-2914874 | 9353 E. Fowler Ave. | (813) 264-9234 | Small Business | Thonotosassa, FL 33592 | (813) 333-9701 | Armando Hernandez | lhernandez@mandyselectric.com |
| 24 | Mar Supply Co. | 27-0206845 | 1660 63rd Avenue East | (941) 286-3240 | Small Business | Bradenton, FL 34203 | (941) 761-6500 | Raul Corona | info@marsupplyco.com |
| 25 | MDH Enterprises, Inc. | 55-0849332 | 281 E C St. | (386) 789-2672 | **African American** | Orange City, FL 32763 | (866) 681-5026 | Matize Hoskins | matize@my-es.com |
| 26 | Milena International, Inc. | 27-5032416 | 5004 E. Fowler Ave, Suite C-152 | (904) 553-3645 | **SLBE/BBE** | Tampa, FL 33617 | (877) 223-6902 | Raoul Thomas | raoul@milenasupply.com |
| 27 | OGONZALEZ TRUCKING INC | 20-2502525 | 4108 DELLBROOK DR | (813) 961-8158 | Small Business | Tampa, FL 33624 | (813) 961-8158 | OMAR GONZALEZ | SOGARA4@VERIZON.NET |
| 28 | On-Point Group, Inc. | 38-3788119 | 5608 Puritan Rd | (813) 927-2808 | **SLBE/BBE** | Tampa, FL 33617 | (813) 374-0993 | Daphne Jones | d.jones@on-pointgroupinc.com |
| 29 | Ortzak Technology, LLC | 45-4837502 | 13014 N. Dale Mabry Hwy, Suite 623 | (813) 961-6023 | Small Business | Tampa, FL 33618 | (813) 961-6023 | Daniel Castro | dcastro@ortzak.com |
| 30 | Par Development Partners, Inc. | 20-5657414 | 2109 E. Palm Ave., Suite 312 | (813) 374-2856 | **SLBE/BBE** | Tampa, FL 33605 | (866) 594-2505 | Yancy Wilson | ydwilson@aol.com |
| 31 | Prime Electric, LLC | 20-1137443 | 1229 W. Main St | (352) 728-5966 | **African American** | Leesburg, FL 34748 | (352) 728-5921 | Wylie Hamilton | wylie@primeelectricllc.net |
| 32 | Rhythms Electric Corporation | 27-3150153 | 433 37th Ave NE | (727) 460-8779 | Small Business | St. Petersburg, FL 33704 | | Mathew Krchmar | rhythmselectric@me.com |
| 33 | Sabrina's Trucking, LLC | 59-3284380 | P.O. Box 992 | (813) 629-7210 | **SLBE/BBE** | Mango, FL 33550 | (813) 627-9094 | Nathaniel Johnson | jtrucker151@aol.com |
| 34 | Sunrise Utility Construction, Inc. | 59-3034012 | P.O. Box 272293 | (813) 949-3749 | Small Business | Tampa, FL 33688-2293 | (813) 949-0408 | Lisa Nehrboss | LMNBOSS@AOL.COM |

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**Report Date: July 27, 2015**

Subcontract Goal Contact List: SLBEs and Underutilized WMBEs
(**The Underutilized WMBE Industry Category for Subcontracts is Construction - BBE Certified)

Project 15-C-00037 (HFC AWTP Dissolved Aeration Reactor Improvements, Phase 1)

| # Of Firms | Company Name | Federal Number | Address | Phone Number | SLBE/WMBE CLASS | City, State, Zip Code | Fax Number | Contact Name | Contact Email |
|---|---|---|---|---|---|---|---|---|---|
| 35 | TAMCO Electric, Inc. | 59-1396630 | 4022 W South Avenue | (813) 986-3472 | Small Business | Tampa, FL 33614 | (813) 986-5979 | Steven Moates | atrujill@tampabay.rr.com |
| 36 | Terrell Industries, Inc. | 65-0530148 | 2067 1st Avenue N | (727) 823-4424 | **SLBE/BBE** | St. Petersburg, FL 33713 | (727) 823-3977 | Grady Terrell | gterrell@verizon.net |
| 37 | TNT Environmental, LLC | 26-3864129 | 17852 Pine Knoll Drive | (352) 567-1822 | Small Business | Dade City, FL 33523 | (352) 567-5817 | Christopher Leibereid | tntenvironmental@gmail.com |

**African American/Black Business Enterprises (BBE) may count toward the subcontract goal. Refer to MBD Form 70-Procurement Guidelines**

**Report Date: July 27, 2015**

Instructions Regarding Use of the SLBE Goal Contact List

**Bidders must solicit a subcontracting bid from ALL of the firms listed on the SLBEs list provided within the Specifications,** and provide documentation of emails, faxes, phone calls, letters, or other communication with the firms as a first step in demonstrating Good-Faith Efforts to achieve the goal set for SLBE participation on this contract.

The list is formatted to facilitate e-mailing of a solicitation to the listed firms by copying and pasting the email addresses.

The SLBE participation Goal is based upon the availability of the certified firms indicated on the contact list. The Goal and Requirements of the City's Equal Business Opportunity Program are stated in the Bid/Contract Document, Specifications.

SOLICITATION FOR SUBCONTRACTOR QUOTES

From:
OUR COMPANY NAME:
TELEPHONE NUMBER:
ADDRESS:
FAX NUMBER:
E-MAIL ADDRESS:

To Subcontractor:

Our firm is in the process of preparing a bid for a **City of Tampa Contract**. Please accept this notice as our request for quotes for the scope of work identified below. Please respond to this request by filling in the information below and returning via e-mail or fax to the address or number provided. Please contact us if you need any assistance in obtaining bonding, lines of credit, insurance, assistance in obtaining necessary equipment, supplies, materials, participation in a City-sponsored mentor-protégé program, or if you have any questions.

Plans and Specs for this project are posted at:
http://www.tampagov.net/dept_contract_administration/programs_and_services/construction_project_bidding/

CONTRACT NO.:
CONTRACT NAME:
CITY'S BID OPENING DATE:
DEADLINE FOR YOUR SUBCONTRACTOR BID OR RESPONSE:
SPECIFIC SCOPE OF WORK:

Please complete and submit with your subcontract bid or response:
YOUR FIRM'S NAME:
MAILING ADDRESS:
CITY:
STATE:
ZIP:
FAX NUMBER:
E-MAIL ADDRESS:
__Yes, my company is interested in quoting this project for the following items of work:

__No, my company will not quote this project for the following reason(s):

(Sample Suggested Sub Solicitation 3-9-9 Tampa MBDO)

Contract 15-C-00037; Howard F. Curren Diffused Air Reactor Improvements, Phase 1

PROPOSAL

To the Mayor and City Council of the City of Tampa, Florida:

Name of Bidder _____

_____
Business Phone Number and Email Address

_____
Business Name and Mailing Address

_____
Phone Number and Name of Contact Regarding Permits

_____
Contractor/Qualifiers Name and Federal Identification Number

Date of Proposal _____

(If Bidder is a firm, fill in the following blanks):

Names and Residential Addresses of Partners

_____

_____

(If Bidder is a corporation, fill in the following blanks):

Organized under the laws of the State of _____

Names and Address of President

_____

_____

Name and Address of Vice President

_____

_____

Name and Address of Secretary

_____

_____

Names and Address of Treasurer

_____

_____

The above-named Bidder affirms and declares:

(1) That the Bidder is of lawful age and that no other person, firm or corporation has any interest in this Proposal or in the Contract proposed to be entered into.

(2) That this Proposal is made without any understanding, agreement or connection with any other person, firm, or corporation making Proposal for the same purposes, and is in all respects fair and without collusion or fraud.

(3) That the Bidder is not in arrears to the City of Tampa, upon debt or contract, and is not a defaulter, as surety or otherwise, upon any obligation to the City of Tampa.

(4) That no officer or employee or person whose salary is payable in whole or in part from the City Treasury is, shall be or become interested, directly or indirectly, as a contracting party, partner, stockholder, surety or otherwise, in this Proposal, or in the performance of the Contract, or in the supplies, materials, or equipment and work or labor to which it relates, or in any portion of the profits thereof.

(5) That the Bidder has carefully examined the site of the work and that, from his own investigations, he has satisfied himself as to the nature and location of the work, the character, quality, and quantity of materials and the kinds and extent of equipment and other facilities needed for the performance of the work, the general and local conditions and all difficulties to be encountered, and all other items which may, in any way, affect the work or its performance.

(6) That the Bidder

_____ Has; Treasury Number _____

_____ Has not
(Check applicable box)

previously performed work under the President's Executive Order Nos. 11246 and 11375.

(7) That the undersigned, as Bidder, also declares that he has carefully examined and fully understands all the component parts of the Contract Documents and agrees that he will execute the Contract and finish the required Performance Bond and will completely perform the work in strict accordance with the terms of the Contract and the Contract Documents therein referred to for the following prices, to wit:

| Contract Item No. | Estimated Quantity | Description and Price in Words | Computed Total Price for Item in Figures |
|---|---|---|---|
| BASE BID | LS | The work includes the furnishing all labor, materials and equipment to remove and replace aeration diffusers, mixers, vegetation, and associated appurtenances within reactor No.1, install internal recycle pump, backflow device, crane davit, and associated piping and appurtenances, install water quality probes (nitrate, ammonium, pH, DO) , PLC, air metering devices, and all associated electrical conduits, panels, and wiring, perform programming to automatically adjust air flow and internal recycle based on probe conditions defined by COT, perform SCADA integration, any allowances that may be listed in Section 01020, and with all associated work required for a complete project in accordance with the Contract Documents.<br><br>_____<br><br>_____ dollars<br><br>and _____ cents<br><br>(BASE BID) LS | $_____ |

Computed Total Price In Words:

_____

_____ dollars and _____ cents.

Computed Total Price in Figures: $_____

The bidder acknowledges that the following addenda have been received and that the changes covered by the addendum(s) have been taken into account in this proposal: #1 ___ #2 ___ #3 ___ #4___ #5___.

The bidder acknowledges the requirements of the City of Tampa's Equal Business Opportunity Program.

Bidder acknowledges that included in the various items of the proposal and the Total Bid Price are costs for complying with the Florida Trench Safety Act (90096), (Laws of Fla.) effective October 1, 1990. The bidder further identifies the costs to be summarized below:

| | Trench Safety Measure (Description) | Unit of Measure (LF, SY) | Unit Quantity | Unit Cost | Extended Cost |
|---|---|---|---|---|---|
| A. | _____ | _____ | _____ | _____ | _____ |
| B. | _____ | _____ | _____ | _____ | _____ |
| C. | _____ | _____ | _____ | _____ | _____ |
| D. | _____ | _____ | _____ | _____ | _____ |

Total Cost $_____

Signed _____

Failure to complete the above may result in the bid being declared non-responsive.

Accompanying this Proposal is a certified check, cashier's check or Bid Bond (form included herein must be used) on the form at least five (5) percent of the total amount of the Proposal which check shall become the property of the

_____ of _____
(Name of Bank or Surety) (City & State)

City of Tampa, or which bond shall become forthwith due and payable to the City of Tampa, if this Proposal shall be accepted by the City of Tampa and the undersigned shall fail to execute a contract with and to furnish the required Performance Bond and Payment Bond to the City of Tampa within twenty (20) days after the date of receipt of written Notice of Award by the City of Tampa to the undersigned so to do.

Dated _____, 20___

_____
(Name of Bidder)

_____
(Address of Bidder)

_____
(Signature)

_____
(Title)

Where Bidder is a Corporation:

Attest:

_____
Secretary

AFFIX
CORPORATE
SEAL

(ACKNOWLEDGMENT OF PRINCIPAL)

STATE OF )
) SS:
COUNTY OF )

For a Corporation:

STATE OF _____
COUNTY OF _____

The foregoing instrument was acknowledged before me this ___ of _____, 20___ by _____ of _____, a _____ corporation, on behalf of the corporation. He/she is ___ personally known or has ___ produced _____ as identification.

_____
Notary

My Commission Expires:

_____

For an Individual:

STATE OF _____
COUNTY OF _____

The foregoing instrument was acknowledged before me this ___ of _____, 20___ by _____ who is ___ personally known to me or has ___ produced _____ as identification.

_____
Notary

My Commission Expires:

_____

For a Firm:

STATE OF _____
COUNTY OF _____

The foregoing instrument was acknowledged before me this ___ of _____, 20___ by _____ who signed on behalf of the said firm. He/she is ___ personally known or has ___ produced _____ as identification.

_____
Notary

My Commission Expires:

_____

_____

# Good Faith Effort Compliance Plan for Small Local Business Subcontracting

City of Tampa - Equal Business Opportunity Program

**Contract** _____ **Bid Date** _____

**Bidder** _____

**Signature** _____ **Date** _____

**Name** _____ **Title** _____

**The following Compliance Plan is a true report of Good Faith Efforts made to accomplish subcontracting goals for Small Local Business Enterprises, SLBEs, on the referenced contract:**

□ **The goal for SLBE participation has been met or exceeded. See the DMI form reporting subcontractors to be utilized.**
(Check Box, if appropriate; the remainder of the Compliance Plan need not be reported.)

□ **The goal for SLBE participation has not been met. The following is a recap of Good Faith Efforts made:**
(Check applicable boxes below. Enclose additional documents, and/or add remarks below as needed.)

(1) Soliciting through reasonable and available means the interest of SLBEs that have the capability to perform the work of the contract. The Bidder or Contractor must solicit this interest within sufficient time to allow the SLBEs to respond. The Bidder or Contractor must take appropriate steps to follow up initial solicitations with interested SLBEs. □ See DMI report forms for subcontractors solicited. □ See enclosed supplemental data on solicitation efforts. □ Remarks:

(2) Providing interested SLBEs with adequate information about the plans, specifications, and requirements of the contract, including addenda, in a timely manner to assist them in responding to the solicitation. □ See enclosed sample solicitation. □ Remarks:

(3) Negotiating in good faith with interested SLBEs that have submitted bids. Documentation of negotiation must include the names, addresses, and telephone numbers of SLBEs that were solicited; the date of each such solicitation; a description of the information provided regarding the plans and specifications for the work selected for subcontracting; and evidence as to why agreements could not be reached with SLBEs to perform the work. That there may be some additional costs involved in soliciting and using SLBEs is not a sufficient reason for a contractor's failure to meet the goals, as long as such costs are reasonable. Bidders are not required to accept higher quotes in order to meet the goal. □ DMI subcontractor-utilized forms reflect successful negotiations □ This project is of a low-bid nature and negotiations are limited to clarifications of scope and specifications. □ See enclosed document. □ Remarks:

(4) Not rejecting SLBEs as being unqualified without sound reasons based on a thorough investigation of their capabilities. The SLBEs standing within its industry, membership in specific groups, organizations, or associations and political or social affiliations are not legitimate causes for rejecting or not soliciting bids to meet the goals. □ Not applicable. □ See attached explanation for rejection of a low-bidding subcontractor's bid. □ Remarks:

(5) Making a portion of the work available to SLBE subcontractors and suppliers and to select those portions of the work or material consistent with the available SLBE subcontractors and suppliers, so as to facilitate meeting the goal. □ Sub-Contractors were allowed to bid on their own choice of work or trade without restriction to a pre-determined portion. □ See enclosed comments. □ Remarks:

(6) Making good faith efforts, despite the ability or desire of a Bidder or Contractor to perform the work of a contract with its own organization. A Bidder or Contractor who desires to self-perform the work of a contract must demonstrate good faith efforts unless the goal has been met. □ Sub-Contractors were not prohibited from submitting bids on work not usually sub-contracted. □ Remarks:

(7) Selecting portions of the work to be performed by SLBEs in order to increase the likelihood that the goals will be met. This includes, where appropriate, breaking out contract work items into economically feasible units to facilitate SLBE participation, even when the Bidder or Contractor might otherwise prefer to perform these work items with its own forces. □ Sub-Contractors were allowed to bid on their own choice of work or trade without restriction to a pre-determined portion. □ Sub-Contractors were not prohibited from submitting bids on work not usually sub-contracted. □ See enclosed comments. □ Remarks:

(8) Making efforts to assist interested SLBEs in obtaining bonding, lines of credit, or insurance as required by the city or contractor. □ See enclosed sample solicitation □ see enclosed document. □ Remarks:

(9) Making efforts to assist interested SLBEs in obtaining necessary equipment, supplies, materials, or related assistance or services, including participation in a City-sponsored mentor-protégé program. □ See enclosed sample solicitation. □ See enclosed document. □ Remarks:

(10) Effectively using the services of the City and other organizations that provide assistance in the recruitment and placement of SLBEs. □ See enclosed document. □ The following services were used:

Other Supporting Good Faith Efforts: □ See enclosed document. □ Remarks:

## Compliance Plan: Guidance For Meeting Good Faith Efforts

1. All firms on the SLBE Goal Setting List must be solicited and documentation provided for email, fax, letters, phone calls, and other communication with the listed firms. The DMI Solicited and DMI-Utilized forms must be completed for all firms solicited or utilized. Other opportunities for subcontracting may be explored by consulting the City of Tampa and/or Hillsborough County certification listings of SLBE's.

2. Solicitation of SLBEs, via written or electronic notification, should provide specific information on the services needed, where plans can be reviewed and assistance offered in obtaining these, if required. Solicitations should be typically be sent a week or more before the bid date. Sample copies of the bidder's solicitations should be provided.

3. With any quotes received, a follow-up should be made whenever needed to confirm scope of work. For any SLBE low quotes rejected, an explanation should be provided detailing negotiation efforts.

4. If a low bid SLBE is rejected or deemed unqualified the contractor must provide an explanation and supporting documentation for this decision.

5. Prime should break down portions of work into economical feasible opportunities for subcontracting. The SLBE directory can be useful in identifying additional subcontracting opportunities and firms not listed in the "SLBE Goal Setting Firms List."

6. Contractor should not preclude SLBEs from bidding on any part of work, even if the Contractor can self-perform the work.

7. Contractor should avoid relying solely on subcontracting out work where availability is not sufficient to attain pre-determined goal.

8. In its solicitations, the Bidder should offer assistance to SLBEs in obtaining bonding, insurance, etc, if required of subcontractors by the City or Prime Contractor.

9. In its solicitation, the Bidder should offer assistance in obtaining equipment for a specific job to SLBEs, if needed.

**10.** Contractor should use the services offered by such agencies as the Minority Business Development Office of the City of Tampa, Hillsborough County and the NAACP Empowerment Center for the recruitment and placement of SLBEs.

# City of Tampa –DMI -Schedule of All Sub-(Contractors/Consultants/Suppliers) Solicited

*(FORM MBD-10)*

Contract No.:_____ Contract Name:_____

Contractor Name:_____ Address:_____

Federal ID:_____Phone:_____ Fax:_____ Email:_____

[] No Firms were contacted/solicited for this contract.

[] No Firms were contacted because:_____

[] See attached documents with supplemental information.

NIGP Code General Categories: Buildings = 909, General = 912, Heavy = 913, Trades = 914, Architects = 906, Engineers & Surveyors = 925, Supplier = 912-77

This DMI Schedule Must Be Submitted with the Bid or Proposal (Do Not Modify This Form)

| S = SLBE<br>W=WMBE<br><br>Federal ID | Company Name<br>Address<br>Phone & Fax | Type of Ownership<br>(F=Female M=Male)<br>BF BM = African Am.<br>HF HM = Hispanic Am.<br>AF AM = Asian Am.<br>NF NM = Native Am.<br>CF CM = Caucasian | Trade or Services<br><br>NIGP Code (listed above) | Contact Method<br>L=Letter<br>F=Fax<br>E=Email<br>P=Phone | Quote or Resp. Rec'd Y/N |
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It is hereby certified that the information provided is an accurate and true account of contacts and solicitations for sub – contracting opportunitieson this contract. ***This form must be completed and submitted with the bid or proposal***.Modifying or failing to sign DMI forms may result in Non-Compliance and/or deemed non-responsive.

Signed:_____ Name/Title:_____ Date:_____



**Note: Detailed Instructions for completing this form are on the next page**

# Instructions for completing The Sub-(Contractors/Consultants/ Suppliers) Solicited Form (Form MBD-10)

**This form must be submitted with all bids or proposals**. All subcontractors (regardless of ownership or size) solicited and subcontractors from whom unsolicited quotations were received must be included on this form. The instructions that follow correspond to the headings on the form required to be completed.Note: Ability or desire to self-perform all work shall not exempt the prime from Good Faith Efforts when Goal has been established.

- **Contract No.** This is the number assigned by the City of Tampa for the bid or proposal.
- **Contract Name.** This is the name of the contract assigned by the City of Tampa for the bid or proposal.
- **Contractor Name.** The name of your business.
- **Address.** The physical address of your business.
- **Federal ID.**FIN. A number assigned to your business for tax reporting purposes.
- **Phone.** Telephone number to contact business.
- **Fax.** Fax number for business.
- **Email.** Provide email address for electronic correspondence.
- **No Firms were contacted/solicited for this contract.** Checking the box indicates that a pre-determined Subcontract Goal was not set by the City resulting in your business not using subcontractors and will self-perform all work. If during the performance of the contract you employ subcontractors, the City must pre-approve subcontractors. Use of the "Sub-(Contractors/Consultants/Suppliers) Payments" form must be submitted with your invoices. Note: Certified SLBE or WMBE firms bidding as Primes are not exempt from outreach and solicitation of subcontractors.
- **No Firms were contacted because.** Provide brief explanation why no firms were contacted/solicited.
- **See attached documents.**Check box, if after you have completed the DMI Form in its entirety, you are providing any additional documentation relating to the form.All DMI data not submitted on the MBD Form-10 must be in the same format and have all requested data from MBD Form-10 included.

The following instructions are for information of any and all subcontractors solicited.

- **"S" = SLBE, "W" = WMBE.** Enter "**S**" for firms Certified by the City as Small Local Business Enterprises and/or "**W**" for firms Certified by the City as Women/Minority Business Enterprise.
- **Federal ID.**FIN. A number assigned to a business for tax reporting purposes. This information is critical in proper identification of the subcontractor.
- **Company Name, Address, Phone & Fax**. Provide company information for verification of payments.
- **Type of Ownership.** Indicate the Ethnicity and Gender of the owner of the subcontracting business.
- **Trade, Services, or Materials** Indicate the trade, service, or material provided by the subcontractor. NIGP codes are listed at top section of document.
- **Contact Method L=letter, F=fax, E=Email, P=Phone.** Indicate with letter the method of soliciting for bid.
- **Quote or Resp. (response) Rec'd (received) Y/N**. Indicate "Y" Yes if you received a quotation or if you received a response to your solicitation. Indicate "N" No if you received no response to your solicitation from the subcontractor.

If any additional information is required or you have any questions, you may call the Minority Business Development Office at (813) 274-5522.

# City of Tampa –DMI Schedule of Sub-(Contractors/Consultants/Suppliers) to be Utilized

*(FORM MBD-20)*

Contract No.:_____ Contract Name:_____

Contractor Name:_____ Address:_____

Federal ID:_____Phone:_____ Fax:_____ Email:_____

[ ] See attached documents.

[ ] No Subcontracting (of any kind) will be performed on this contract.

NIGP Code General Categories: Buildings = 909, General = 912, Heavy = 913, Trades = 914, Architects = 906, Engineers & Surveyors = 925, Supplier = 912-77

## This DMI Schedule Must Be Submitted with the Bid or Proposal (Do Not Modify This Form)

Enter "S" for firms Certified as Small Local Business Enterprises, "W" for firms Certified as Women/Minority Business Enterprise

| S = SLBE<br>W=WMBE<br>Federal ID | Company Name<br>Address<br>Phone & Fax | Type of Ownership<br>(F=Female M=Male)<br>BF BM = African Am.<br>HF HM = Hispanic Am.<br>AF AM = Asian Am.<br>NF NM = Native Am.<br>CF CM = Caucasian | Trade, Services, or Materials<br>NIGP Code Listed above | Amount of Quote. Letter of Intent if available. | Percent of Scope/Contract % |
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Total Subcontract/Supplier Utilization $_____

Total SLBE Utilization $ _____

Total WMBE Utilization $ _____

Percent SLBE Utilization of Total Bid/Proposal Amt. _____% Percent WMBE Utilization of Total Bid/Proposal Amt. _____%

It is hereby certified that the following information is a true and accurate account of utilization for sub-contracting opportunities on this contract. ***This form must be completed and submitted with the bid or proposal.*** Modifying or failing to sign DMI forms may result in Non-Complianceand/or deemed non-responsive.

Signed:_____ Name/Title:_____ Date:_____



**Note: Detailed Instructions for completing this form are on the next page.**

**Instructions for completing The Sub-(Contractors/Consultants/ Suppliers) to be Utilized Form**

# (Form MBD-20)

***This form must be submitted with all bids or proposals. All subcontractors projected to be utilized must be included on this form.***

- **Contract No.** This is the number assigned by the City of Tampa for the bid or proposal.
- **Contract Name.** This is the name of the contract assigned by the City of Tampa for the bid or proposal.
- **Contractor Name.** The name of your business.
- **Address.** The physical address of your business.
- **Federal ID.**FIN. A number assigned to your business for tax reporting purposes.
- **Phone.** Telephone number to contact business.
- **Fax.** Fax number for business.
- **Email.** Provide email address for electronic correspondence.
- **No Subcontracting (of any kind) will be performed on this contract.** Checking box indicates your business will not use subcontractors when no Subcontract Goal has been set by the City, but will self-perform all work. When subcontractors are utilized during the performance of the contract, the "Sub-(Contractors/Consultants/Suppliers) Payments" form must be submitted with your invoices. Note: Certified SLBE or WMBE firms bidding as Primes are not exempt from outreach and solicitation of subcontractors.
- **See attached documents.** Check if you have provided any additional documentation relating to the utilization of subcontractors.
-

The following instructions are for information of Any and All subcontractors to be utilized.

- **Federal ID.**FIN. A number assigned to a business for tax reporting purposes. This information is critical in proper identification of the subcontractor.
- **"S" = SLBE, "W" = WMBE.** Enter "**S**" for firms Certified by the City as Small Local Business Enterprises and/or "**W**" for firms Certified by the City as Women/Minority Business Enterprise.
- **Company Name, Address, Phone & Fax**. Provide company information for verification of payments.
- **Type of Ownership.** Indicate the Ethnicity and Gender of the owner of the subcontracting business.
- **Trade, Services, or Materials (NIGP code if Known)** Indicate the trade, service, or material provided by the subcontractor. NIGP codes are available at http:/www.tampagov.net/mbd.
- **Amount of Quote, Letters of Intent** (required for both SLBEs and WMBEs)
- **Percent of Work/Contract.** Indicate the percent of the total contract price the subcontract(s) represent.
- **Total Subcontract/Supplier Utilization.** – Provide total dollar amount of all subcontractors/suppliers projected to be used for the contract. (Dollar amounts may not apply to CCNA proposals.)
- **Total SLBE Utilization.** Provide total dollar amount for all projected SLBE subcontractors/Suppliers used for this contract. (Dollar amounts may not apply to CCNA proposals.)
- **Total WMBE Utilization.** Provide total dollar amount for all projected WMBE subcontractors/Suppliers used for this contract. (Dollar amounts may not apply to CCNA proposals.)
- **Percent SLBE Utilization.** Total amount allocated to SLBEs divided by the total bid amount. (Dollar amounts may not apply to CCNA proposals.)
- **Percent WMBE Utilization.** Total amount allocated to WMBEs divided by the total bid/proposal amount. (Dollar amounts may not apply to CCNA proposals.)

If any additional information is required or you have any questions, you may call the Minority Business Development Office at (813) 274-5522.

TAMPA BID BOND
Contract 15-C-00037; Howard F. Curren Diffused Air Reactor Improvements, Phase 1

KNOW ALL MEN BY THESE PRESENTS, that we, _____

_____

(hereinafter called the Principal) and _____

(hereinafter called the Surety) a Corporation chartered and existing under the laws of the State of _____, with its principal offices in the City of _____, and authorized to do business in the State of Florida, are held and firmly bound unto the City of Tampa, a Municipal Corporation of Hillsborough County, Florida, in the full and just sum of 5% of the amount of the (Bid) (Proposal) good and lawful money of the United States of America, to be paid upon demand of the City of Tampa, Florida, to which payment will and truly to be made we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally and firmly these presents.

WHEREAS, the Principal is about to submit, or has submitted to the City of Tampa, Florida, a Proposal for the construction of certain facilities for the City designated Contract 15-C-00037, Howard F. Curren Diffused Air Reactor Improvements, Phase 1.

WHEREAS, the Principal desires to file this Bond in accordance with law, in lieu of a certified Bidder's check otherwise required to accompany this Proposal.

NOW, THEREFORE: The conditions of this obligation are such that if the Proposal be accepted, the Principal shall, within twenty (20) days after the date of receipt of written Notice of Award, execute a contract in accordance with the Proposal and upon the terms, conditions and price set forth therein, in the form and manner required by the City of Tampa, Florida and execute a sufficient and satisfactory Public Construction Bond payable to the City of Tampa, Florida in an amount of one hundred percent (100%) of the total contract price, in form and with security satisfactory to said City, then this Bid Bond obligation is to be void; otherwise to be and remain in full force and virtue in law, and the Surety shall, upon failure of the Principal to comply with any or all of the foregoing requirements within the time specified above, immediately pay to the aforesaid City, upon demand, the amount thereof, in good and lawful money of the United States of America, not as a penalty, but as liquidated damages.

IN TESTIMONY THEREOF, the Principal and Surety have caused these presents to be duly signed and sealed this _____ day of _____, 20___.

Principal _____

BY _____

TITLE _____

BY _____

TITLE _____

(SEAL)

_____
Producing Agent

_____
Producing Agent's Address

_____
Name of Agency

_____
The addition of such phrases as "not to exceed" or like import shall render the (Bid) (Proposal)non-responsive.

# AGREEMENT

For furnishing all labor, materials and equipment, together with all work incidental thereto, necessary and required for the performance of the work for the construction of Contract 15-C-00037 in accordance with your Proposal dated _____, amounting to a total of $_____ as completed in accordance with subsections I-2.09 and I-2.10 of the Instruction to Bidders.

THIS AGREEMENT, made and entered into in triplicate, this ____ day of _____, 20___, between the City of Tampa, Florida, hereinafter called the City, and hereinafter called the Contractor.

WITNESSETH that, in consideration of the mutual stipulations, agreements, and covenants herein contained, the parties hereto have agreed and hereby agree with each other, the Party of the First Part for itself, its successors and assigns, and the Party of the Second Part for itself, or himself, or themselves, and its successors and assigns, or his or their executors, administrators and assigns, as follows:

Contract 15-C-00037; Howard F. Curren Diffused Air Reactor Improvements, Phase 1, shall include, but not be limited to, furnishing all labor, materials and equipment to remove and replace aeration diffusers, mixers, vegetation, and associated appurtenances within reactor No.1, install internal recycle pump, backflow device, crane davit, and associated piping and appurtenances, install water quality probes (nitrate, ammonium, pH, DO) , PLC, air metering devices, and all associated electrical conduits, panels, and wiring, perform programming to automatically adjust air flow and internal recycle based on probe conditions defined by COT, perform SCADA integration with all associated work required for a complete project in accordance with the Contract Documents.

Contract Documents referred to in Article 1.01 of this Agreement also includes this volume, applicable standard drawings, the plans and any provisions referred to whether actually attached or not.

# TAMPA AGREEMENT

## SECTION 1
## GENERAL

### ARTICLE 1.01 THE CONTRACT

Except for titles, subtitles, headings, running headlines, and tables of contents (all of which are printed herein merely for convenience), the following, except for such portions thereof as may be specifically excluded, constitute the Contract:

The Notice to Bidders;
The Instructions to Bidders, including Special Instructions and General Instructions;
The Proposal;
The Bid Bond;
The Certification of Nonsegregated Facilities;
The Notice of Award;
The Agreement;
The Performance Bond;
The Notice To Proceed;
The Specifications, including the General Provisions, the Workmanship and Materials, the Specific Provisions or the Contract Items
The Plans;
All Supplementary Drawings Issued after award of the Contract;
All Addenda issued by the City prior to the receipt of proposals;
All provisions required by law to be inserted in this Contract, whether actually inserted or not.

### ARTICLE 1.02 DEFINITIONS

The following words and terms, or pronouns used in their stead, shall, wherever they appear in this Contract, be construed as follows, unless different meaning is clear from the context:

(a)"City" shall mean the City of Tampa, Florida, represented by its Mayor and City Council, Party of the First Part, or such other City official as shall be duly empowered to act for the City on matters relating to this Contract.

(b)"Contractor" shall mean the Party of the Second Part hereto, whether corporation, firm or individual, or any combination thereof, and its, their, or his successors, personal representatives, executors, administrators, and assigns, and any person, firm or corporation who or which shall at any time be substituted in the place of the Party of the Second Part under this Contract.

(c)"Engineer" shall mean the Director of the Department or his duly authorized representative.

(d)"Consultant" shall mean the engineering or architectural firm or individual employed by the City to consult with and advise the City in the construction of the project.

(e)"Surety" shall mean any person, firm or corporation that has executed as Surety the Contractor's Performance Bond securing the performance of this Contact.

(f)"The Work" shall mean everything expressly or implied required to be furnished and done by the Contractor under the Contract, and shall include both Contract Work and Extra Work.

(g)"Contract Work" shall mean everything expressly or implied required to be furnished and done by the Contractor by any one or more of the Contract parts referred to in Article 1.01 hereof, except Extra Work, as hereinafter defined; it being understood that, in case of any inconsistency in or between any part or parts of this Contract, the Engineer shall determine which shall prevail.

(h)"Contract" or "Contract Documents" shall mean each of the various part of the Contract referred to in Article 1.01 hereof, both as a whole and severally.

(i)"Extra Work" shall mean work other than that required either expressly or implied by the contract in its present form.

(j)"Plans" shall mean only those drawings specifically referred to as such in these documents, or in any Addendum. Drawings issued after the execution of the Contract to explain further, or to illustrate, or to show changes in the work, will be known as "Supplementary Drawings" and shall be binding upon the Contractor with the same force as the Plans.

(k)"Specifications" shall mean all of the directions, requirements, and standards of performance applying to the work, as hereinafter detailed and designated as such, or which may be issued in an addendum.

(l)"Addendum or Addenda" shall mean the additional contract provisions issued in writing prior to the receipt of bids.

(m)"Notice" shall mean written notice. Notice shall be served upon the Contractor, either personally or by leaving the said notice at his residence or with any employee found on the work, or addressed to the Contractor at the residence or place of business given in his proposal and deposited in a postpaid wrapper in any post office box regularly maintained by the United States Post Office.

(n)"Project" shall mean the entire improvement package or related work. The "project" may consist of several different, but related, contracts.

(o)"Site" shall mean, and be limited to, the area upon or in which the Contractor's operations are carried on and such other appropriate areas as may be designed as such by the Engineer.

(p)"Subcontractor" shall mean any person, firm, or corporation, other than employees of the Contractor, who or which contracts with the Contractor to furnish, or actually furnishes labor, or labor and materials, or labor and equipment or labor, materials, and equipment at the site.

(q)Whenever in the Contract the words "directed", "required", "permitted", "ordered", "designated", "prescribed", and words of like import are used, they shall imply the direction, requirement, permission, order, designation, or prescription of the Engineer; and "approved", "acceptable", "satisfactory", "in the judgement of", and words of like import shall mean approved by, or acceptable to, or satisfactory to, or in the judgment of the Engineer.

(r)Whenever in the Contract the word "day" is used, it shall mean calendar day.

(s)"Final Acceptance" shall mean acceptance of the

work as evidenced by an official resolution of the City. Such acceptance shall be deemed to have taken place only if and when an approving resolution has been adopted by the City Council. The final acceptance shall be signed only after the City has assured itself by tests, inspection, or otherwise, that all of the provisions of the Contract have been carried out to its satisfaction.

(t)"Eastern Standard Time" shall be construed as the time being observed in the City on the day proposals are received or other documents issued or signed.

## SECTION 2
## POWERS OF THE CITY'S REPRESENTATIVES

**ARTICLE 2.01 THE ENGINEER**

It is covenanted and agreed that the Engineer, in addition to those matters elsewhere herein expressly made subject to his determination, direction, or approval, shall have the power, subject to such express provisions and limitations herein contained as are not in conflict herewith, and subject to review by the Mayor and City Council:

(a)To monitor the performance of the work.

(b)To determine the amount, kind, quality, sequence, and location of the work to be paid for hereunder and, when completed, to measure such work for payment.

(c)To determine all questions of an engineering character in relation to the work, to interpret the Plans, Specifications and Addenda.

(d)To determine how the work of this Contract shall be coordinated with the work of other contractors engaged simultaneously on this project.

(e)To make minor changes in the work as he deems necessary, provided such changes do not result in a net increase in the cost to the City or to the Contractor of the work to be done under the Contract.

(f)To amplify the Plans, add explanatory information and furnish additional Specifications and Drawings consistent with the intent of the Contract Documents.

The power of the Engineer shall not be limited to the foregoing enumeration, for it is the intent of this Contract that all of the work shall be subject to his determinations and approval, except where the determination or approval of someone other than the Engineer is expressly called for herein and except as subject to review by the Mayor and City Council. All orders of the Engineer requiring the Contractor to perform work as Contract work shall be promptly obeyed by the Contractor.

The Engineer shall not, however, have the power to issue an extra work order, and the performance of such work on the order of the Engineer without previously obtaining written confirmation thereof from the Mayor in accordance with Article 7.02 hereof may constitute a waiver of any right to extra compensation therefor. The Contractor is warned that the Engineer has no power to change the terms and provisions of this Contract, except minor changes where such change results in no net increase in the Contract Price.

**ARTICLE 2.02 DIRECTOR**

The Director of the Department in addition to those matters expressly made subject to his determination, direction or approval in his capacity as "Engineer", shall also have the power:

(a)To review any and all questions in relation to this Contract and its performance, except as herein otherwise specifically provided, and his determination upon such review shall be final and conclusive upon the Contractor.

(b)With the approval of the Mayor and City Council to authorize modifications or changes in the Contract so as to require: (1) the performance of extra work, or (2) the omission of Contract work whenever he deems it in the interest of the City to do so, or both.

(c)To suspend the whole or any part of the work whenever, in his judgment, such suspension is required: (1) in the interest of the City generally, or (2) to coordinate the work of the various Contractors engaged on this project, or (3) to expedite the completion of the entire project, even though the completion of this particular Contract may be thereby delayed, without compensation to the Contractor for such suspension other than extending the time for the completion of the work, as much as it may have been, in the opinion of the City, delayed by such a suspension.

(d)If, before the final acceptance of all the work contemplated herein, it shall be deemed necessary to take over, use, occupy, or operate any part of the completed or partly completed work, the Engineer shall have the right to do so and the Contractor will not, in any way, interfere with or object to the use, occupation, or operation of such work by the City after receipt of notice in writing from the Engineer that such work or part thereof will be used by the City on and after the date specified in such notice. Such taking over, use, occupancy or operation of any part of the completed or partially completed work shall not constitute final acceptance or approval of any such part of the work.

**ARTICLE 2.03 NO ESTOPPEL**

The City shall not, nor shall any department, officer, agent, or employee thereof, be bound, precluded, or estopped by any determination, decision, acceptance, return, certificate, or payment made or given under or in connection with this Contract by any officer, agent or employee of the City at any time either before or after final completion and acceptance of the work and payment therefor: (a) from showing the true and correct classification, amount, quality, or character of the work done, or that any determination, decision, acceptance, return certificate or payment is untrue, incorrect or improperly made in any particular, or that the work or any part thereof does not in fact conform to the requirements of the Contract Documents, and (b) from demanding and recovering from the Contractor any overpayments made to him or such damages as it may sustain by reason his failure to comply with the requirements of the Contract of Documents, or both.

**ARTICLE 2.04 NO WAIVER OF RIGHTS**

Neither the inspection, nor any order, measurements or certificate of the City or its employees, officers, or agents, nor by any order of the City for payment of money, nor any money, nor payments for or acceptance of the whole or any part of the work by the City, nor any extension of time, nor any changes in the Contract, Specifications or Plans, nor any possession by the City or its employees shall operate as a

waiver of any provisions of this Contract, nor any power herein provided nor shall any waiver of any breach of this Contract be held as a waiver of any other subsequent breach.

Any remedy provided in this Contract shall be taken and construed as cumulative, namely, in addition to each and every other suit, action, or legal proceeding. The City shall be entitled as of right to an injunction against any breach of the provisions of this Contract.

## SECTION 3
## PERFORMANCE OF WORK

**ARTICLE 3.01 CONTRACTOR'S RESPONSIBILITY**
The Contractor shall do all the work and furnish, at his own cost and expense, all labor, materials, equipment, and other facilities, except as herein otherwise provided, as may be necessary and proper for performing and completing the work under this Contract. The Contractor shall be responsible for the entire work until completed and finally accepted by the City.

The work shall be performed in accordance with the true intent and meaning of the Contract Documents. Unless otherwise expressly provided, the work must be performed in accordance with the best modern practice, with materials as specified and workmanship of the highest quality, all as determined by and entirely to the satisfaction of the Engineer.

Unless otherwise expressly provided, the means and methods of construction shall be such as the Contractor may choose, subject, however, to the approval of the Engineer. Only adequate and safe procedure, methods, structures and equipment shall be used. The Engineer's approval or the Engineer's failure to exercise his right thereon shall not relieve the Contractor of obligations to accomplish the result intended by the Contract, nor shall such create a cause of action for damages.

**ARTICLE 3.02 COMPLIANCE WITH LAWS**
The Contractor must comply with all local, State and Federal laws, rules, ordinances and regulations applicable to this Contract and to the work done hereunder, and must obtain, at his own expense, all permits, licenses or other authorization necessary for the prosecution of the work.

No work shall be performed under this Contract on Sundays, legal holidays or after regular working hours without the express permission of the Engineer. Where such permission is granted, the Engineer may require that such work be performed without additional expense to the City.

**ARTICLE 3.03 INSPECTION**
During the progress of the work and up to the date of final acceptance, the Contractor shall, at all times, afford the representatives of the City, the Florida Department of Environmental Regulation, and if applicable, the Federal Environmental Protection Agency and the Federal Department of Labor every reasonable, safe and proper facility for inspecting the work done or being done at the site. The inspection of any work shall not relieve the Contractor of any of his obligations to perform proper and satisfactory work as herein specified. Finished or unfinished work found not to be in strict accordance with the Contract shall be replaced as directed by the Engineer, even though such work may have been previously approved and payment made therefor.

The City shall have the right to reject materials and workmanship which are defective or require their correction. Rejected work and materials must be promptly removed from the site, which must at all times be kept in a reasonably clean and neat condition.

Failure or neglect on the part of the City to condemn or reject bad or inferior work or materials shall not be construed to imply an acceptance of such work or materials, if it becomes evident at any time prior to the final acceptance of the work by the City. Neither shall it be construed as barring the City at any subsequent time from the recovery of damages of such a sum of money as may be needed to build anew all portions of the work in which inferior work or improper materials were used, wherever found.

Should it be considered necessary or advisable by the City at any time before final acceptance of the entire work to make examinations of work already completed, by removing or tearing out all or portions of such work, the Contractor shall, on request, promptly furnish all necessary facilities, labor, and material for that purpose. If such work is found to be defective in any material respect, due to the fault of the Contractor or his subcontractors, he shall defray all expenses of such examination and of satisfactory reconstruction. If, however, such work is found to meet the requirements of the Contract, the cost of examination and restoration of the work shall be considered an item of extra work to be paid for in accordance with the provisions of Article 7.02 hereof.

**ARTICLE 3.04 PROTECTION**
During performance and until final acceptance, the Contractor shall be under an absolute obligation to protect the finished and unfinished work against any damage, loss, or injury. The Contractor shall take proper precaution to protect the finished work from loss or damage, pending completion and the final acceptance of all the work included in the entire Contract, provided that such precaution shall not relieve the Contractor from any and all liability and responsibility for loss or damage to the work occurring before final acceptance by the City. Such loss or damage shall be at the risk of and borne by the Contractor, whether arising from acts or omissions of the Contractor or others. In the event of any such loss or damage, the Contractor shall forthwith repair, replace, and make good the work without extension of time therefor, except as may be otherwise provided herein.

The provisions of this Article shall not be deemed to create any new right of action in favor of third parties against the Contractor or the City.

**ARTICLE 3.05 PRESERVATION OF PROPERTY**

The Contractor shall preserve from damage all property along the line of the work, or which is in the vicinity of or is in anywise affected by the work, the removal or destruction of which is not called for by the Plans. This applies, but is not limited, to the public utilities, trees, lawn areas, building monuments, fences, pipe and underground structures, public streets (except natural wear and tear of streets resulting from legitimate use thereof by the Contractor), and wherever such property is damaged due to the activities of the Contractor, it shall be immediately restored to its original condition by the Contractor and at his own expense.

In case of failure on the part of the Contractor to restore such property, or make good such damage or injury, the City may, upon forty-eight (48) hour written notice, proceed to repair, rebuild, or otherwise restore such property as may be deemed necessary, and the cost thereof will be deducted from any monies due or which may become due the Contractor under this Contract. Nothing in this clause shall prevent the Contractor from receiving proper compensation for the removal, damage, or replacement of any public or private property not shown on the Plans, when this is made necessary by alteration of grade or alignment authorized by the Engineer, provided that such property has not been damaged through fault of the Contractor, his employees or agents.

**ARTICLE 3.06 BOUNDARIES**
The Contractor shall confine his equipment, apparatus, the storage of materials, supplies and apparatus of his workmen to the limits indicated on the plans, by law, ordinances, permits or direction of the Engineer.

**ARTICLE 3.07 SAFETY AND HEALTH REGULATIONS**
The Contractor shall comply with the Department of Labor Safety and Health Regulations for construction promulgated under the Occupational Safety and Health Act of 1970 (PL 91- 596) and under Section 107 of the Contract Work Hours and Safety Standards Act (PL91-54).

**ARTICLE 3.08 TAXES**
All taxes of any kind and character payable on account of the work done and materials furnished under this Contract shall be paid by the Contractor and shall be deemed to have been included in his bid. The laws of the State of Florida provide that sales and use taxes are payable by the Contractor upon the tangible personal property incorporated in the work and such taxes shall be paid by the Contractor and shall be deemed to have been included in his bid.

**ARTICLE 3.09 ENVIRONMENTAL CONSIDERATIONS**
The Contractor, in the performance of the work under this Contract, shall comply with all Local, State and Federal laws, statutes, ordinances, rules and regulations applicable to protection of the environment; and, in the event he violates any of the provisions of same, he shall be answerable to the Local, State and Federal agencies designated by law to protect the environment. In the event the City receives, from any of the environmental agencies, a citation which is occasioned by an act or omission of the Contractor or his subcontractor or any officers, employees or agents of either, it is understood and agreed that the Contractor shall automatically become a party-respondent under said citation; and the City immediately shall notify the Contractor and provide him with a copy of said citation.

The Contractor shall comply with the requirements of the citation and correct the offending conditions(s) within the time stated in said citation and further shall be held fully responsible for all fines and/or penalties.

## SECTION 4
## TIME PROVISIONS

**ARTICLE 4.01 TIME OF START AND COMPLETION**
The Contractor must commence work within thirty (30) days subsequent to the date of the receipt of the "Notice to Proceed" by the City unless otherwise provided in the Specific Provisions and Special Instructions. Time being of the essence of this Contract, the Contractor shall thereafter prosecute the work diligently, using such means and methods of construction as well as secure its full completion in accordance with the requirements of the Contract Documents no later than the date specified therefor, or on the date to which the time for completion may be extended.

The Contractor must complete the work covered by this Contract in the number of consecutive calendar days set forth in the Instructions to Bidders, unless the date of completion is extended pursuant to the provisions of Article 4.05 hereof. The period for performance shall start from the date of signing of this Agreement by the City.

The actual date of completion will be established after a final inspection as provided in Article 4.07 hereof.

**ARTICLE 4.02 PROGRESS SCHEDULE**
To enable the work to be laid out and prosecuted in an orderly and expeditious manner, the Contractor shall submit to the Engineer a proposed progress schedule within fifteen (15) days after the award of this Contract.

The schedule shall state the Contract starting date, time for completion and date of completion and shall show the anticipated time of starting and completion of each of the various operations to be performed under this Contract, together with all necessary and appropriate information regarding sequence and correlation of work and an estimated time required for the delivery of all materials and equipment required for the work. The proposed schedule shall be revised as directed by the Engineer until finally approved by him, and, after such approval, shall be strictly adhered to by the Contractor. The approved progress schedule may be changed only with the written permission of the Engineer.

If the Contractor shall fail to adhere to the approved progress schedule or the schedule as revised, he shall promptly adopt such other or additional means and methods of construction as will make up for the time lost, and will assure completion in accordance with the contract time.

**ARTICLE 4.03 APPROVAL REQUESTS**
From time to time, as the work progresses and in the sequence indicated by the approved schedule, the Contractor must submit to the Engineer a specific request, in writing, for each item of information or approval required of him by the Contract. These requests must be submitted sufficiently in advance of the date upon which the information or approval is actually required by the Contractor to allow for the time the Engineer may take to act upon such submissions or resubmissions. The Contractor shall not have any right to an extension of time on account of delays due to his failure to submit his requests for the required information or the required approval in accordance with these requirements.

**ARTICLE 4.04 COORDINATION WITH OTHER CONTRACTORS**
During progress of the work, other Contractors may be engaged in performing other work on this project or on other projects on the site. In that event, the Contractor shall coordinate the work to be done hereunder with the work of such other Contractors in such manner as the Engineer may direct.

**ARTICLE 4.05 EXTENSION OF TIME**
If such an application is made, the Contractor shall be entitled to an extension of time for delay in completion of the work should the Contractor be obstructed or delayed in the commencement, prosecution or completion of any part of said work by any act or delay of the City, or by acts or omissions of other Contractors on this project, or by a riot, insurrection, war, pestilence, acts of public authorities, fire, lightning, hurricanes, earthquakes, tornadoes, floods, extremely abnormal and excessive inclement weather as indicated by the records of the local weather bureau for a five-year period preceding the date of the Contract, or by strikes, or other causes, which causes of delay mentioned in this Article, in the opinion of the City, are entirely beyond the expectation and control of the Contractor.

The Contractor shall, however, be entitled to an extension of time for such causes only for the number of days of delay which the City may determine to be due solely to such causes and only to the extent that such occurrences actually delay the completion of the project and then only if the Contractor shall have strictly complied with all of the requirements of Articles 4.01, 4.02, 4.03 and 4.04 hereof. It is hereby understood that the determination by the Engineer as to the order and sequence of the work shall not in itself constitute a basis for extension of time.

The determination made by the City on an application for an extension of time shall be binding and conclusive on the Contractor.

Delays caused by failure of the Contractor's materialmen, manufacturers, and dealers to furnish approved working drawings, materials, fixtures, equipment, appliances, or other fittings on time or failure of subcontractors to perform their work shall not constitute a basis of extension of time.

The Contractor agrees to make no claim for damages for delay in the performance of this Contract occasioned by any act or omission to act of the City or any of its representatives or because of any injunction which may be brought against the City or its representatives and agrees that any such claim shall be fully compensated for by an extension of time to complete performance of the work as provided herein.

**ARTICLE 4.06 LIQUIDATED DAMAGES**
It is mutually agreed between the parties that time is the essence of this Contract and that there will be on the part of the City considerable monetary damage in the event the Contractor should fail to complete the work within the time fixed for completion in the Contract or within the time to which such completion may have been extended.

The amount per day set forth in the Instructions to Bidders is hereby agreed upon as the liquidated damages for each and every calendar day that the time consumed in completing the work under this Contract exceeds the time allowed.

This amount shall, in no event, be considered as a penalty or otherwise than as the liquidated and adjusted damages to the City because of the delay and the Contractor and his Surety agree that the stated sum per day for each such day of delay shall be deducted and retained out of the monies which may become due hereunder and if not so deductible, the Contractor and his Surety shall be liable therefor.

**ARTICLE 4.07 FINAL INSPECTION**
When the work has been completed in accordance with the requirements of the Contract and final cleaning up performed, a date for final inspection of the work by the Engineer shall be set by the Contractor in a written request therefor, which date shall be not less than ten (10) days after the date of such request. The work will be deemed complete as of the date so set by the Contractor if, upon such inspection, the Engineer determines that no further work remains to be done at the site.

If such inspection reveals interms of work still to be performed, however, the Contractor shall promptly perform them and then request a reinspection. If, upon such inspection, the Engineer determines that the work is complete, the date of final completion shall be deemed to be the last day of such reinspection.

## SECTION 5
## SUBCONTRACTS AND ASSIGNMENTS

**ARTICLE 5.01 LIMITATIONS AND CONSENT**
The Contractor shall not assign, transfer, convey, sublet or otherwise dispose of this Contract or of his right, title, or interest therein, or his power to execute such Contract, or to assign any monies due or to become due thereunder to any other person, firm or corporation unless the previous written consent of the City shall first be obtained thereto and the giving of any such consent to a particular subcontract or assignment shall not dispense with the necessity of such consent to any further or other assignment.

Before making any subcontract, the Contractor must submit a

written statement to the Engineer, giving the name and address of the proposed contractor, the portion of the work and materials which he is to perform and furnish and any other information tending to prove that the proposed subcontractor has the necessary facilities, skill, integrity, past experience and financial resources to perform the work in accordance with the terms and conditions of this Contract.

If the City finds that the proposed subcontractor is qualified, the Contractor will be notified in writing. The City may revoke approval of any subcontractor when such subcontractor evidences an unwillingness or inability to perform his work in strict accordance with these Contract Documents. Notice of such revocation of approval will be given in writing to the Contractor.

The Contractor will promptly, upon request, file with the City a conformed copy of the subcontract. The Contractor shall cause appropriate provisions to be inserted in all subcontracts relative to the work to bind subcontractors to the Contractor by the terms of these Contract Documents, insofar as applicable to the work of subcontractors, and to give the Contractor the same power as regards terminating any subcontracts that the City may exercise over the Contractor under provisions of these Contract Documents.

The Contractor shall be required to perform with his own forces at least twenty-five (25) percent of the work, unless written consent to subcontract a greater percentage of the work is first obtained from the City.

**ARTICLE 5.02 RESPONSIBILITY**
The approval by the City of a subcontractor shall not relieve the Contractor of any of his responsibilities, duties, and liabilities hereunder. The Contractor shall be solely responsible to the City for the acts or defaults or omissions of his subcontractor and of such subcontractor's officers, agents, and employees, each of whom shall for all purposes be deemed to be the agent or employee of the Contractor. Nothing contained in the Contract Documents shall create any contractual relationship between any subcontractor and the City.

## SECTION 6
## SECURITY AND GUARANTY

**ARTICLE 6.01 CONTRACT SECURITY**
The Contractor shall execute and deliver to the City a Performance Bond on the form as provided herein, in an amount at least equal to one hundred (100) percent of the full Contract price, such Bond to be executed by a surety company acceptable to the City. The surety on such Performance Bond shall be a surety company duly authorized to do business in the State of Florida, and the Bond shall be issued or countersigned by a local resident producing agent of such surety company who is a resident of the State of Florida, regularly commissioned and licensed in said State, and satisfactory evidence of the authority of the person or persons executing such Bond shall be submitted with the Bond. The Performance Bond shall serve as security for the faithful performance of this Contract, including maintenance and guaranty provisions, and for the payment of all persons performing labor and furnishing materials in connection with the Contract. The premiums on the Performance Bond shall be paid by the Contractor.

If, at any time, the City shall become dissatisfied with any surety or sureties then upon the Performance Bond, or if for any other reason such bond shall cease to be adequate security for the City, the Contractor shall, within five days after notice so to do, substitute an acceptable Bond in such form and sum and signed by such other sureties as may be satisfactory to the City. The premiums on such Bond shall be paid by the Contractor. No further partial payments shall be deemed due or shall be made until the new sureties have qualified.

**ARTICLE 6.02 CONTRACTORS INSURANCE**
Insurance required shall be as indicated on Special Instructions pages beginning with "INS-1"

**ARTICLE 6.03 AGAINST CLAIMS AND LIENS**
The City may withhold from the Contractor as much as any approved payments to him as may, in the opinion of the City, be necessary to secure (a) just claims of any persons supplying labor or materials to the Contractor or any of his subcontractors for the work then due and unpaid; (b) loss due to defective work not remedied, or (c) liability, damage, or loss due to injury to persons or damages to the work or property of other contractors, subcontractors, or others, caused by the act or neglect of the Contractor or of any of his subcontractors. The City shall have the right, as agent for the Contractor, to apply any such amounts so withheld in such manner as the City may deem proper to satisfy such claims or to secure such protection. Such application of such money shall be deemed payments for the account of the Contractor.

**ARTICLE 6.04 MAINTENANCE AND GUARANTY**
The Contractor hereby guarantees all the work furnished under this Contract against any defects in workmanship and materials for a period of one year following the date of final acceptance of the work by the City. Under this guarantee, the Contractor hereby agrees to make good, without delay, at his own expense, any failure of any part of the work due to faulty materials or manufacture, construction, or installation, or the failure of any equipment to perform satisfactorily all the work put upon it within the limits of the Contract Documents, and further, shall make good any damage to any part of the work caused by such failure. It is hereby agreed that the Performance Bond shall fully cover all guarantees contained in this Article.
It is also agreed that all warranties, expressed or implied, inure to the benefit of the City and are enforceable by the City.

## SECTION 7
## CHANGES

**ARTICLE 7.01 MINOR CHANGES**
The City reserves the right to make such additions, deductions, or changes to this Contract from time to time as

it deems necessary and in a manner not materially affecting the substance thereof or materially changing the price to be paid in order to carry out and complete more fully and perfectly the work herein agreed to be done and performed. This Contract shall in no way be invalidated by any such additions, deductions, or changes, and no claim by the Contractor shall be made for any loss of anticipated profits thereby.

Construction conditions may require that minor changes be made in the location and installation of the work and equipment to be furnished and other work to be performed hereunder, and the Contractor when ordered by the Engineer, shall make such adjustments and changes in said locations and work as may be necessary, without additional cost to the City, provided such adjustments and changes do not alter the character, quantity of cost of the work as a whole, and provided further that Plans and Specifications showing such adjustments and changes are furnished to the Contractor by the City within a reasonable time before any work involving such adjustment and changes is begun. The Engineer shall be the sole judge of what constitutes a minor change for which no additional compensation shall be allowed.

**ARTICLE 7.02 EXTRA WORK**

The City may at any time by a written order and without notice to the sureties require the performance of such extra work as it may find necessary or desirable. An order for extra work shall be valid only if issued in writing and signed by the Mayor and the work so ordered must be performed by the Contractor.

The amount of compensation to be paid to the Contractor for any extra work as so ordered shall be determined as follows:

(a)By such applicable unit prices, if any, as are set forth in the Proposal; or

(b)If no such unit prices are set forth then by a lump sum or other unit prices mutually agreed upon by the City and the Contractor; or

(c)If no such unit prices are set forth in the Proposal and if the parties cannot agree upon a lump sum or other unit prices then by the actual net cost in money to the Contractor of the extra work performed, which cost shall be determined as follows:

(1) For all labor and foreman in direct charge of the authorized operations, the Contractor shall receive the current local rate of wages to be agreed upon, in writing, before starting such work for each hour that said labor and foremen are actually engaged thereon, to which shall be added an amount equal to 25 percent of the sum thereof which shall be considered and accepted as full compensation for general supervision, FICA taxes, contributions under the Florida Unemployment Compensation Act, insurance, bond, subcontractor's profit and overhead, the furnishing of small tools and miscellaneous equipment used, such as picks, shovels, hand pumps, and similar items.

(2) For all materials used, the Contractor shall receive the actual cost of such materials delivered at the site or previously approved delivery point as established by original receipted bills. No percentage shall be added to this cost.

(3) For special equipment and machinery such as power-driven pumps, concrete mixers, trucks, and tractors, or other equipment, required for the economical performance of the authorized work, the Contractor shall receive payment based on the average local area rental price for each item of equipment and the actual time of its use on the work. No percentage shall be added to this sum.

(4) Records of extra work done under this procedure shall be reviewed at the end of each day by the Contractor or his representative and the Engineer. Duplicate copies of accepted records shall be made and signed by both Contractor or his representative and the Engineer, and one copy retained by each.

Request for payment for approved and duly authorized extra work shall be submitted in the same form as Contract work or in the case of work performed under paragraph (c) (1) above upon a certified statement supported by receipted bills. Such statement shall be submitted for the current Contract payment for the month in which the work was done.

**ARTICLE 7.03 DISPUTED WORK**

If the Contractor is of the opinion that any work required, necessitated, or ordered violates the terms and provisions of this Contract, he must promptly notify the Engineer, in writing, of his contentions with respect thereto and request a final determination thereof. If the Engineer determines that the work in question is Contract work and not extra work or that the order complained of is proper, he will direct the Contractor to proceed and the Contractor shall promptly comply. In order, however, to reserve his right to claim compensation for such work or damages resulting from such compliance, the Contractor must, within five (5) days after receiving notice of the Engineer's determination and direction, notify the City in writing that the work is being performed or that the determination and direction is being complied with under protest. Failure of the Contractor to notify shall be deemed as a waiver of claim for extra compensation or damages therefor.

Before final acceptance by the City, all matters of dispute must be adjusted to the mutual satisfaction of the parties thereto. Final determinations and decisions, in case any questions shall arise, shall constitute a condition precedent to the right of the Contractor to receive the money therefor until the matter in question has been adjusted.

**ARTICLE 7.04 OMITTED WORK**

The City may at any time by a written order and without notice to the sureties require the omission of such Contract work as it may find necessary or desirable.

An order for omission of work shall be valid only if signed by the Mayor and the work so ordered must be omitted by the Contractor. The amount by which the Contract price shall be reduced shall be determined as follows:

(a) By such applicable unit prices, if any, as are set forth in the Contract; or

(b) By the appropriate lump sum price set forth in the Contract; or

(c) By the fair and reasonable estimated cost to the City

of such omitted work as determined by the Engineer and approved by the City.

## SECTION 8
## CONTRACTOR'S EMPLOYEES

**ARTICLE 8.01 CHARACTER AND COMPETENCY**
The Contractor and his subcontractors shall employ upon all parts of the work herein contracted for only competent, skillful, and trustworthy workers. Should the Engineer at any time give notice, in writing, to the Contractor or his duly authorized representative on the work that any employee in his opinion is incompetent, unfaithful, disorderly, careless, unobservant of instructions, or in any way a detriment to the satisfactory progress of the work, such employee shall immediately be dismissed and not again allowed upon the site.

**ARTICLE 8.02 SUPERINTENDENCE**
The Contractor shall give his personal supervision to the faithful prosecution of the work and in case of his absence shall have a competent, experienced, and reliable supervisor or superintendent, acceptable to the Engineer on the site who shall follow without delay all instructions of the Engineer in the prosecution and completion of the work and every part thereof, in full authority to supply workers, material, and equipment immediately. He shall keep on hand at all times copies of the Contract Documents.

**ARTICLE 8.03 EMPLOYMENT OPPORTUNITIES**
The Contractor shall, in the performance of the work required to be done under this Contract, employ all workers without discrimination regarding race, creed, color, sex or national origin and must not maintain or provide facilities that are segregated on the basis of race, color, creed or national origin.

**ARTICLE 8.04 RATES OF WAGES**
On federally assisted projects, the rates of wages to be paid under this Contract shall not be less than the rates of wages set forth in Section 12 of this Agreement.

On other projects, no wage rate determination is included. Florida's Prevailing Wage Law (Section 215.19, Florida Statutes) was repealed effective April 25, 1979.

**ARTICLE 8.05 PAYROLL REPORTS**
The Contractor and each subcontractor shall, if requested to do so, furnish to the Engineer a duly certified copy of his payroll and also any other information required by the Engineer to satisfy him that the provisions of the law as to the hours of employment and rate of wages are being observed.

Payrolls shall be prepared in accordance with instructions furnished by the City and on approved forms. The Contractor shall not carry on his payroll any persons not employed by him. Subcontractor's employees shall be carried only on the payrolls of the employing subcontractor.

## SECTION 9
## CONTRACTOR'S DEFAULT

**ARTICLE 9.01 CITY'S RIGHT AND NOTICE**
It is mutually agreed that: (a) if the Contractor fails to begin work when required to do so, or (b) if at any time during the progress of the work it shall appear to the Engineer that the Contractor is not prosecuting the work with reasonable speed, or is delaying the work unreasonably and unnecessarily, or (c) if the force of workmen or quality or quantity of material furnished are not sufficient to insure completion of the work within the specified time and in accordance with the Specifications hereto attached, or (d) if the Contractor shall fail to make prompt payments for materials or labor or to subcontractors for work performed under the Contract, or (e) if legal proceedings have been instituted by others than the City in such manner as to interfere with the progress of the work and may subject the City to peril of litigation or outside claims of (f) if the Contractor shall be adjudged a bankrupt or make an assignment for the benefit of creditors, or (g) if in any proceeding instituted by or against the Contractor an order shall be made or entered granting an extension of time of payment, composition, adjustment, modification, settlement or satisfaction of his debts or liabilities, or (h) if a receiver or trustee shall be appointed for the Contractor or the Contractor's property, or (i) if the Contract or any part thereof shall be sublet without the consent of the City being first obtained in writing, or (j) if this Contract or any right, monies, or claim thereunder shall be assigned by the Contractor, otherwise than as herein specified, or (k) if the Contractor shall fail in any manner of substance to observe the provisions of this Contract, or (l) if any of the work, machinery, or equipment shall be defective, and shall not be replaced as herein provided, or (m) if the work to be done under this Contract shall be abandoned, then such fact or conditions shall be certified by the Engineer and thereupon the City without prejudice to any other rights or remedies of the City, shall have the right to declare the Contractor in default and so notify the Contractor by a written notice, setting forth the ground or grounds upon which such default is declared and the Contractor must discontinue the work, either as a portion of the work or the whole thereof, as directed.

**ARTICLE 9.02 CONTRACTOR'S DUTY UPON DEFAULT**
Upon receipt of notice that his Contract is in default, the Contractor shall immediately discontinue all further operations on the work or such part thereof, and shall immediately quit the site or such part thereof, leaving untouched all plant, materials, equipment, tools, and supplies.

**ARTICLE 9.03 COMPLETION OF DEFAULTED WORK**
The City, after declaring the Contractor in default, may then have the work completed or the defective equipment or machinery replaced or anything else done to complete the work in strict accordance with the Contract Documents by such means and in such manner, by Contract with or without public letting, or otherwise, as it may deem advisable,

utilizing for such purpose without additional cost to the City such of the Contractor's plant, materials, equipment, tools, and supplies remaining on the site, and also such subcontractors as it may deem advisable.

The City shall reimburse all parties, including itself, for the expense of such completion, including liquidated damages, if any, and the cost of reletting. The City shall deduct this expense from monies due or to become due to the Contractor under this Contract, or any part thereof, and in case such expense is more than the sum remaining unpaid of the original contract price, the Contractor and his sureties shall pay the amount of such deficiency to the City.

**ARTICLE 9.04 PARTIAL DEFAULT**
In case the City shall declare the Contractor in default as to a part of the work only, the Contractor shall discontinue such part, shall continue performing the remainder of the work in strict conformity with the terms of the Contract, and shall in no way hinder or interfere with any other contractor or person whom the City may engage to complete the work as to which the Contractor was declared in default.

## SECTION 10
## PAYMENTS

**ARTICLE 10.01 PRICES**
For the Contractor's complete performance of the work, the City will pay and the Contractor agrees to accept, subject to the terms and conditions hereof, the lump sum prices or unit prices in the Contractor's Proposal and the award made therein, plus the amount required to be paid for any extra work ordered under Article 7.02 hereof, less credit for any work omitted pursuant to Article 7.04 hereof. Under unit price items, the number of units actually required to complete the work under the Contract may be more than stated in the Proposal. The Contractor agrees that no claim will be made for any damages or for loss of profits because of a difference between the quantities of the various classes of work assumed and stated in the Proposal Form as a basis for comparing Proposals and the quantities of work actually performed.

The sum as awarded for any lump sum Contract or lump sum Contract Item shall represent payment in full for all of the various classes of work, including materials, equipment, and labor necessary or required to complete, in conformity with the Contract Document, the entire work shown, indicated or specified under the lump sum Contract or lump sum Contract Item.

The amount as awarded as a unit price for any unit price Contact Item shall represent payment in full for all the materials, equipment, and labor necessary to complete, in conformity with the Contract Documents, each unit of work shown, specified, or required under the said unit price Contract Item.

No payment other than the amount as awarded will be made for any class of work included in a lump sum Contract Item or a unit price Contract Item, unless specific provision is made therefor in the Contract Documents.

**ARTICLE 10.02 SUBMISSION OF BID BREAKDOWN**
Within fifteen (15) days after the execution of this Contract, the Contractor must submit to the Engineer in duplicate an acceptable breakdown of the lump sums and unit prices bid for items of the Contract, showing the various operations to be performed under the Contract, as described in the progress schedule required under Article 4.02 hereof, and the value of each of such operations, the total of such items to equal the total price bid. The Contractor shall also submit such other information relating to the bid prices as may be required and shall revise the bid breakdown as directed. Thereafter, the breakdown may be used for checking the Contractor's applications for partial payments hereunder but shall not be binding upon the City or the Engineer for any purpose whatsoever.

**ARTICLE 10.03 REPORTS, RECORDS AND DATA**
The Contractor shall furnish to the Engineer such schedules of quantities and costs, progress schedules, reports, invoices, delivery tickets, estimates, records, and other data as the Engineer may request concerning work performed or to be performed and the materials furnished under the Contract.

**ARTICLE 10.04 PAYMENTS BY CONTRACTOR**
The Contractor shall pay (a) for all transportation and utility services not later than the 20th day of the calendar month following that in which such services are rendered, (b) for all materials, tools, and equipment delivered at the site of the project, and the balance of the cost thereof not later than the 30th day following the completion of that part of the work in or on which such materials, tools, and equipment are incorporated or used, and (c) to each of his subcontractors, not later than the 5th day following each payment to the Contractor, the respective amounts allowed the Contractor on account of the work performed by his subcontractors, to the extent of each subcontractor's interest therein; and proof of such payments or releases therefor shall be submitted to the Engineer upon request.

**ARTICLE 10.05 PARTIAL PAYMENTS**
On or about the first of each month, the Contractor shall make and certify an estimate, on forms prescribed by the City, of the amount and fair value of the work done, and may apply for partial payment therefor. The Contractor shall revise the estimate as the Engineer may direct. When satisfactory progress has been made, and shows that the value of the work completed since the last payment exceeds one percent (1%) of the total Contract price in amount, the Engineer will issue a certificate that such work has been completed and the value thereof. The City will then issue a voucher to the Contractor in accordance with the following schedule:

**FOR CONTRACT AMOUNTS UNDER $250,000**
(A)In the amount of ninety percent (90%) of the value of the work completed as certified until construction is one hundred percent (100%) complete (operational or beneficial occupancy), the withheld amount may be reduced below ten percent (10%), at the Engineer's option, to only that amount necessary to assure completion.

**FOR CONTRACT AMOUNTS OVER $250,000**

(A)In the amount of ninety percent (90%) of the value of the work completed as certified until construction is fifty percent (50%) complete.

(B)When the dollar value, as determined by the Engineer, of satisfactorily completed work in place is greater than fifty percent (50%) of the original contract price, vouchers for partial payment will be issued by the City to the Contractor in the amount of one hundred percent (100%) of the value of the work, above 50%, completed as certified for that payment period.

(C)If the Contractor has performed satisfactorily and the work is substantially complete (operational or beneficial occupancy) the withheld amount may be reduced, at the Engineer's option, to only that amount necessary to assure completion.

In addition to the Conditions set forth in (A), (B), and (C) above, payments will always be less any sums that may be retained or deducted by the City under the terms of any of the contract documents and less any sums that may be retained to cover monetary guarantees for equipment, materials or progress performance.

Payment on estimates made on or about the first of the month may be expected on or about the 20th of the month.

Unless specified otherwise in the Contract Items, the delivered cost of equipment and nonperishable materials suitably stored at the site of the work and tested for adequacy may be included in the Contractor's application for partial payment provided, however, that the Contractor shall furnish evidence satisfactory to the City that the Contractor is the unconditional owner and in possession of such materials or equipment. The amount to be paid will be 90 percent of the invoice cost to the Contractor which cost shall be supported by receipted bills within 30 days of the date of payment by the City to the Contractor. Such payment shall not relieve the Contractor from full responsibility for completion of the work and for protection of such materials and equipment until incorporated in the work in a permanent manner as required by the Contract Documents.

Before any payment will be made under this Contract, the Contractor and every subcontractor, if required, shall deliver to the Engineer a written, verified statement, in satisfactory form, showing in detail all amounts then due and unpaid by such Contractor or subcontractor to all laborers, workmen, and mechanics, employed by him under the Contract for the performance of the work at the site thereof, for daily or weekly wages, or to other persons for materials, equipment, or supplies delivered at the site of the work during the period covered by the payment under consideration.

**ARTICLE 10.06 FINAL PAYMENT**

Under determination of satisfactory completion of the work under this Contract as provided in Article 4.07 hereof, the Engineer will prepare the final estimate showing the value of the completed work. This estimate will be prepared within 30 days after the date of completion or as soon thereafter as the necessary measurements and computations can be made. All prior certificates and estimates, being approximate only, are subject to correction in the final estimate and payment.

When the final estimate has been prepared and certified by Engineer, he will submit to the Mayor and City Council the final certificate stating that the work has been completed and the amount based on the final estimate remaining due to the Contractor. The City will then accept the work as fully completed and will, not later than 30 days after the final acceptance, as defined in Article 1.02, of the work done under this Contract, pay the Contractor the entire amount so found due thereunder after deduction of all previous payments and all percentages and amounts to be kept and retained under provisions of this Contract; provided, however, and it is understood and agreed that, as a precedent to receiving final payment, the Contractor shall submit to the City a sworn affidavit that all bills for labor, service, materials, and subcontractors have been paid and that there are no suits pending in connection with this work. The City, at its option, may permit the Contractor to execute a separate surety bond in a form satisfactory to the City. The surety bond shall be in the full amount of the suit or suits.

Neither the final payment nor any part of the retained percentage shall be paid until the Contractor, if required, shall furnish the City with a complete release from any should remain unsatisfied after all payments are made, the Contractor shall refund to the City all monies which the City may be compelled to pay in discharging such claim, including incidental costs and attorney's fees.

**ARTICLE 10.07 ACCEPTANCE OF FINAL PAYMENT**

The acceptance by the Contractor, or by anyone claiming by or through him, of the final payment shall operate as and shall be a release to the City and every officer and agent thereof from any and all claims and liability to the Contractor for anything done or furnished in connection with the work or project and for any act or neglect of the Contractor or of any others relating to or affecting the work. No payment, however, final or otherwise, shall operate to release the Contractor or his sureties from any obligations under this Contract or the Performance Bond.

## SECTION 11
## MISCELLANEOUS PROVISIONS

**ARTICLE 11.01 CONTRACTOR'S WARRANTIES**

In consideration of, and to induce the award of this contract to him, the Contractor represents and warrants:

(a)That he is not in arrears to the City upon debt or contract, and he is not a defaulter, as surety, contractor, or otherwise.

(b)That he is financially solvent and sufficiently experienced and competent to perform the work.

(c)That the work can be performed as called for by the Contract Documents.

(d)That the facts stated in his proposal and the information given by him are true and correct in all respects.

(e)That he is fully informed regarding all the conditions affecting the work to be done and labor and materials to be

furnished for the completion of this Contract, and that his information was secured by personal investigation and research.

**ARTICLE 11.02 PATENTED DEVICES, MATERIAL AND PROCESSES**

It is mutually understood and agreed that Contract prices include all royalties and costs arising from patents, trademarks, and copyrights in any way involved in the work. Whenever the Contractor is required or desires to use any design, device, material, or process covered by letters of patent or copyright, the Contractor shall indemnify and save harmless the City, its officers, agents and employees from any and all claims for infringement by reason of the use of any such patented design, device, tool, material, equipment, or process, to be performed under the Contract, and shall indemnify the said City, its officers, agents, and employees for any costs, expenses, and damages which may be incurred by reason of such infringement at any time during the prosecution or after completion of the work.

**ARTICLE 11.03 SUITS AT LAW**

In case any action at law or suit in equity may or shall be brought against the City or any of its officers, agents, or employees for or on account of the failure, omission, or neglect of the Contractor or his subcontractors, employees, or agents, to do or perform any of the covenants, acts, matters, or things by this Contract undertaken to be done or performed by the Contractor of his subcontractors, employees, or agents, or from any injuries done to property or persons and caused by the negligence or alleged negligence of the Contractor of his subcontractors, employees, or agents, or in any other manner arising out of the performance of this Contract, then the Contractor shall immediately assume and take charge of the defense of such actions or suits in like manner and to all intents and purposes as if said actions or suits have been brought directly against the Contractor, and the Contractor shall also indemnity and save harmless the City, its officers, agents, and employees from any and all loss, cost or damage whatever arising out of such actions or suits, in like manner and to all intents and purposes as if said actions or suits have been brought directly against the Contractor.

The Contractor shall and does hereby assume all liability for and agrees to indemnify the City or its Engineer against any or all loss, costs, damages, and liability for any or by reason of any lien, claims or demands, either for materials purchased or for work performed by laborers, mechanics, and others and from any damages, costs, actions, or causes of action and judgement arising from injuries sustained by mechanics, laborers, or other persons by reason of accidents or otherwise, whether caused by the carelessness or inefficiency or neglect of said Contractor, his subcontractors, agents, employees, workmen or otherwise.

**ARTICLE 11.04 CLAIMS FOR DAMAGES**

If the Contractor shall claim compensation for any damage sustained, other than for extra or disputed work covered by Article 7.02 and 7.03 hereof, by reason of any act or omission of the City, its agents, or any persons, he shall, within five days after sustaining such damage, make and deliver to the Engineer a written statement of the nature of the damage sustained and of the basis of the claim against the City. On or before the 15th of the month succeeding that in which any damage shall have been sustained, the Contractor shall make and deliver to the Engineer an itemized statement of the details and amounts of such damage, duly verified by the Contractor. Unless such statements shall be made delivered within the times aforesaid, it is stipulated that and all claims for such compensation shall be forfeited and invalidated, and the Contractor shall not be entitled to payment on account of such claims.

**ARTICLE 11.05 NO CLAIMS AGAINST INDIVIDUALS**

No claim whatsoever shall be made by the Contractor against any officer, agent, employee of the City for, or on account of, anything done or omitted to be done in connection with this Contract.

**ARTICLE 11.06 LIABILITY UNAFFECTED**

Nothing herein contained shall in any manner create any liability against the City on behalf of any claim for labor, services, or materials, or of subcontractors, and nothing herein contained shall affect the liability of the Contractor or his sureties to the City or to any workmen or materialsmen upon bond given in connection with this Contract.

**ARTICLE 11.07 INDEMNIFICATION PROVISIONS**

Whenever there appears in this Agreement, or in the other Contact Documents made a part hereof, an indemnification provision within the purview of Chapter 725.06, Laws of Florida, the monetary limitation on the extent of the indemnification under each such provision shall be One Million Dollars or a sum equal to the total Contract price, whichever shall be the greater.

**ARTICLE 11.08 UNLAWFUL PROVISIONS DEEMED STRICKEN**

If this contract contains any unlawful provisions not an essential part of the Contract and which shall not appear to have a controlling or material inducement to the making thereof, such provisions shall be deemed of no effect and shall, upon notice by either party, be deemed stricken from the Contract without affecting the binding force of the remainder.

**ARTICLE 11.09 LEGAL PROVISIONS DEEMED INCLUDED**

Each and every provision of any law and clause required by law to be inserted in this Contract shall be deemed to be inserted herein, and the Contract shall be read and enforced as though it were included herein and if, through mistake or otherwise, any such provision is not inserted or is not correctly inserted, then upon application of either party the Contract shall forthwith be physically amended to make such insertion.

**ARTICLE 11.10 DEATH OR INCOMPETENCY OF CONTRACTOR**

In the event of death or legal incompetency of a Contractor who shall be an individual or surviving member of a contracting firm, such death or adjudication of incompetency

shall not terminate the Contract, but shall act as default hereunder to the effect provided in Article 9.01 hereof and the estate of the Contractor and his surety shall remain liable hereunder to the same extent as though the Contractor had lived. Notice of default, as provided in Article 9.01 hereof, shall not be required to be given in the event of such death or adjudication of incompetency.

**ARTICLE 11.11 NUMBER AND GENDER OF WORDS**

Whenever the context so admits or requires, all references herein in one number shall be deemed extended to and including the other number, whether singular or plural, and the use of any gender shall be applicable to all genders.

**ARTICLE 11.12 ACCESS TO RECORDS**

Representatives of Federal Agencies, if applicable, and the State of Florida shall have access to the work whenever it is in preparation of progress. On federally assisted projects the Federal Agency, the Comptroller General of the United States, or any authorized representative shall have access to any books, documents, papers, and records of the Contractor which are pertinent to the project for the purpose of making audit, examination, excerpts, and transcription thereof.

## SECTION 12
## LABOR STANDARDS

**ARTICLE 12.01 LABOR STANDARDS**

The Contractor shall comply with all of the regulations set forth in "Labor Standards Provisions for Federally Assisted Construction Contracts", which may be attached, and any applicable Florida Statutes.

**ARTICLE 12.02 NOTICE TO LABOR UNIONS**

If required, the Contractor shall provide Labor Unions and other organizations of workers, and shall post, in a conspicuous place available to employees or applicants for employment, a completed copy of the form entitled "Notice to Labor Unions or Other Organizations of Workers" attached to and made a part of this Agreement.

**ARTICLE 12.03 SAFETY AND HEALTH REGULATIONS**

The Contractor shall comply with the Department of Labor Safety and Health Regulations for construction promulgated under the Occupational Safety and Health Act of 1970 (PL 91- 596) and under Section 107 of the Contract Work Hours and Safety Standards Act (PL 91-54). Nothing in these Acts shall be construed to supersede or in any manner affect any worker's compensation law or statutory rights, duties, or liabilities of employers and employees under any law with respect to injuries, diseases, or death of employees arising out of, or in the course of, employment.

**ARTICLE 12.04 EEO AFFIRMATIVE ACTION REQUIREMENTS**

The Contractor understands and agrees to be bound by the equal opportunity requirements of Federal regulations which shall be applicable throughout the performance of work under this Contract. The Contractor also agrees to similarly bind contractually each subcontractor. In policies, the Contractor agrees to engage in Affirmative Action directed at promoting and ensuring equal employment opportunity in the work force used under the Contract (and the Contractor agrees to require contractually the same effort of all subcontractors whose subcontractors exceed $100,000). The Contractor understands and agrees that "Affirmative Action" as used herein shall constitute a good faith effort to achieve and maintain minority employment in each trade in the on-site work force used on the Contract.

**ARTICLE 12.05 PREVAILING RATES OF WAGES**

Florida's prevailing wage law was repealed effective April 25, 1979.

For Federally assisted projects, appropriate prevailing wage rate determinations are indicated on pages beginning with WR-1.

* * * * * * *

IN WITNESS THEREOF, the parties have hereunto set their hands and seals, and such of them as are corporation have caused these present to be signed by their duly authorized officers.

CITY OF TAMPA, FLORIDA

_____
Bob Buckhorn, Mayor
(SEAL)

ATTEST:

_____
City Clerk

Approved as to Form:
The execution of this document was authorized by Resolution No. _____

_____
Rachel S. Peterkin, Assistant City Attorney

Contractor

By:_____
(SEAL)

Title:

ATTEST:

_____
Secretary

STATE OF )
) SS:
COUNTY OF )

For a Corporation:

STATE OF _____
COUNTY OF _____

The foregoing instrument was acknowledged before me this ___ of _____, 20___ by _____ of _____, a _____ corporation, on behalf of the corporation. He/she is ___ personally known or has ___ produced _____ as identification.

_____
Notary

My Commission Expires:

_____

For an Individual:

STATE OF _____
COUNTY OF _____

The foregoing instrument was acknowledged before me this ___ of _____, 20___ by _____ who is ___ personally known to me or has ___ produced _____ as identification.

_____
Notary

My Commission Expires:

_____

For a Firm:

STATE OF _____
COUNTY OF _____

The foregoing instrument was acknowledged before me this ___ of _____, 20___ by _____ who signed on behalf of the said firm. He/she is ___ personally known or has ___ produced _____ as identification.

_____
Notary

My Commission Expires:

_____

_____

PUBLIC CONSTRUCTION BOND

Bond No. (enter bond number)_____

Name of Contractor:_____

Principal Business Address of Contractor:_____

_____

Telephone Number of Contractor:_____

Name of Surety (if more than one list each):_____

_____

Principal Business Address of Surety:_____

_____

Telephone Number of Surety:_____

Owner is The City of Tampa, Florida

Principal Business Address of Owner: 306 E Jackson St, Tampa, FL 33602

Contract Administration Department (280A4N)

Telephone Number of Owner: 813/274-8456

Contract Number Assigned by City to contract which is the subject of this bond:_____

Legal Description or Address of Property Improved or Contract Number is:_____

_____

_____

_____

General Description of Work and Services:_____

_____

_____

_____

KNOW ALL MEN BY THESE PRESENTS That we, _____

_____
(Name of Contractor)

as Principal, hereinafter called CONTRACTOR, of the State of _____, and

_____(Name of Surety)
a corporation organized and existing under and by virtue of the laws of the State of _____, and regularly authorized to do business in the State of Florida, as SURETY, are held and firmly bound unto the City of Tampa, a municipal corporation organized and existing under the laws of the State of Florida, hereinafter called Owner, in the penal sum of _____Dollars and _____Cents ($_____), lawful money of the United States of America, for the payment whereof well and truly to be made, we bind ourselves, our heirs, executors, and administrators, successors and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS BOND is that if Principal:

1. Performs the contract dated _____, _____, 20___, between Principal and Owner for construction of _____, the contract being made a part of this bond by reference, in the time and in the manner prescribed in the contract; and

2. Promptly makes payments to all claimants, as defined in Section 255.05(1) (Section 713.01), Florida Statutes, supplying Principal with labor, materials, or supplies, used directly or indirectly by Principal in the prosecution of the work provided for in the contract; and

3. Pays Owner all losses, damages, expenses, costs, and attorney's fees, including appellate proceedings, that Owner sustains because of a default by Principal under the contract; and

4. 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.

5. Contractor and Surety acknowledge that the Work for which this bond has been issued may be one of several such contract documents for a group of projects. This bond does not secure covenants to pay for or to perform design services survey or program management services. The Owner/Obligee is expected to reasonably account for damages that are caused to Owner with respect to Principal's (Contractor's) default in performance of the scope of the Work incorporated by reference into the bond, and notwithstanding any contractual or common law remedy permitted to Owner as against Contractor, the obligation of Surety for any damages under this bond shall be determined by the cost of completion of the Work less the contract balance unpaid upon default of Contractor for the Work plus liquidated damages at the rate of $500.00 per day for delays by the Contractor and/or Surety in reaching substantial completion.

6. The notice requirements for claimants and conditions for entitlement to payment set forth in Section 255.05, Fla. Stat. and the limitations period to actions upon Section 255.05, Fla. Stat. bonds apply to claimants seeking payment from surety under this bond. 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, Florida Statutes.

7. The Surety, for value received, hereby stipulates and agrees that no changes, extensions of time, alterations or additions to the terms of the contract documents or other Work to be performed hereunder, or the specifications referred to therein shall in any way affect its obligations under this bond, and it does hereby waive notice of any such changes, extensions of time, alterations or additions to the terms of the Contract or to Work or to the specifications.

8. The above SURETY states that it has read all of the Contract Documents made by the CONTRACTOR with the CITY, hereto attached, and the terms and conditions of the contract and work, and is familiar therewith and in particular those portions of the Agreement concerning the guaranty of such CONTRACTOR for a period of one year following the date of the final acceptance of the completed work under the Contract by the CITY, all of which this BOND includes.

DATED ON _____, 20___

_____
(Name of Principal)

_____
(Principal Business Address)

By _____

Title _____

_____
Telephone Number of Principal

Countersignature:

_____
(Name of Local Agency)

_____
(Address of Resident Agent)

By _____

Title _____

_____
Telephone Number of Local Agency

_____
(Name of Surety)

_____
(Surety Address)

By _____
(As Attorney in Fact)*

_____
Telephone Number of Surety

Accepted by City of Tampa:

By _____
Bob Buckhorn, Mayor

Date: _____ 20____

Approved as to legal sufficiency:

By _____
Assistant City Attorney

Date: _____, 20____

*(As Attorney in Fact) attach Power of Attorney and Current Certificate with Original Signature

# SPECIFICATIONS
# GENERAL PROVISIONS

## SECTION 1
## SCOPE AND INTENT

### G-1.01 DESCRIPTION
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.

### G-1.02 WORK INCLUDED
The Contractor shall furnish all labor, superintendence, materials, plant, power, light, heat, fuel, water, tools, appliances, equipment, supplies, and other means of construction necessary or proper for performing and completing the work. He shall obtain and pay for all required permits. He 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.

The cost of incidental work described in these General Provisions, for which there are no specific Contract Items, shall be considered as part of the overhead cost of doing the work and shall be included in the prices for the various Contract Items. No additional payment will be made therefor.

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 plant and equipment, prior approval of the Engineer notwithstanding.

### G-1.03 PUBLIC UTILITY INSTALLATIONS AND STRUCTURES
Public utility installations and structures shall be understood to include all poles, tracks, pipes, wires, conduits, house service connections, vaults, manholes, and all other appurtenances and facilities pertaining thereto whether owned or controlled by the City, other governmental bodies or privately owned by individuals, firms, or corporations, and 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.

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.

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 only in such locations and by means approved by the Engineer. The Contractor shall so arrange his operations as 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 which are shown on the Plans or have been located in the field by the utility shall be repaired by the Contractor, at his expense, as directed by the Engineer. No separate payment shall be made for such protection or repairs to public utility installations or structures.

Public utility installations or structures owned or controlled by the City or other governmental body which are shown on the Plans 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.

Where public utility installations or structures owned or controlled by the City or other governmental body are encountered during the course of the work, and are not indicated on the Plans or in the 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 for in Article 7.02 of the Agreement.

The Contractor shall, at all times in performance of the work, employ approved 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 shall cooperate fully with the owners thereof to that end.

All City and other governmental utility departments and other owners of public utilities, which may be affected by the work, will be informed in writing by the Engineer within two weeks after the execution of the Contract or Contracts covering the work. Such notice will set out, in general, and direct attention to, the responsibilities of the City and other governmental

utility departments and other owners of public utilities for such installations and structures as may be affected by the work and will be accompanied by one set of Plans and Specifications covering the work under such Contract or Contracts.

In addition to the general notice given by the Engineer, the Contractor shall give written notice to all City and other governmental utility departments and other owners of public utilities of the location of his proposed construction operations, at least forty-eight (48) hours in advance of breaking ground in any area or on any unit of the work. This can be accomplished by making the appropriate contact with the "Underground Utility Notification Center for Excavators (Call Candy)".

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 Engineer.

## SECTION 2
## PLANS AND SPECIFICATIONS

**G-2.01 PLANS**
The Plans referred to in the Contract Documents bear the general project name and number as shown in the Notice To Bidders.

When obtaining data and information from the Plans, figures shall be used in preference to scaled dimensions, and large scale drawings in preference to small scale drawings.

**G-2.02 COPIES FURNISHED TO CONTRACTOR**
After the Contract has been executed, the Contractor will be furnished with five sets of paper prints, the same size as the original drawings, of each sheet of the Plans and five copies of the Specifications. Additional copies of the Plans and Specifications, when requested, may be furnished to the Contractor at cost of reproduction.

The Contractor shall furnish each of the subcontractors, manufacturers, and material suppliers such copies of the Contract Documents as may be required for his work.

**G-2.03 SUPPLEMENTARY DRAWINGS**
When, in the opinion of the Engineer, it becomes necessary to explain more fully the work to be done or to illustrate the work further or to show any changes which may be required, drawings known as Supplementary Drawings, with specifications pertaining thereto, will be prepared by the Engineer and five paper prints thereof will be given to the Contractor.

The Supplementary Drawings shall be binding upon the Contractor with the same force as the Plans. Where such Supplementary Drawings require either less or more than the estimated quantities of work, credit to the City or compensation therefor to the Contractor shall be subject to the terms of the Agreement.

**G-2.04 CONTRACTOR TO CHECK PLANS AND DATA**
The Contractor shall verify all dimensions, quantities, and details shown on the Plans, Supplementary Drawings, Schedules, Specifications, or other data received from the Engineer, and shall notify him 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. 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 the making of estimates of the size, kind, and quality of materials and equipment included in work to be done under the Contract.

**G-2.05 SPECIFICATIONS**
The specifications consist of four parts, the General Provisions, the Technical Specifications, the Special Provisions and the Contract Items. The General Provisions and Technical Specifications contain general requirements which govern the work. The Special Provisions and the Contract Items modify and supplement these by detailed requirements for the work and shall always govern, whenever there appears to be conflict.

**G-2.06 INTENT**
All work called for in the Specifications applicable to this Contract, but not shown on the Plans 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 Plans 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.

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, and interpretation of these Specifications shall be made upon that basis.

## SECTION 3
## WORKING DRAWINGS

**G-3.01 SCOPE**
The Contractor shall promptly prepare and submit layout, detail and shop drawings to insure proper construction, assembly, and installation of the work using those materials and methods as hereafter specified under the Technical Specifications, Special Provisions and Contract Items.

These drawings shall accurately and distinctly present the following:

a. All working and erection dimensions.
b. Arrangements and sectional views.
c. Necessary details, including complete information for making connections between work under this Contract and work under other Contracts.
d. Kinds of materials and finishes.
e. Parts listed and description thereof.

Drawings for mechanical equipment shall present, where applicable, such data as dimensions, weight and performance characteristics. These data shall show conformance with the performance characteristics and other criteria incorporated in the Plans and Specifications.

Each drawing shall be dated and shall contain the name of the project, Division number and description, the technical specifications section number, names of equipment or materials and the location at which the equipment or materials are to be installed. Location shall mean both physical location and location relative to other connected or attached material. The Engineer will return unchecked any submittal which does not contain complete data on the work and full information on related matters.

Stock or standard drawings will not be accepted for review unless full identification and supplementary information is shown thereon in ink or typewritten form.

The Contractor shall review all working drawing submittals before transmitting them to the Engineer to determine that they comply with requirements of the Specifications. Drawings which are incomplete or are not in compliance with the Contract Documents shall not be submitted for processing by the Engineer. The Contractor shall place his stamp of approval on all working drawings submitted to the Engineer to indicate compliance with the above.

**G-3.02 APPROVAL**
If the working drawings show departures from the Contract requirements, the Contractor shall make specific mention thereof in his letter of submittal; otherwise approval of such submittals shall not constitute approval of the departure. Approval of the drawings shall constitute approval of the subject matter thereof only and not of any structure, material, equipment, or apparatus shown or indicated.

The approval of drawings will be general and shall not relieve the Contractor of responsibility for the accuracy of such drawings, nor for the proper fitting and construction of the work, nor for the furnishing of materials or work required by the Contract and not indicated on the drawings. No work called for by working drawings shall be done until such drawings have been approved by the Engineer.

The procedure in seeking approval of the working drawings shall be as follows:

1.The Contractor shall submit four complete sets of drawings and other descriptive data together with one copy of a letter of transmittal to the Engineer for approval. The letter of transmittal shall contain the name of the project, contract number, technical specifications section number, the name of the Contractor, a list of drawings with numbers and titles, and any other pertinent information.

2.Drawings or descriptive data will be stamped "Approved", "Approved Subject to Corrections Marked", or "Examined and Returned for Correction" and one copy with a letter of transmittal will be returned to the Contractor.

3.If a drawing or other data is stamped "Approved", the Contractor shall insert the date of approval on five additional copies of the document and transmit the five copies to the Engineer together with one copy of a letter of transmittal containing substantially the same information as described in Instruction 1. above.

4.If a drawing or other data is stamped "Approved Subject to Corrections Marked", the Contractor shall make the corrections indicated and proceed as in Instruction 3., above.

5.If a drawing or data is stamped "Examined and Returned for Correction", the Contractor shall make the necessary corrections and resubmit the documents as set forth in Instruction 1., above. The letter of transmittal shall indicate that this is a resubmittal.

The Contractor shall revise and resubmit the working drawings as required by the Engineer, until approval thereof is obtained.

## SECTION 4
## MATERIALS AND EQUIPMENT

**G-4.01 GENERAL REQUIREMENTS**
All materials, appliances, and types or methods of construction shall be in accordance with the Specifications and shall, in no event, be less than that necessary to conform to the requirements of any applicable laws, ordinances, and codes.

All materials and equipment shall be new, unused, and correctly designed. They shall be of standard first grade quality, produced by expert personnel, and intended for the use for which they are offered. Materials or equipment which, in the opinion of the Engineer, are inferior or of a lower grade than indicated, specified, or required will not be accepted.

The quality of Workmanship and Materials entering into the work under this Contract shall conform to the requirements of the pertinent sections, clauses, paragraphs, and sentences, both directly and indirectly applicable thereto, of that part of the Technical Specifications, whether or not direct reference to such occurs in the Contract Items.

Equipment and appurtenances shall be designed in conformity with ANSI, ASME, IEEE, NEMA and other

generally accepted standards and shall be of rugged construction and of sufficient strength to withstand all stresses which may occur during fabrication, testing, transportation, installation, and all conditions of operation. All bearings and moving parts shall be adequately protected against wear by bushings or other approved means and shall be fully lubricated by readily accessible devices. Details shall be designed for appearance as well as utility. Protruding members, joints, corners, gear covers, and the like, shall be finished in appearance. All exposed welds shall be ground smooth and the corners of structural shapes shall be mitered.

Equipment shall be of the approximate dimensions as indicated on the Plans or as specified, shall fit the spaces shown on the Plans with adequate clearances, and shall be capable of being handled through openings provided in the structure for this purpose. The equipment shall be of such design that piping and electrical connections, ductwork, and auxiliary equipment can be assembled and installed without causing major revisions to the location or arrangement of any of the facilities.

Machinery parts shall conform exactly to the dimensions shown on the working drawings. There shall be no more fitting or adjusting in setting up a machine than is necessary in assembling high grade apparatus of standard design. The equivalent parts of identical machines shall be made interchangeable. All grease lubricating fittings on equipment shall be of a uniform type. All machinery and equipment shall be safeguarded in accordance with the safety codes of the ANSI and applicable state and local codes.

**G-4.02 MANUFACTURER**

The names of proposed manufacturers, suppliers, material, and dealers who are to furnish materials, fixtures, equipment, appliances or other fittings shall be submitted to the Engineer for approval, as early as possible, to afford proper investigation and checking. Such approval must be obtained before shop drawings will be checked. No manufacturer will be approved for any materials to be furnished under this Contract unless he shall be of good reputation and have a plant of ample capacity. He shall, upon the request of the Engineer, be required to submit evidence that he has manufactured a similar product to the one specified and that it has been previously used for a like purpose for a sufficient length of time to demonstrate its satisfactory performance.

All transactions with the manufacturers or subcontractors shall be through the Contractor, unless the Contractor shall request, in writing to the Engineer, 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.

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.

**G-4.03 REFERENCE TO STANDARDS**

Whenever reference is made to the furnishing of materials or testing thereof to conform to the standards of any technical society, organization or body, it shall be construed to mean the latest standard, code, specification or tentative specification adopted and published at the date of advertisement for proposals, even though reference has been made to an earlier standard, and such standards are made a part hereof to the extent which is indicated or intended.

Reference to a technical society, organization or body may be made in the Specifications by abbreviations, in accordance with the following list:

AASHTO for American Association of State Highway and Transportation Officials (formerly AASHO)
ACI for American Concrete Institute
AGMA for American Gear Manufacturer's Association
AFBMA for Anti-Friction Bearing Manufacturer's Association
AISC for American Institute of Steel Construction
AISI for American Iron and Steel Institute
ANSI for American National Standards Institute
ASCE for American Society of Civil Engineers
ASTM for American Society for Testing and Materials
ASME for American Society of Mechanical Engineers
AWS for American Welding Society
AWWA for American Water Works Association
AWPA for American Wood Preservers Association
CEMA for Conveyor Equipment Manufacturers Association
CIPRA for Cast Iron Pipe Research Association
IEEE for Institute of Electrical and Electronic Engineers
IPCEA for Insulated Power Cable Engineers Association
NEC for National Electrical Code
NEMA for National Electrical Manufacturers Association
SAE for Society of Automotive Engineers
SHBI for Steel Heating Boiler Institute
Fed.Spec. for Federal Specifications
Navy Spec. for Navy Department Specifications
U.L.,Inc. for Underwriters' Laboratories, Inc.

When no reference is made to a code, standard or specification, the Standard Specifications of the ANSI, the ASME, the ASTM, the IEEE, or the NEMA shall govern.

**G-4.04 SAMPLES**

The Contractor shall, when required, submit to the Engineer for approval typical samples of materials and equipment. The samples shall be properly identified by tags and shall be submitted sufficiently in advance of the time when they are to be incorporated into the work, so that rejections thereof will not cause delay. A letter of transmittal, in duplicate, from the Contractor requesting approval must accompany all such samples.

**G-4.05 EQUIVALENT QUALITY**

Whenever, in the Contract Documents, an article, material, apparatus, equipment, or process is called for by trade name or by the name of a patentee, manufacturer, or dealer or by reference to catalogs of a manufacturer or dealer, it shall be understood as intending to mean and specify the article, material, apparatus, equipment or process designated, or any

equal thereto in quality, finish, design, efficiency, and durability and equally serviceable for the purposes for which it is intended.

Whenever material or equipment is submitted for approval as being equal to that specified, the decision as to whether or not such material or equipment is equal to that specified shall be made by the Engineer.

Upon rejection of any material or equipment submitted as the equivalent of that specifically named in the Contract, the Contractor shall immediately proceed to furnish the designated material or equipment.

Neither the approval by the Engineer of alternate material or equipment as being equivalent to that specified nor the furnishing of the material or equipment specified, shall in any way relieve the Contractor of responsibility for failure of the material or equipment, due to faulty design, material, or workmanship, to perform the functions required of them by the Specifications.

**G-4.06 DELIVERY**
The Contractor shall deliver materials in ample quantities to insure the most speedy and uninterrupted progress of the work so as to complete thw work within the allotted time. The Contractor shall also coordinate deliveries in order to avoid a delay in, or impediment of, the progress of the work of any related Contractor.

**G-4.07 CARE AND PROTECTION**
The Contractor shall be solely responsible for properly storing and protecting all materials, equipment, and work furnished under the Contract from the time such materials and equipment are delivered at the site of the work until final acceptance thereof. He shall, at all times, take necessary precautions to prevent injury or damage by water, freezing, or by inclemencies of the weather to such materials, equipment and work. All injury or damage to materials, equipment, or work resulting from any cause whatsoever shall be made good by the Contractor.

The Engineer shall, in all cases, determine the portion of the site to be used by the Contractor for storage, plant or for other purposes. If, however, it becomes necessary to remove and restack materials to avoid impeding the progress of any part of the work or interference with the work to be done by any other Contractor, the Contractor shall remove and restack such materials at his own expense.

**G-4.08 TOOLS AND ACCESSORIES**
The Contractor shall, unless otherwise stated in the Contract Documents, 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.

Spare parts shall be furnished as specified.

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 rating data.

**G-4.09 INSTALLATION OF EQUIPMENT**
The Contractor shall have on hand sufficient proper equipment and machinery of ample capacity to facilitate the work and to handle all emergencies normally encountered in work of this character.

Equipment shall be erected in a neat and workmanlike manner on the foundations at the locations and elevations shown on the Plans, unless directed otherwise by the Engineer during installation. All equipment shall be correctly aligned, leveled and adjusted for satisfactory operation and shall be installed so that proper and necessary connections can be made readily between the various units.

The Contractor shall furnish, install and protect all necessary anchor and attachment bolts and all other appurtenances needed for the installation of the devices included in the equipment specified. Anchor bolts shall be as approved by the Engineer and made of ample size and strength for the purpose intended. Substantial templates and working drawings for installation shall be furnished.

The Contractor shall, at his own expense, furnish all materials and labor for, and shall properly bed in non-shrink grout, each piece of equipment on its supporting base that rests on masonry foundations. Grout shall completely fill the space between the equipment base and the foundation.

**G-4.10 OPERATING INSTRUCTIONS**
The Contractor, through qualified individuals, shall adequately instruct designated employees of the City in the operation and care of all equipment installed hereunder, except for equipment that may be furnished by the City.

The Contractor shall also furnish and deliver to the Engineer three complete sets for permanent files, identified in accordance with Subsection G-3.01 hereof, of instructions, technical bulletins and any other printed matter, such as diagrams, prints or drawings, containing full information required for the proper operation, maintenance, and repair, of the equipment installed and the ordering of spare parts, except for equipment that may be furnished by the City.

In addition to the above three copies, the Contractor shall furnish any additional copies that may be required for use during construction and start-up operations.

**G-4.11 SERVICE OF MANUFACTURER'S ENGINEER**
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 assist the Contractor, when required, to install, adjust, test and place in operation the equipment in conformity with the Contract Documents. After the equipment is placed in

permanent operation by the City, such engineer or superintendent shall make all adjustments and tests required by the Engineer to provide that such equipment is in proper and satisfactory operating condition, and shall instruct such personnel as may be designated by the City in the proper operation and maintenance of such equipment.

## SECTION 5
## INSPECTION AND TESTING

**G-5.01 GENERAL**
The Contractor's attention is hereby directed to Article 3.03 of the Agreement.

Inspection and testing of materials will be performed by the City unless otherwise specified.

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.

If, in the making of any test of any material or equipment, it is ascertained by the Engineer that the material or equipment does not comply with the Contract, the Contractor will be notified thereof and he will be directed to refrain from delivering said material and equipment, or to remove it promptly from the site or from the work and replace it with acceptable material, without cost to the City.

Tests of electrical and mechanical equipment and appliances shall be conducted in accordance with recognized test codes of the ANSI, ASME, or the IEEE, except as may otherwise be stated herein.

The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the City formally takes over the operation thereof.

**G-5.02 COSTS**
All inspection and testing of materials furnished under this Contract will be performed by the City or duly authorized inspection engineers or inspection bureaus without cost to the Contractor, unless otherwise expressly specified.

The cost of shop and field tests of equipment and of certain other tests specifically called for in the Contract Documents shall be borne by the Contractor and such costs shall be deemed to be included in the contract price.

Materials and equipment submitted by the Contractor as the equivalent to those specifically named in the Contract may be tested by the City for compliance. The Contractor shall reimburse the City for the expenditures incurred in making such tests on materials and equipment which are rejected for noncompliance.

**G-5.03 INSPECTIONS OF MATERIALS**
The Contractor shall give notice, in writing to the Engineer, sufficiently in advance of his intention to commence the manufacture or preparation of materials especially manufactured or prepared for use in or as part of the permanent construction. Such notice shall contain a request for inspection, the date of commencement and the expected date of completion of the manufacture or preparation of materials. Upon receipt of such notice the Engineer will arrange to have a representative present at such times during the manufacture as may be necessary to inspect the materials or he will notify the Contractor that inspection will be made at a point other than the point of manufacture, or he will notify the Contractor that inspection will be waived. The Contractor must comply with these provisions before shipping any material. Such inspection shall not release the Contractor from the responsibility for furnishing materials meeting the requirements of the Contract Documents.

**G-5.04 CERTIFICATE OF MANUFACTURE**
When inspection is waived or when the Engineer so requires, the Contractor shall furnish to him authoritative evidence in the form of Certificates of Manufacture that the materials to be used in the work have been manufactured and tested in conformity with the Contract Documents. 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.

**G-5.05 SHOP TESTS OF OPERATING EQUIPMENT**
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. No such equipment shall be shipped to the work until the Engineer notifies the Contractor, in writing, that the results of such tests are acceptable.

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, shall be forwarded to the Engineer for approval.

The cost of the shop tests and of furnishing manufacturer's preliminary and shop test data of operating equipment shall be borne by the Contractor.

**G-5.06 PRELIMINARY FIELD TESTS**
As soon as conditions permit, the Contractor shall furnish all labor, materials, and instruments and shall make preliminary field tests of equipment. If the preliminary field tests disclose any equipment furnished under this Contract which does not comply with the requirements of the Contract Documents, the Contractor shall, prior to the acceptance tests, make all changes, adjustments, and replacements required.

**G-5.07 FINAL FIELD TESTS**
Upon completion of the work and prior to final payment, all equipment and appliances installed under this Contract shall be subjected to acceptance tests as specified or required to prove compliance with the Contract Documents.

The Contractor shall furnish labor, fuel, energy, water and all other materials, equipment, and instruments necessary for all acceptance tests, at no additional cost to the City.

**G-5.08 FAILURE OF TESTS**
Any defects in the materials and equipment or their failure to meet the tests, guarantees or requirements of the Contract Documents shall be promptly corrected by the Contractor by replacements or otherwise. The decision of the Engineer as to whether or not the Contractor has fulfilled his obligations under the Contract shall be final and conclusive. If the Contractor fails to make those corrections or if the improved materials and equipment, when tested, shall again fail to meet the guarantees or specified requirements, the City, notwithstanding its partial payment for work, and materials and equipment, may reject the materials and equipment and may order the Contractor to remove them from the site at his own expense.

In case the City rejects any materials and equipment, then the Contractor shall replace the rejected materials and equipment within a reasonable time. If he fails to do so, the City may, after the expiration of a period of thirty calendar days after giving him notice in writing, proceed to replace such rejected materials and equipment, and the cost thereof shall be deducted from any compensation due or which may become due the Contractor under this Contract.

The City agrees to obtain other equipment within a reasonable time and the Contractor agrees that the City may use the equipment furnished by him without rental or other charges until the new equipment is obtained.

Materials or work in place that fails to pass acceptability tests shall be retested at the direction of the construction engineer all such retests shall be at the Contractor's expense. The rates charged shall be in accordance with the Department of Public Works current annual inspection contract which is available for inspection at the offices of the Department of Public Works.

**G-5.09 FINAL INSPECTION**
The procedures for final inspection shall be in accordance with the provisions of Article 4.07 of the Agreement. During such final inspections, the work shall be clean and free from water. In no case will the final estimate be prepared until the Contractor has complied with all the requirements set forth and the Engineer has made his final inspection of the entire work and is satisfied that the entire work is properly and satisfactorily cosntructed in accordance with the requirements of the Contract Documents.

## SECTION 6

## TEMPORARY STRUCTURES

**G-6.01 GENERAL**
All false work, scaffolding, ladders, hoistways, braces, pumping plants, shields, trestles, roadways, sheeting, centering forms, barricades, drains, flumes, and the like, any of which may be needed in the construction of any part of the work and which are not herein described or specified in detail, must be furnished, maintained and removed by the Contractor, and he shall be responsible for the safety and efficiency of such works and for any damages that may result from their failure or from their improper construction, maintenance, or operation.

**G-6.02 PUBLIC ACCESS**
At all points in the work where public access to any building, house, place of business, public road, or sidewalk would be obstructed by any action of the Contractor in executing the work required by this Contract, the Contractor shall provide such temporary structure, bridges or roadway as may be necessary to maintain public access at all times. At least one lane for vehicular traffic shall be maintained in streets in which the Contractor is working. Street closure permits are required from the Department of Public Works.

The Contractor shall provide suitable temporary bridges, as directed by the Engineer, at street intersections when necessary for the maintenance of vehicular and pedestrian traffic.

Prior to temporarily cutting of access to driveways and garages, the Contractor shall give twelve (12) hours notice to affected property owners. Interruptions to use of private driveways shall be kept to a minimum.

**G-6.03 CONTRACTOR'S FIELD OFFICE**
The Contractor shall erect, furnish and maintain a field office with a telephone at the site during the entire period of construction. He or an authorized agent shall be present at this office at all times while his work is in progress. Readily accessible copies of both the Contract Documents and the latest approved working drawings shall be kept at this field office.

**G-6.04 TEMPORARY FENCE**
If, during the course of the work, it is necessary to remove or disturb any fence or part thereof, the Contractor shall, at his own expense, if so ordered by the Engineer, provide a suitable temporary fence which shall be maintained until the permanent fence is replaced. The Engineer shall be solely responsible for the determination of the necessity for providing a temporary fence and the type of temporary fence to be used.

**G-6.05 RESPONSIBILITY FOR TEMPORARY STRUCTURES**
In accepting the Contract, the Contractor assumes full responsibility for the sufficiency and safety of all temporary structures or work and for any damage which may result from their failure or their improper construction, maintenance, or operation and will indemnify and save harmless the City from

all claims, suits or actions and damages or costs of every description arising by reason of failure to comply with the above provisions.

## SECTION 7
## TEMPORARY SERVICES

**G-7.01 WATER**
The Contractor shall provide the necessary water supply at his own expense. He shall, if necessary, provide and lay necessary waterlines from existing mains to the place of using, shall secure all necessary permits and pay for all taps to water mains or hydrants and for all water used at the established rates.

**G-7.02 LIGHT AND POWER**
The Contractor shall provide, at his own expense, temporary lighting and power facilities required for the proper prosecution and inspection of the work. If, in the opinion of the Engineer, these facilities are inadequate, the Contractor will not be permitted to proceed with any portion of the work affected thereby.

**G-7.03 SANITARY REGULATIONS**
The Contractor shall prohibit and prevent the committing of nuisances on the site of the work or on adjoining property and shall discharge any employee who violates this rule.

Ample washrooms and toilet facilities and a drinking water supply shall be furnished and maintained in strict conformity with the law by the Contractor for use by his employees.

**G-7.04 ACCIDENT PREVENTION**
Precautions shall be exercised at all times for the protection of persons and property. The safety provisions of applicable laws, building and construction codes shall be observed. The Contractor shall comply with the U. S. Department of Labor Safety and Health Regulations for construction promulgated under the Occupational Safety and Health Act of 1970 (PL 91-596), and under Section 107 of the Contract Work. Hours and Safety Standards Act (PL 91-54), except where state and local safety standards exceed the federal requirements and except where state safety standards have been approved by the Secretary of Labor in accordance with provisions of the Occupational Safety and Health Act.

**G-7.05 FIRST AID**
The Contractor shall keep upon the site, at each location where work is in progress, a completely equipped first aid kit and shall provide ready access thereto at all times when men are employed on the work.

**G-7.06 HEATING**
The Contractor shall provide temporary heat, at his own expense, whenever required on account of work being carried on during cold weather and to prevent freezing of water pipes and other damage to the work.

## SECTION 8
## LINES AND GRADES

**G-8.01 GENERAL**
All work done under this Contract shall be constructed in accordance with the lines and grades shown on the Plans, or as given by the Engineer. The full responsibility for keeping alignment and grade shall rest upon the Contractor.

The Engineer will establish bench marks and base line controlling points. Reference remarks for lines and grades as the work progresses will be located to cause as little inconvenience to the prosecution of the work as possible. The Contractor shall so place excavation and other materials as to cause no inconvenience in the use of the use of the reference marks provided. He shall remove any obstructions placed by him contrary to this provision.

**G-8.02 SURVEYS**
The Contractor shall furnish and maintain, at his own expense, stakes and other such materials, and give such assistance, including qualified helpers, as may be required by the Engineer for setting reference marks. 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. The Contractor shall, at his own expense, 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 thereof. He shall, however, be subject to the check and review of the Engineer.

The Contractor shall keep the Engineer informed a reasonable time in advance as to his need for line and grade reference marks, in order that they may be furnished and all necessary measurements made for record and payment with the minimum of inconvenience to the Engineer or of delay to the Contractor.

It is the intention not to delay the work for the establishment of reference marks but, when necessary, working operations shall be suspended for such reasonable time as the Engineer may require for this purpose.

**G-8.03 SAFEGUARDING MARKS**
The Contractor shall safeguard all points, stakes, grade marks, monuments and bench marks made or established on the work, bear the cost of reestablishing 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.

The Contractor shall safeguard all existing and known property corners, monuments and marks adjacent to but not related to the work and, if required, shall bear the cost of reestablishing them if disturbed or destroyed.

**G-8.04 DATUM PLANE**
All elevations indicated or specified refer to the Mean Sea Level Datum of the U.S.C. & G.S. (N.O.S.) which is 0.80 feet above the Mean Low Water Datum of the U. S. Army

Corps of Engineers.

## SECTION 9
## ADJACENT STRUCTURES AND LANDSCAPING

**G-9.01 RESPONSIBILITY**
The responsibility for removal, replacement, relocation, repair, rebuilding or protection of all public utility installations, including poles, tracks, pipes, wires, conduits, house service connections, vaults, manholes, sewers, traffic control and fire alarm signal circuit installations and other appurtenances and facilities shall be in accordance with G-1.02 and G-1.03.

The Contractor shall also be entirely responsible and liable for all damage or injury as a result of his operations to all other adjacent public and private property, structures of any kind and appurtenances thereto met with during the progress of the work. The cost of protection, replacement in their original locations and conditions or payment of damages for injuries to such adjacent public and private property and structures affected by the work, whether or not shown on the Plans, and the removal, relocation, and reconstruction of such items called for on the Plans or specified shall be included in the various Contract Items and no separate payment will be made therefor. Where such public and private property, structures of any kind and appurtenances thereto are not shown on the Plans and when, in the opinion of the Engineer, removal or relocation and reconstruction is necessary to avoid interference with the work, payment therefor will be made as provided for extra work in Article 7.02 of the Agreement.

**G-9.02 PROTECTION OF TREES**
All trees and shrubs shall be adequately protected by the Contractor with boxes or otherwise and, within the City of Tampa, in accordance with ordinances governing the protection of trees. No excavated materials shall be placed so as to injure such trees or shrubs. Trees or shrubs destroyed by negligence of the Contractor or his employees shall be replaced by him with new stock of similar size and age, at the proper season, and at the sole expense of the Contractor.

Beneath trees or other surface structures, where possible, pipelines may be built in short tunnels, backfilled with excavated materials, except as otherwise specified, or the trees or structures carefully supported and protected from damage.

The City may order the Contractor, for the convenience of the City, to remove trees along the line of trench excavation. If so ordered, the City will obtain any permits required for removal of trees. Such tree removal ordered shall be paid for under the appropriate Contract Items.

**G-9.03 LAWN AREAS**
Lawn areas shall be left in as good condition as before the starting of the work. Where sod is to be removed, it shall be carefully removed and later replaced, or the area where sod has been removed shall be restored with new sod in the manner described in the Technical Specifications section.

**G-9.04 RESTORATION OF FENCES**
Any fence, or part thereof, that is damaged or removed during the course of the work shall be replaced or repaired by the Contractor and shall be left in as good a condition as before the starting of the work. The manner in which the fence is repaired or replaced and the materials used in such work shall be subject to the approval of the Engineer. The cost of all labor, materials, equipment, and work for the replacement or repair of any fence shall be deemed included in the appropriate Contract Item or Items, or if no specific Item is provided therefor, as part of the overhead cost of the work, and no additional payment will be made therefor.

## SECTION 10
## PROTECTION OF WORK AND PUBLIC

**G-10.01 TRAFFIC REGULATIONS**
The Contractor shall arrange his work to comply with Article G-6.02. The work shall be done with the least possible inconvenience to the public and to that end the work may be confined by the Engineer to one block at a time.

**G-10.02 BARRIERS AND LIGHTS**
During the prosecution of the work, the Contractor shall put up and maintain at all times such barriers, and lights, as will effectually prevent accidents. The Contractor shall provide suitable barricades, red lights, "danger" or "caution" or "street closed" signs and watchmen at all places where the work causes obstructions to the normal traffic or constitutes in any way a hazard to the public. Such barriers and signs shall be constructed to State of Florida Department of Transportation standards and placed as recommended by the Traffic Division of the City's Department of Public Works.

No open fires will be permitted.

**G-10.03 SMOKE PREVENTIONS**
The Contractor shall use hard coal, coke, oil or gas as fuel for equipment generating steam. A strict compliance with ordinances regulating the production and emission of smoke will be required.

**G-10.04 NOISE**
The Contractor shall eliminate noise to as great an extent as practicable at all times. Air compressing plants shall be equipped with silencers and the exhaust of all gasoline motors or other power equipment shall be provided with mufflers. In the vicinity of hospitals and schools, special care shall be used to avoid noise or other nuisances. The Contractor shall strictly observe all local regulations and ordinances covering noise control.

Except in the event of an emergency, no work shall be done between the hours of 7:00 p.m. and 7:00 a.m., or on Sundays. If the proper and efficient prosecution of the work requires operations during the night, the written permission of the Engineer shall be obtained before starting such items of the work.

**G-10.05 ACCESS TO PUBLIC SERVICES**
Neither the materials excavated nor the materials or plant used in the construction of the work shall be so placed as to prevent free access to all fire hydrants, valves or manholes.

**G-10.06 DUST PREVENTION**
The Contractor shall prevent dust nuisance from his operations or from traffic by keeping the streets sprinkled with water at all times.

**G-10.07 PRIVATE PROPERTY**
The Contractor shall so conduct the work that no equipment, material, or debris will be placed or allowed to fall upon private property in the vicinity of the work unless he shall have obtained the owner's written consent thereto and shall have shown this consent to the Engineer.

## SECTION 11
## SLEEVES AND INSERTS

**G-11.01 COORDINATION**
When the Contract requires the placing of conduits, saddles, boxes, cabinets, sleeves, inserts, foundation bolts, anchors, and other like work in floors, roofs, or walls of buildings and structures, they shall be promptly installed in conformity with the construction program. The Contractor who erects the floors, roofs, and walls shall facilitate such work by fully cooperating with the Contractors responsible for installing such appurtenances. The Contractor responsible for installing such appurtenances shall arrange the work in strict conformity with the construction schedule and avoid interference with the work of other contractors.

**G-11.02 OPENINGS TO BE PROVIDED**
In the event timely delivery of sleeves and other materials cannot be made and to avoid delay, the affected Contractor may arrange to have boxes or other forms set at the locations where the appurtenances are to pass through or into the floors, roofs, walls, or other work. Upon the subsequent installation of these appurtenances, the Contractor erecting the structure shall fill around them with materials as required by the Contract. The necessary expenditures incurred for the boxing out and filling in shall be borne by the Contractor or Contractors required to furnish the sleeves and inserts. Formed openings and later installation of sleeves will not be permitted at locations subject to hydrostatic pressure.

## SECTION 12
## CUTTING AND PATCHING

**G-12.01 GENERAL**
The Contractor shall do all cutting, fitting, or patching of his portion of the work that may be required to make the several parts thereof join and coordinate in a manner satisfactory to the Engineer and in accordance with the Plans and Specifications. The work must be done by competent workmen skilled in the trade required by the restoration.

## SECTION 13
## CLEANING

**G-13.01 DURING CONSTRUCTION**
During construction of the work, the Contractor shall, at all times, keep the site of the work and adjacent premises as free from material, debris, and rubbish as is practicable and shall remove the same from any portion of the site if, in the opinion of the Engineer, such material, debris, or rubbish constitutes a nuisance or is objectionable.

The Contractor shall remove from the site all of his surplus materials and temporary structures when no further need therefor develops.

**G-13.02 FINAL CLEANING**
At the conclusion of the work, all erection plant, tools, temporary structures and materials belonging to the Contractor shall be promptly taken away, and he shall remove and promptly dispose of all water, dirt, rubbish or any other foreign substances.

The Contractor shall thoroughly clean all equipment and materials installed by him and shall deliver such materials and equipment undamaged in a bright, clean, polished, and new appearing condition.

## SECTION 14
## MISCELLANEOUS

**G-14.01 PROTECTION AGAINST SILTATION AND BANK EROSION**
The Contractor shall arrange his operations to minimize siltation and bank erosion on construction sites and on existing or proposed watercourses and drainage ditches.

**G-14.02 EXISTING FACILITIES**
The work shall be so conducted to maintain existing facilities in operation insofar as is possible. Work shall be scheduled to minimize bypassing during construction. Requirements and schedules of operations for maintaining existing facilities in service during construction shall be as described in the Special Provisions.

**G-14.03 USE OF CHEMICALS**
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 EPA or USDA. Use of all such chemicals and disposal of residues shall be in strict conformance with instructions.

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# SUPPLEMENTARY GENERAL PROVISIONS

## 1.0 GENERAL:

1.1 This Section sets forth modifications to the "General Provisions" of the Contract Documents which are referred to as Specifications, General Provisions.

1.2 Paragraph numbers and titles used herein refer to similarly numbered and titled articles in the General Provisions.

1.3 Only those paragraphs contained herein shall be assumed to be modified. Paragraphs not appearing herein shall apply as written in the General Provisions.

1.4 Any portion of the General Provisions, whether or not modified herein, may be further modified in Special Conditions and in the Instructions to Bidders of these Specifications.

1.5 Where the Supplementary General Provisions, Special Conditions and Instructions to Bidders conflict with the General Provisions, the Supplementary General Provisions, Special Conditions and the Instructions to Bidders shall take precedence.

## 2.0 MODIFICATIONS TO THE GENERAL PROVISIONS AS FOLLOWS:

### 2.1 SECTION 1 SCOPE AND INTENT

G-1.02 WORK INCLUDED

The first paragraph shall be deleted in its entirety and replaced by the following paragraph:

"The Contractor shall furnish all labor, superintendence, materials, plant, power, light, heat, fuel, water, tools, appliances, equipment, supplies, and other means of construction necessary or proper for performing and completing the work. He shall obtain all required permits. He 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 incidental thereto. He shall repair or restore all during performance of the work."

### 2.2 SECTION 3 WORKING DRAWINGS

a. Change to read as follows:

SECTION 3 SHOP DRAWINGS

b. Replace the existing paragraphs in their entirety with the following paragraphs:

G-3.01 SCOPE

Shop drawings, schedules, etc., shall be submitted to the Engineer and/or Architect in quadruplet, accompanied by a letter of transmittal. Subcontractors and suppliers shall submit shop drawings and make requests for approvals through their respective prime Contractors.

The drawings shall be numbered consecutively and shall accurately and distinctly present the following:

(1) Names of equipment or materials, and the locations at which the equipment or materials are to be installed in the work.

(2) All working and erection dimensions.

(3) Arrangement and sectional views.

(4) Necessary details, including complete information for making connections between work under this contract and work under other contracts.

(5) Kinds of materials and finishes.

(6) Parts list and description thereof.

The Engineer and/or Architect may decline to consider any shop drawing that does not contain complete data on the work and full information of related matters.

Fax submittals will not be reviewed.

G-3.02 APPROVAL:

Shop drawings shall be examined by the Contractor prior to his transmitting them to the Engineer and/or Architect. Shop drawings submitted to the Engineer and/or Architect shall bear the Contractor's stamp of approval evidencing that he has examined and checked each drawing and that he has found said drawings to be in accordance with the Contract requirements. Any drawings submitted without this stamp will not be considered by the Engineer and/or Architect and will be returned to the Contractor for re- submission.

If the shop drawings show departures from the Contract requirements, the Contractor shall make specific mention thereof in his letter of submittal and the following shall be submitted:

(1) Each request shall include a complete description of the proposed substitute and the name of the material or equipment for which it is to be substituted.

(2) Furnish drawings, cut, manufacturer's printed specifications, performance and test data and any other data or information necessary for a complete evaluation of both the item specified and the proposed substitute item.

Approval of the drawings shall constitute approval of the subject matter thereof only and not of any structure, material, equipment or apparatus shown or indicated.

Approval of the drawings shall be general and shall not relieve the Contractor of responsibility for the accuracy of such drawings, nor for the quantities of materials and equipment, nor for the proper fitting and construction of the work, nor for the furnishing of materials, tools, equipment, etc., required by this contract and not indicated on the drawings.

No work called for by Shop Drawings shall be done until the said drawings have been approved by the Engineer and/or Architect.

The Contractor shall revise and resubmit the shop drawings as required by the Engineer and/or Architect until approval thereof is obtained.

The City shall retain four (4) copies of all submittals unless the Engineers and/or Architect makes a specific request for additional copies.

| Items | Submittals | *Approval |
|---|---|---|
| All trade | Fourteen (14) Days | Fourteen (14) Days |

*From date of receipt of submittal.

Delays on account of tardy or untimely submittals will not be considered as causes of extension of time of the Contract or increases to the Contract Sum.

G-3.03 JOB SITE:

One (1) copy of all approved submittals SHALL BE available at the Contractor's Office at the job site.

2.3 SECTION 4 MATERIALS AND EQUIPMENT

G-4.01 GENERAL REQUIREMENTS

In the first paragraph, second line, delete the word "specifications" and substitute the words "Contract Documents".

G4.03 REFERENCE TO STANDARDS

The following paragraph shall be added in its entirety:

"Compliance with the Standard Building Code, latest edition, and all local electrical and plumbing codes shall be required. In the event of a conflict in code requirements, the most stringent code or standard shall apply."

G-4.05 EQUIVALENT QUALITY

Add the following sentence to paragraph two: "Any professional fees associated with shop drawing review of materials or equipment submitted for approval as equivalent to that specified shall be borne by the Contractor.

2.4 SECTION 5 INSPECTION AND TESTING

G-5.06 PRELIMINARY FIELD TESTS

G-5.07 FINAL FIELD TEST

A. Add the following sentence to BOTH of the above paragraphs:

The Contractor shall provide, at NO EXTRA COST to the City, ALL labor, tools, equipment, materials, etc., for the Engineer and/or Architect to make any field test that may be required in the judgment of the Engineer and/or Architect.

2.5 SECTION 6 TEMPORARY STRUCTURES

G-6.03 CONTRACTOR'S FIELD OFFICE

A. Delete this paragraph G-6.03 in its entirety.

## 2.6 SECTION 7 TEMPORARY SERVICES

### G-7.01 WATER, G-7.02 LIGHT AND POWER, AND G-7.03 SANITARY REGULATIONS

The City of Tampa shall provide, at no cost to the Contractor, water and electricity facilities for installation of this project. All water and electricity shall be applied and/or connected by the Contractor.

### G-7.07 TELEPHONE

The Contractor shall furnish the Engineer with a telephone number(s) by which the Engineer may contact the site.

## 2.7 SECTION 14 MISCELLANEOUS

### G-14.04 USE OF EXPLOSIVES:

Explosives will not be used on the work except when authorized by the Engineer and/or Architect. The use of same, if authorized, shall conform to laws or ordinances which may pertain to the use of same and the utmost care will be exercised by the Contractor so as not to endanger life or property. The Contractor will assume full responsibility in connection with use of any explosives even though authorized. Explosives will not be stored within the City limits.

### G-14.05 OWNERSHIP OF MATERIALS:

The removal of any underground and surface structures as required shall be performed in a careful manner to permit salvaging of as much material, such as pipe and brick, also broken section of sidewalk, as practical for use in repair and maintenance of City-owned facilities.

Such acceptable salvaged material remains the property of the City and shall be placed in stock piles so as not to interfere with new construction work but accessible for loading and hauling by the City or by the Contractor within the free haul limit of six (6) miles. The Engineer and/or Architect shall direct the Contractor as to the location of stockpile.

The paving material, such as vitrified brick, asphalt block and other paving materials removed from the excavated areas and suitable for reuse but not reused in the work, shall also be considered the property of the City. The handling of such materials shall be as set forth elsewhere in the Specifications or Special Provisions.

All salvageable materials, as determined by the Engineer, shall be removed by the Contractor and shall remain the property of the City unless otherwise noted. All carbon steel from the exiting digester cover, gas mixing tubes and supports shall become property of the Contractor and shall be removed from the site and be properly disposed of. Contractor shall salvage ballast blocks from existing digester cover for installation in proposed digester cover.

All such salvaged items shall be removed by the Contractor, delivered, and unloaded at a location within the treatment plant's site, as directed by the Engineer. The Contractor shall include all necessary labor and equipment to unload the materials at a location designated by the City. The coat of removing, disposing, delivering, and unloading as salvage items of pipe and appurtenances shall be included in the various Contract Unit Prices or the Lump Sum Price, as applicable, and no separate payment will be made therefor.

### G-14.06 NOTICE OR SERVICE THEREOF:

All notices, which shall include demands, instructions, requests, approvals and claims, shall be in writing.

Any notice to or demand upon the Contractor shall be sufficiently given if delivered to the office of the Contractor specified in the bid (or to such other office as the Contractor may, from time to time, designate to the City in writing), or if deposited in the United States mail in a sealed, postage-prepaid envelope, or delivered, with charges case addressed to such office.

All notices required to be delivered to the City shall, unless otherwise specified in writing to the Contractor, be delivered to Contract Administration Department – Construction Management Division, 3808 East 26th Avenue, Tampa, Florida 33605, and any notice to or demand upon the City shall be sufficiently given if delivered to the office of the said Engineer and/or Architect, or if deposited in the United States mail in a sealed, postage- prepaid envelope, or delivered with charges prepaid to any telegraph company for transmission, in each case addressed to said Engineer and/or Architect or to such other representative of the City or to such other address as the City may subsequently specify in writing to the Contractor or to its representative at the construction site for such purposes.

Any such notice or demand shall be deemed to have been given or made as of the time of actual delivery or (in the case of mailing) when the same should have been received in due course of post or (in the case of telegram) at the time of actual receipt, as the case may be.

G-14.07 REQUIREMENTS FOR CONTROL OF THE WORK:

Prior to the start of the work included in this contract, a Preconstruction Conference will be held by the Engineer and/or Architect to be attended by the Contractor and representatives of the various utilities and others for the purpose of establishing a schedule of operations which will coordinate the work to be done under this contract with all related work to be done by others within the limits of the project. The Contractor shall be prepared for this meeting and shall present a comprehensive construction schedule for all items of work to be accomplished by him, which will be used as the basis for the development of an overall operational schedule and a list of subcontractors to be used on this work.

All items of work on this contract shall be coordinated so that progress on each related work item will be continuous from week to week. The progress of the work will be reviewed by the Engineer and/or Architect at the end of each week, and if the progress on any item of work during that week is found to be unsatisfactory, the Contractor shall be required to adjust the rate of progress on that item or other items as directed by the Engineer and/or Architect.

The Contractor shall conduct his operations in such a manner as will result in a minimum of inconvenience to occupants of adjacent homes and business establishments and shall provide temporary access as directed or as conditions in any particular location may require.

G-14.08 WORK DIRECTIVE CHANGE:

"A Work Directive Change is a written directive to the Contractor, issued on or after the date of the execution of the Agreement, and signed by the Engineer on behalf of the City, ordering an addition, deletion or revision in the work, or responding to an emergency. A Work Directive Change will not change the contract price or the time for completion, but is evidence that the parties expect that the change directed or documented by a Work Directive Change 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 the time for completion. "Without invalidating the Agreement, additions, deletions or revisions in the Work may, at any time or from time to time, be authorized by a Change Order or a Work Directive Change. Upon receipt of any such document, the Contractor shall promptly proceed with the work involved."

G-14.09 RESERVED PARKING SIGNS IN PARKING METER AREAS

Not Applicable.

G-14.10 EROSION AND SEDIMENT CONTROL:

During construction, the Contractor shall provide adequate erosion and sediment controls to prevent adverse effects to the environment and public and private property. He shall construct and maintain control structures necessary to prevent erosion and sediment. He shall conduct and schedule construction operations to avoid, prevent, and minimize erosion and sediment. He shall comply with City, County, State, and Federal codes, laws, and regulations and the plans and specifications for this project pertaining to erosion and sediment prevention and control.

At the Preconstruction Conference, the Contractor shall present a plan for erosion and sediment prevention and control. This plan shall include the operations methods, also temporary and permanent control measures and structures to be used on this project.

G-15.0 NOTIFICATION TO CONTRACTORS:

All Contractors working in City of Tampa buildings and facilities that contain ACM will be provided with a written notice, including contract custodial firms. The notice when applicable will advise Contractors about the possibility of encountering ACM while working for the City and will require Contractors to become familiar with locations of ACM within their work areas. The Contractor Notice shall include the name and phone number of the designated Building Asbestos Contact Person assigned to that building/facility. This notice is provided in Appendix C.

# Appendix C

## Contractor Notification Requirements

Asbestos-Containing Material (ACM) may be present in the facility. The presence of ACM does not necessarily mean that a hazard exists; however, a hazard may be created when ACM is disturbed and asbestos fibers become airborne. The best way to maintain a safe environment is to avoid the disturbance of ACM.

It is possible that you may encounter ACM while working in the facility. On the bulletin board, there is a summary of known locations of ACM in that building. The summary may or may not be all inclusive. Therefore, workers must exercise caution and be watchful for materials that might contain asbestos. Avoid disturbing ACM or suspected ACM as you carry out your work.

If your work necessitates the disturbance of ACM you shall take whatever precautions that are necessary to protect human health and the environment from asbestos fibers. At minimum, you will comply with all Federal, Sate, and Local responsible for assuring that you are medically certified, trained, and equipped with the proper personal protective devices for safe handling of ACM. You must notify the designated Building Asbestos Contact Person before disturbing any asbestos-containing materials in City-Owned buildings. The designated Building Asbestos Contract Person is listed on the bulletin board with the asbestos location summary.

If you need additional information regarding ACM in a particular building or would like to see a copy of the Operations and Maintenance Plan, contact the Building Asbestos Contact Person responsible for the building for which you will be working.

Comply with all regulatory requirements for removal and disposal.

# SPECIAL CONDITIONS

## 1.0 PRECONSTRUCTION BRIEFING:

The Contractor, upon receiving notice that he has been awarded the contract for the construction of the project, shall make an appointment with the Engineer and/or Architect for said briefing. The Contractor shall bring to this meeting the following:

1. Contract Documents not yet submitted.
2. A detailed Job Progress Schedule.
3. Samples, questions, etc., he feels necessary.
4. List of subcontractors.

Failure to bring the above items to the meeting will result in cancellation of meeting. Once items have been submitted, meeting will be rescheduled by the City. Site access and commencement of work will not be allowed during period between meetings.

Contractor shall have representatives present at meeting that are familiar with, and conversant on, the scope of the work and Contract Document requirements. Failure to have such persons present will also result in cancellation and rescheduling of meeting until such a time when condition is corrected.

Elapsed time as a result of the Contractor's failure to comply with above will not result in an extension of contract time.

## 2.0 SITE REVIEW:

Before submitting Proposals, Bidders shall carefully examine the entire site of the proposed work and adjacent premises and the various means of approach and access to the site, and make all necessary investigations to inform themselves thoroughly as to the facilities for delivering, placing and operating the necessary construction equipment, and for delivering and handling materials at the site, and inform themselves thoroughly as to all difficulties involved in the completion of all the work in accordance with the Contract Documents.

The Contractor shall immediately, upon entering project site for the purpose of beginning work, review project site with the Engineer and/or Architect for the purpose of selecting area(s) to place materials for storage.

The Contractor must exercise proper precaution to verify all figures shown or indicated on the drawings, all existing trees, paved areas; utilities, etc., shall be located before beginning any work, and he shall be held responsible for any error resulting from his failure to exercise such precaution.

## 2.1 LAYING OUT WORK:

The Contractor shall locate all general reference points and take necessary action to prevent their destruction; lay out his own work and be responsible for all lines, elevations, measurements, grading, trenching, backfilling, utilities and other work to be executed by him for a complete project under this contract.

The Contractor shall lay out all work and have final approval by the Engineer and/or Architect before installation begins. Contractor shall be held responsible for any error resulting from his failure to exercise such approval. Said errors shall be corrected by the Contractor at NO EXTRA COST to the City.

The Contractor shall coordinate with the Parks Department and shall identify each and every tree to remain prior to the start of work. The specific trees to remain shall be approved by the Parks Department.

The final location of all work to be performed shall be made jointly by the Engineer and/or Architect and the Contractor at the project site.

## 3.0 SAFETY AND HEALTH STANDARDS:

The performance of all construction under this contract shall conform to ALL Local, State, Federal Occupation Safety and Health Act Standards.

At the end of each work day, all work areas shall be left in a safe condition. Barricades and/or warning devices shall be provided for at any open excavations or barriers on the project site.

The Contractor's attention is directed to paragraphs Article 3.07 (page A-10) and Article 12.03 (page A-31) of the Agreement, and paragraph G-7.04 (page G-18) of the General Provisions.

## 4.0 INFORMATION FOR COLOR SCHEDULES:

Not later than thirty (30) calendar days after authorization to proceed with contract work, the Contractor shall submit to the Engineer and/or Architect the names of all manufacturers and trade names for all materials involving selection based upon color or texture or other design appearance features which are to be used in this project. Where samples are necessary for such selection, furnish same.

If such information is not furnished by Contractor within thirty (30) day period, the Engineer and/or Architect will select colors and textures from products named in the Contract Documents.

## 5.0 RESPONSIBILITY OF CONTRACTOR:

The Contractor shall take all necessary precautions to protect all project surfaces and adjoining areas from mechanical damage from tools, equipment, materials, supports, etc., and shall provide adequate protection from leaking lubricants or fluids from his equipment.

Damage to said project surfaces and adjoining areas caused by a lack of protection or negligence by the Contractor shall be repaired and/or replaced at NO EXTRA COST to the City and to the full satisfaction of the Engineer and/or Architect.

The Contractor and all subcontractors are charged with the protection of the work and property, but the final responsibility for these provisions rests with the Contractor who shall take complete charge of the project site from start to finish of work.

The Contractor shall take particular precautions to protect existing trees and plant material. All trees and other plant material to remain shall be marked by the City prior to start of work.

Excavation, earthwork or sitework within the drip line of existing trees shall be done either manually or by methods approved by the City of Tampa Parks Department.

If the Contractor damages any tree or plant material in any way he shall be required to replace the damaged tree or plant material as follows:

1. Trees

    a. Replace a 6" caliper or less with a 6" caliper of the same species.

    b. Replace a 7"-10" caliper with two (2) 6" caliper of the same species.

    c. Replace a 10"-15" caliper with three 6" caliper of the same species.

    d. Replace a 16"-20" caliper with five (5) 6" caliper of the same species.

e. Replace a 21"-36" caliper with ten (10) 6" caliper of the same species.

2. Plant Material

Replace any damaged plant material with an equal size and quantity of the same material.

The replaced trees and plant material shall be guaranteed by the Contractor for a period of six (6) months.

6.0 COORDINATION WITH N.I.C. ITEMS:

The Contractor shall give to the Engineer and/or Architect, in writing, a time schedule for the installation or removal of all N.I.C. items at the beginning of the project. Failure of the Contractor to supply the Engineer and/or Architect with said schedule shall not be used for reason of time extension by the Contractor.

7.0 ELECTRICAL SERVICE LOCATION:

The Contractor shall verify and coordinate the service location with the local power company and the Engineer and/or Architect.

The Contractor shall coordinate with the local power company and shall include in his bid all costs for electrical service to work area(s) under this Contract, including but not limited to new service, connections from existing and/or new service and all required labor, equipment, materials etc. and all other associated electrical work.

8.0 SCHEDULING:

The Contractor shall provide the City with a detailed schedule prior to start of work.

The schedule shall be a fully developed, horizontal bar-chart type Contractor's construction schedule. Provide a separate time bar for each significant construction activity. Provide a continuous vertical line to identify the first working day of each week. Use the same breakdown of units of the Work as indicated in the "Schedule of Values".

Unless otherwise directed or approved, prepare schedule on a single 8-1/2" X 14" sheet of plain bond white paper.

Secure time commitments for performing critical elements of the Work from parties involved. Coordinate each element on the schedule with other construction activities; include minor elements involved in the sequence of the Work. Show each activity in proper sequence. Indicate graphically the sequences necessary for completion of related portions of the Work.

Contractor shall also prepare schedule in accordance with applicable portions of Section 4.02 of the Agreement.

9.0 ASSIGNMENT OF CONTRACT: Not applicable.

10.0 WORKMANSHIP AND MATERIALS:

Workmanship and materials shall be installed in accordance with accepted standards of the specific trade, as defined by the applicable recognized trade association(s). In the event of a conflict between these trade standards and the Contract Documents, the conflict shall be brought to the Engineer's and/or Architect's attention writing and the final decision shall be made by the Engineer and/or Architect.

11.0 RECORD DRAWINGS:

During the course of the work, Contractor shall maintain, at the site, a clean undamaged set of the Contract Documents. Contractor shall mark set, on a daily basis, with location and progress of all contract work, including but not limited to:

1. Sewer, water, stormwater and irrigation fabrication drawings showing to scale all manholes, all distances and angles between manholes, line dimension, grid co-ordinates, trunk lines, inverts and cleanouts,

2. Fencing, roadway, parking and sleeving,

3. Electrical service, and

4. General building location, and/or foundations, structures, etc.

Drawings shall be on site at all times and available for review by the City. Failure of Contractor to have drawings on site and/or up to date may result in suspension of work until situation is corrected. Extension of contract will not be granted for such condition.

At conclusion of work, the Contractor shall provide the City with one complete set of Electronic Record Drawings incorporating changes described above, and four marked hard copy sets of as-built record drawings clean and damaged free shall also be submitted to the City at the same time. Electronic files will be issued to the Contractor by the City of Tampa. These files will be AutoCAD DWG, AutoCAD DWF or Adobe PDF latest versions.

` 12.0 ON SITE RECYCLABLE CRITERIA:

Contractor shall make reasonable attempts to recycle and/or salvage at least 50% of non-hazardous construction and demolition debris. Contractor shall develop and implement a Construction Waste Management Plan that identifies the materials that are to be diverted from disposal by weight or volume and be directed to a recycling facility. Specific area(s) on the construction site shall be designated for collection and tracking of the designated materials as needed. Location of the recycling area on site shall be coordinated with the project owner's representative on site prior to construction start. The intent of this section is to encourage recycling where practical in the context of the scope of work.

Contractor shall submit the following but not limited to items related to this section:

1. Provide a submittal of the contractor's plan of action to recycle

2. Contractor is required to document all activities with above requirements and provide to the city upon request items that are recyclable, documentation of the quantity of material disposed at a recycling facility.

# City of Tampa – DMI Sub-(Contractors/Consultants/Suppliers) Payments

*(FORM MBD-30)*

[ ] Partial [ ] Final

Contract No.: _____ WO#,(if any):_____ Contract Name:_____

Contractor Name:_____ Address:_____

Federal ID:_____ Phone:_____ Fax:_____ Email:_____

GC Pay Period:_____ Payment Request/Invoice Number:_____ City Department:_____

Total Amount Requested for pay period: $_____ Total Contract Amount(including change orders):$_____

-Type of Ownership - (F=Female M=Male), BF BM = African Am., HF HM = Hispanic Am., AF AM = Asian Am., NF NM = Native Am., CF CM = Caucasian S = SLBE

| Type<br>Trade/Work Activity<br>[]Sub []Supplier<br>Federal ID | Company Name<br>Address<br>Phone & Fax | Total Sub Contract Or PO Amount | Amount Paid To Date<br>Amount Pending Previously Reported | Amount To Be Paid For This Period<br>Sub Pay Period Ending Date |
|---|---|---|---|---|
| | | | $ | $ |
| | | | | |
| | | | $ | $ |
| | | | | |
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| | | | | |

(Modifying This Form or Failure to Complete and Sign May Result in Non-Compliance)

Certification: I hereby certify that the above information is a true and accurate account of payments to sub – contractors/consultants on this contract.

Signed:_____ Name/Title:_____ Date:_____



**Note: Detailed Instructions for completing this form are on the next page**

# Page 2 of 2 – DMI Payment

## Instructions for completing The DMI Sub-(Contractors/Consultants/ Suppliers) Payment Form (Form MBD-30)

This form must be submitted with all invoicing or payment requests where there has been subcontracting rendered for the pay period. If applicable, after payment has been made to the subcontractor, "Waiver and Release of Lien upon Progress Payment", "Affidavit of Contractor in Connection with Final Payment", or an affidavit of payment must be submitted with the amount paid for the pay period. The following will detail what data is required for this form. The instructions that follow correspond to the headings on the form required to be completed. **(Modifying or omitted information from this form my result in non-compliance).**

- **Contract No.** This is the number assigned by the City of Tampa for the bid or proposal.
- **W.O.#** If the report covers a work order number (W.O.#) for the contract, please indicate it in that space.
- **Contract Name.** This is the name of the contract assigned by the City of Tampa for the bid or proposal.
- **Contractor Name.** The name of your business.
- **Address.** The physical address of your business.
- **Federal ID.** A number assigned to a business for tax reporting purposes.
- **Phone.** Telephone number to contact business.
- **Fax.** Fax number for business.
- **Email.** Provide email address for electronic correspondence.
- **Pay Period.** Provide start and finish dates for pay period. (e.g. 05/01/13 – 05/31/13)
- **Payment Request/Invoice Number.** Provide sequence number for payment requests. (ex. Payment one, write 1 in space, payment three, write 3 in space provided.)
- **City Department**. The City of Tampa department to which the contract pertains.
- **Total Amount Requested for pay period.** Provide all dollars you are expecting to receive for the pay period.
- **Total Contract Amount (including change orders).** Provide expected total contract amount. This includes any change orders that may increase or decrease the original contract amount.
- **Signed/Name/Title/Date**. This is your certification that the information provided on the form is accurate.
- **See attached documents.** Check if you have provided any additional documentation relating to the payment data. Located at the bottom middle of the form.
- **Partial Payment.** Check if the payment period is a partial payment, not a final payment. Located at the top right of the form.
- **Final Payment.** Check of this period is the final payment period. Located at the top right of the form.

The following instructions are for information of any and all subcontractors used for the pay period.

- **(Type) of Ownership.** Indicate the Ethnicity and Gender of the owner of the subcontracting business or SLBE.
- **Trade/Work Activity.** Indicate the trade, service, or material provided by the subcontractor.
- **SubContractor/SubConsultant/Supplier.** Please indicate status of firm on this contract.
- **Federal ID.** A number assigned to a business for tax reporting purposes. This information is critical in proper identification of the subcontractor.
- **Company Name, Address, Phone & Fax**. Provide company information for verification of payments.
- **Total Subcontract Amount.** Provide total amount of subcontract for subcontractor including change orders.
- **Amount Paid To Date.** Indicate all dollars paid to date for the subcontractor.
- **Amount Pending, Previously Reported.** Indicate any amount previously reported that payments are pending.
- **Amount To Be Paid for this Period.** Provide dollar amount of dollars requested for the pay period.
- **Sub Pay Period Ending Date.** Provide date for which subcontractor invoiced performed work.

*Forms must be signed and dated or will be considered incomplete. The company authorized representative must sign and certify the information is true and accurate. Failure to sign this document or return the document unsigned can be cause for determining a company is in non-compliance of Ordinance 2008-89.*

If any additional information is required or you have any questions, you may call the Minority Business Development Office at (813) 274-5522.


**SIGN EXAMPLE ONLY GRAPHIC TO BE DEVELOPED BY CONTRACTOR**

scale: 3"

## Sign Information

### Building a Better Tampa

**David L. Tippin Water Treatment Facility**
**Caustic Soda Piping Improvements**

***Project provides for improvements at the David L. Tippin Water Treatment Facility to improve the reliability and safety of the Sodium Hydroxide System of the water distribution system within the facility.***

*$TBD investment*
*Scheduled for completion in TBD 2014*

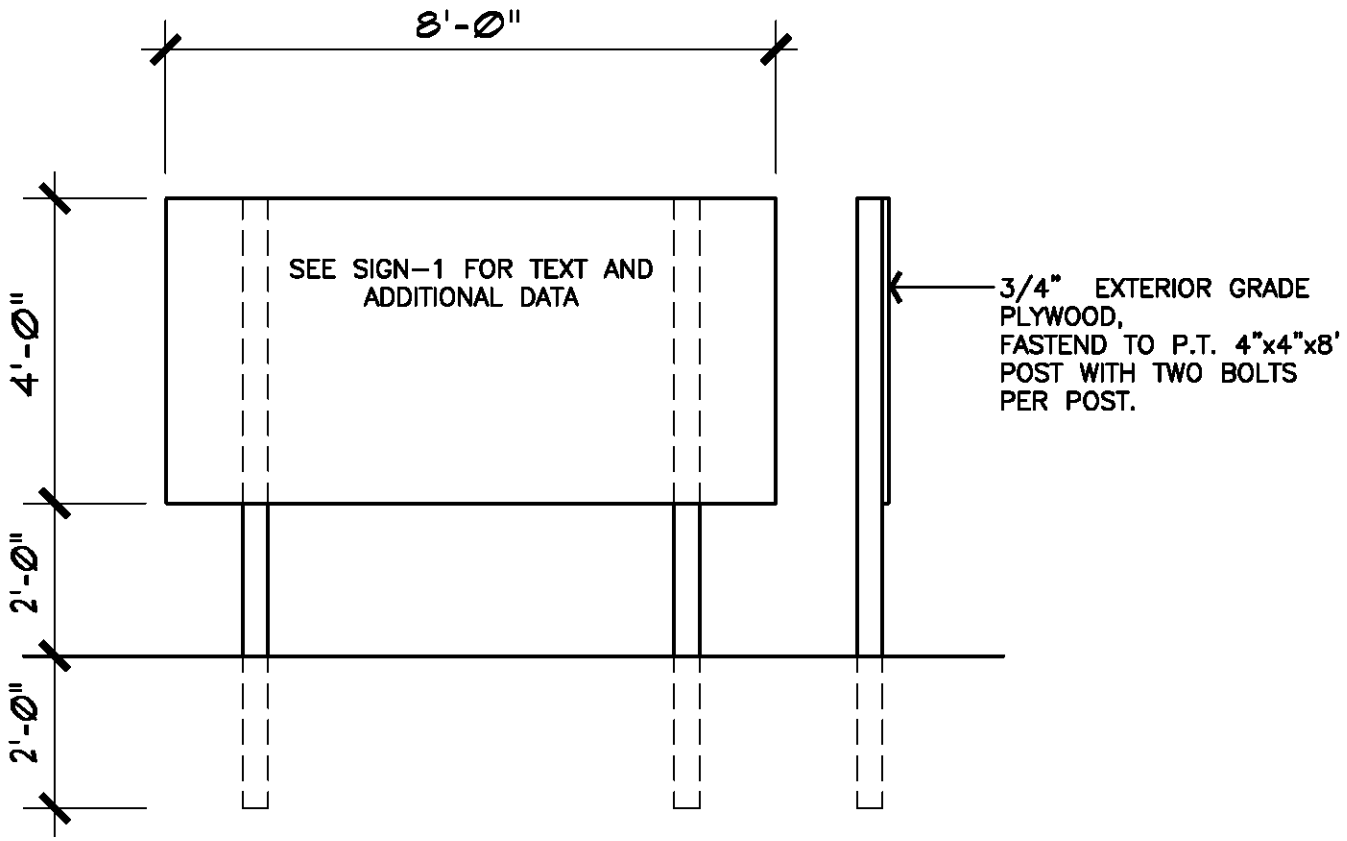
*TBD*

### Colors

Blue: Sherwin Williams Naval SW6244
Green: Sherwin Williams Center Stage SW6920
White: Sherwin Williams Pure White SW7005

### Font

Franklin Gothic




CITY OF TAMPA–PROJECT SIGN
REVISED 4/28/04

SECTION 01010 - SUMMARY OF WORK

1.0 GENERAL:

The work shall consist of furnishing all materials, labor, equipment, tools, and all items and services required for the complete construction in conformity with Contract Documents of:

Howard F. Curren Advanced Wastewater Treatment Plant
Diffused Air Reactor Improvements – Phase 1
at
2545 Guy Verger Boulevard
for the
City of Tampa

All construction work and materials, in addition to complying with requirements of Contract Documents, shall fully comply with all requirements of local building codes, all ordinances, and regulations of other Federal, State and public authorities having jurisdiction over this type of work in the given area.

2.0 SCOPE:

The work shall include but not be limited to, furnishing all labor, materials, and equipment to remove all existing mechanical mixers small bubble air diffusers, piping and associated equipment, removal of sediment, debris, and existing plant growth within Train #1 of the Diffused Air Reactor; installation of new mechanical mixers, fine bubble air diffusers, piping, valves, controls, electrical, instrumentation and telecommunications, with all associated work required for a complete project, as shown and indicated on the Drawings and in the Specifications.

3.0 LEGAL DESCRIPTION OF PROJECT SITE:

S-T-R 30-29S-19E

4.0 VERIFICATION OF OWNER'S SURVEY DATA:

Prior to commencing any work, the Contractor shall satisfy himself as to accuracy of all survey data which shall affect his work as indicated in these plans and specifications and/or provided by the City.

Should the Contractor discover any inaccuracies or errors which will affect his work, he shall notify the Engineer and/or Architect in order that proper adjustments can be ordered.

The exact location of the building and related items shall be determined on site jointly by the Contractor and the Engineer and/or Architect. NO work shall commence until said final approval of the locations is made by the Engineer and/or Architect.

5.0 CONTRACT DOCUMENTS:

a. BIDDING REQUIREMENTS

b. GENERAL PROVISIONS, SUPPLEMENTARY GENERAL PROVISIONS, AND SPECIAL, CONDITIONS

6.0 SPECIFICATIONS: (DATED: May, 2015)

Divisions: 1, 2, 3, 5, 9, 11, 13, 14, 15, 16

7.0 DRAWINGS: (DATED: May, 2015)

Sheets:

Cover Sheet, G-001, G-005, D-101 thru D103, S-001, S-101, S-301, S-501, M-001, M-101, M-110, M-501, E-001, E-100 thru 105, I-001, I-100 thru I-105

8.0 ADDENDA AND LETTERS OF CLARIFICATION:

All addenda and letters of clarification issued prior to bid opening time date.

# SECTION 01020 - ALLOWANCES

## PART 1 - GENERAL

### RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

### SUMMARY

This Section includes administrative and procedural requirements governing allowances.

Types of allowances include the following:

Contingency allowances.

### SELECTION AND PURCHASE

### SUBMITTALS

Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.

Submit invoices or delivery slips to show the actual quantities of materials delivered to the site for use in fulfillment of each allowance.

### CONTINGENCY ALLOWANCES

Use the contingency allowance only as directed by the Owner.

The Contractor's related costs for services, products and equipment ordered by the Owner under the contingency allowance include delivery, installation, taxes, insurance, equipment rental, and similar costs.

Work Directive Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit margins.

At Project closeout, credit unused amounts remaining in the contingency allowance to the Owner by Change Order.

## PART 2 - PRODUCTS (Not Applicable)

## PART 3 - EXECUTION

### EXAMINATION

Examine products covered by an allowance promptly upon delivery for damage or defects.

### PREPARATION

Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

SCHEDULE OF ALLOWANCES

Allowance No. 1: Include a contingency allowance of $300,000 for use according to the Owner's instructions. The allowance shall be included in the Base Bid.

END OF SECTION 01020

# SECTION 01040 - PROJECT COORDINATION

## PART 1 - GENERAL

### RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

### SUMMARY

This Section specifies administrative and supervisory requirements necessary for Project coordination including, but not necessarily limited to:

Coordination.
Administrative and supervisory personnel.
General installation provisions.
Cleaning and protection.

### COORDINATION

Coordination: Coordinate construction activities included under various Sections of these Specifications to assure efficient and orderly installation of each part of the Work. Coordinate construction operations included under different Sections of the Specifications that are dependent upon each other for proper installation, connection, and operation.

Where installation of one part of the Work is dependent on installation of other components, either before or after its own installation, schedule construction activities in the sequence required to obtain the best results.

Where availability of space is limited, coordinate installation of different components to assure maximum accessibility for required maintenance, service and repair.

Make adequate provisions to accommodate items scheduled for later installation.

Where necessary, prepare memoranda for distribution to each party involved outlining special procedures required for coordination. Include such items as required notices, reports, and attendance at meetings.

Prepare similar memoranda for the Owner and separate Contractors where coordination of their Work is required.

Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

Preparation of schedules.
Installation and removal of temporary facilities.
Delivery and processing of submittals.
Progress meetings.
Project Close-out activities.

### Treatment Plant Permits

The Contractor shall have in his possession the proper license to perform the work before submittal of his bid and shall obtain any required City/County building permits and shall obtain and pay for all other licenses and authorizations

required for the prosecution of the work, including the cost of all work performed in compliance with the terms and conditions of such permits, licenses and authorizations, whether by himself or others.

City permit fees will be paid by the City.

The Contractor shall require all subcontractors to be currently licensed by the City to perform the proposed work in their respective fields and to obtain permits for the execution of said work. All work shall be performed in accordance with the licenses, permits and the requirements of the current Building and Construction Regulations Chapter of the City of Tampa Code.

The Contractor is responsible to schedule and coordinate with the City Inspectional Services Division of the Department of Housing and Development Coordination all required inspections and tests for all phases of work to obtain final approval thereof.

The Contractor is encouraged to contact the City's Permitting Department and Building Inspections Bureau prior to commencement of work to ascertain their respective requirements.

Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.

Salvage materials and equipment involved in performance of, but not actually incorporated in, the Work. Refer to other sections for disposition of salvaged materials that are designated as Owner's property.

Pre-Bid Site Access Requirements - Prior to the Pre-bid meeting, Bidders shall email names and companies represented for all attendees a minimum of 24 hours in advance to Richard.Birchmire@tampagov.net, Mariam.Vliet@tampagov.net and Elaine.Tait@tampagov.net to obtain security clearance.

Contractor Emergency Response Time: The Contractor must be available to service emergency calls seven (7) days a week, twenty-four (24) hours a day. The response time for emergency calls shall be within two (2) hours. A contact person and telephone number shall be provided to the Engineer for such purposes.

Interruption of Service: Because of the nature of the work, it is imperative that the diffused air reactor not be out of service for very long. The Contractor shall plan all this work, especially the work pertinent to the pumping operation, in detail and ensure that all the required items and equipment are on hand and in good working condition.

Prior to initiating any work pertaining to the operation of the pumping station, the Contractor shall submit to the City a detailed plan for shutdown of the station. No shutdown shall be performed until the plan is approved by the Engineer. Contractor must provide the City with a written notice of shutdown with minimum 1 week prior notice.

Scheduling of all shutdowns (partial or full) shall be coordinated with Tampa Electric Company (TECO) and the City. The Contractor shall make provisions and pay for temporary power used by him in performing this work.

Electrical Equipment Certification

All equipment and materials shall be UL listed or listed and labeled as complying with the requirements of a Southern Building Code Congress International, Inc. (SBCCI) recognized testing laboratory, for the particular application, whenever available.

An electrical/mechanical system that is not available as a standard UL listed assembly (e.g. industrial equipment of unique configuration or custom design) shall be composed of listed components, whenever they are available, and constructed in accordance with the design documents, and the latest nationally recognized industry standards. The Contractor shall certify in writing that the equipment satisfies the above requirements and that it has been installed in compliance with the latest edition of the National Electrical Code (NEC) and Chapter 5 of the City of Tampa Code. The certification shall be submitted to the City's Electrical Inspection Bureau, with a copy sent to the

Sanitary Sewer Department's Resident Engineer, prior to final inspection. A sample certification document is attached to these Specific Provisions as a formatting guide.

The Contractor shall secure all required permits and arrange for progress and final inspections as the work develops.

Electrical Work

Where definite requirements are not set forth in the Specifications, all electrical equipment, materials, and work under this Division shall comply with the requirements of the Occupational Safety and Health Act (OSHA) and shall be in accordance with applicable ANSI, IEEE, IPCEA, and NEMA standards. The work shall be performed in compliance with the latest issue of the NEC, all applicable state and municipal regulations and codes, and the service rules of the Tampa Electric Company, unless otherwise specified or directed. All equipment and materials shall be listed and labeled as complying with the requirements of a Southern Building Code Congress International (SBCCI) recognized testing laboratory for the particular applications wherever available.

Where listing is not available for the device as a whole, refer to the provision entitled "Electrical Equipment Certification" for submittal requirements.

SUBMITTALS

Coordination Drawings: Prepare and submit coordination Drawings where close and careful coordination is required for installation of products and materials fabricated off-site by separate entities, and where limited space availability necessitates maximum utilization of space for efficient installation of different components.

Show the interrelationship of components shown on separate Shop Drawings.

Indicate required installation sequences.

Refer to Division-15 Section "Basic Mechanical Requirements," and Division-16 Section "Basic Electrical Requirements" for specific coordination Drawing requirements for mechanical and electrical installations.

Staff Names: At the Preconstruction Conference, submit a list of the Contractor's principal staff assignments, including the Superintendent and other personnel in attendance at the site; identify individuals, their duties and responsibilities; list their addresses and telephone numbers.

Post copies of the list in the Project meeting room, the temporary field office, and each temporary telephone.

Operation and Maintenance Manual, Submittals / Request for Information / Shop Drawings, and Asset Tracking Form

Operation and Maintenance Manuals

The Contractor shall prepare and submit to the Engineer four (4) hardcopies and one (1) high resolution color, bookmarked, and unsecured electronic portable document format (PDF) of an Operation and Maintenance Manual for all equipment and associated control systems furnished and installed under this Contract. Black and white copies will not be accepted. When the work reaches 75 to 80 percent completion, the Contractor shall submit to the Engineer for approval one (1) hardcopy and (1) PDF electronic copy of the manual with all specified material that is available at that time. The submittal shall accompany the Contractor's partial payment request for the specified completion. Within 30 days after approval of the Engineer of the PDF submittal, the Contractor shall furnish to the Engineer four (4) hardcopies of the manual. Appropriate space shall be left in the manual for material not available at the time of submittal. All missing material for the manual shall be submitted with the request for final payment.

Also along with the missing material submitted with the request for final payment, one electronic copy (in pdf format) complete with all the missing material to be included in the earlier submitted hard copies shall be submitted. The manual shall be prepared and arranged as follows:

1. Space shall be provided in the manual for a reduced set of record Contract Drawings, size approximately 11 by 17 inches and folded to 8-1/2 by 11 inches. Drawings will be furnished by the Engineer.

2. One copy of all approved shop drawings and diagrams for all equipment furnished. The shop drawings and diagrams shall be reduced to either 8-1/2 by 11 inches or to 11 inches in the vertical dimension and as near as practicable to 17 inches in the horizontal dimension. Such sheets shall be folded to 8-1/2 by 11 inches.

3. One copy of manufacturer's operating, lubrication and maintenance instructions for all equipment and controls furnished. All equipment operating, lubrication and maintenance instruction and procedures shall be furnished on 8-1/2 by 11 inch commercially printed or typed forms. Such forms shall include equipment name, serial number and other identifying references.

4. One copy of manufacturer's spare parts list for all equipment furnished and prepared as specified in No. 3 above.

5. One valve schedule, giving the valve number, location, fluid and fluid destination for each valve installed and prepared as specified in No. 3 above. All valves in the same piping system shall be grouped together in the schedule. A sample of the valve numbering system to be used will be furnished by the Engineer. Valve numbers may include three or four numerals and a letter.

6. List of electrical relay settings and control and alarm contact settings.

Each copy of the manual shall be assembled in one or more binders, each with title page, typed table of contents, and heavy section dividers with copper reinforced holes and numbered plastic index tabs. Each manual shall be divided into sections headed by the equipment specification section included in "Workmanship and Materials." Binders shall be 3-ring hard-back. All data shall be punched for binding and composition and printing shall be arranged so that punching does not obliterate any data. The cover and binding edge of each manual shall have the project title, Division designation and manual title printed thereon, all as furnished and approved by the Engineer.

Where more than one binder is required, they shall be labeled Vol. 1, Vol. 2, and so on. The table of contents for the entire set, identified by volume number, shall appear in each binder.

The four (4) hardcopies of the manuals and data included therein shall be provided in conformance with the subsection headed "Working Drawings" and, in addition, to the requirements of the General Provisions. The costs of the Operation and Maintenance Manual shall be included in the various Contract Items, or in the total Lump Sum Price, as applicable, and no separate payment will be made therefor.

Submittals / Request for Information / Shop Drawings

Contractor shall prepare and submit up to four (4) hardcopies and one (1) bookmarked, unsecured electronic post document format (PDF) file for all Submittals, RFI, and Shop Drawings. The City will review the submittals and return one (1) hardcopy and PDF file of the marked up submittal to the contractor. The contractor shall have approved hard copies of all submittals at the job site. Each electronic submission must be in a high resolution color format and shall be original electronic documents from the manufacturer. Hardcopies shall be high quality printed in color. Scanned printouts or poor quality resolution PDF files will not be accepted.

Asset Tracking Form

The Asset Tracking Form (ATF) is a form that is intended to begin tracking assets and their respective preventative maintenance at an early stage in the project. The Contractor will be required to submit an electronic Asset Tracking Form for each piece of equipment. The information to be included on the form will include general information

and specifications on the equipment such as, but not limited to, model, voltage, amperage, horsepower, material, manufacturer, serial number, recommended spare parts and preventative maintenance tasks.

During the preconstruction meeting of the project, the City will furnish the contractor with a blank electronic copy of the ATF in Microsoft Office 2010 and a preliminary list of equipment that will require an ATF. The City may provide the contractor a list of additional equipment requiring an ATF as the project progresses.

The Contractor shall submit all ATF(s) after the project is substantially complete. The City prefers one submission of all ATF(s).

PART 2 - PRODUCTS (Not Applicable).

PART 3 - EXECUTION

GENERAL INSTALLATION PROVISIONS

Inspection of Conditions: Require the Installer of each major component to inspect both the substrate and conditions under which Work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.

Manufacturer's Instructions: Comply with manufacturer's installation instructions and recommendations, to the extent that those instructions and recommendations are more explicit or stringent than requirements contained in Contract Documents.

Inspect materials or equipment immediately upon delivery and again prior to installation. Reject damaged and defective items.

Provide attachment and connection devices and methods necessary for securing Work. Secure Work true to line and level. Allow for expansion and building movement.

Visual Effects: Provide uniform joint widths in exposed Work. Arrange joints in exposed Work to obtain the best visual effect. Refer questionable choices to the Architect for final decision.

Recheck measurements and dimensions, before starting each installation.

Install each component during weather conditions and Project status that will ensure the best possible results. Isolate each part of the completed construction from incompatible material as necessary to prevent deterioration.

Coordinate temporary enclosures with required inspections and tests, to minimize the necessity of uncovering completed construction for that purpose.

Mounting Heights: Where mounting heights are not indicated, install individual components at standard mounting heights recognized within the industry for the particular application indicated. Refer questionable mounting height decisions to the Architect for final decision.

CLEANING AND PROTECTION

During handling and installation, clean and protect construction in progress and adjoining materials in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

Clean and maintain completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

Limiting Exposures: Supervise construction activities to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period. Where applicable, such exposures include, but are not limited to, the following:

Excessive static or dynamic loading.
Excessive internal or external pressures.
Excessively high or low temperatures.
Thermal shock.
Excessively high or low humidity.
Air contamination or pollution.
Water or ice.
Solvents.
Chemicals.
Light.
Radiation.
Puncture.
Abrasion.
Heavy traffic.
Soiling, staining and corrosion.
Bacteria.
Rodent and insect infestation.
Combustion.
Electrical current.
High speed operation,
Improper lubrication,
Unusual wear or other misuse.
Contact between incompatible materials.
Destructive testing.
Misalignment.
Excessive weathering.
Unprotected storage.
Improper shipping or handling.
Theft.
Vandalism.

## FACILITY OPERATIONS DURING CONSTRUCTION

The Contractor shall perform all work in recognition of, and coordination with, ongoing building activities. Adhere to approved sequence/layout plan and project schedule. Work hours are 7:00 a.m. to 3:30 p.m. daily. Please note the following:

## ACCESS

### GENERAL

Access to the site of the work shall be from Guy Verger Boulevard. The Contractor shall construct, as required for his purposes or as necessary, such temporary access roads between the public roads and the site as may be required for movement of heavy construction equipment and material delivery vehicles at locations approved by the Engineer.

Access facilities shall be adequate for equipment movement and shall provide for surface drainage. Areas used for temporary access, haul roads and access from public or plant roads shall be graded and restored to proposed site grade conditions, all to the satisfaction of the Engineer.

Access to existing plant roads by the Contractor will be restricted to those roads so designated. The Contractor will not be permitted to use any existing plant roads not designated for such use. All existing plant roads which are designated for use by the Contractor shall be maintained in serviceable condition by the Contractor during construction. Any damage to such roads caused by construction operations shall be promptly repaired to keep the road in serviceable condition. Any accumulations of soil, gravel or any other debris deposited on such plant roads as a result of construction operations shall be promptly removed by the Contractor to his own place of disposal.

Additionally, all existing plant roads which are designated for use by the Contractor shall be open at all times for unrestricted use by plant operations, maintenance and inspection service.

In NO case will the Contractor be permitted to use the monitored plant entrances for the passage of heavy construction equipment, concrete trucks or any other large vehicles.

PARKING

All employees of the Contractor shall park personal vehicles within the Contractor's storage and field office site. Contractor employees will not be permitted to drive personal vehicle onto the construction site. The Contractor shall provide transportation for all employees between the Contractor's storage and field office site and the work areas on the construction site.

IDENTIFICATION

The Contractor shall provide a Photo I.D. card for each employee. Each photo I.D. card shall be encapsulated in plastic and be provided with a clip for fastening to each employee's apparel. Each photo I.D. card shall be approximately 2 inches by 3 inches in size and shall include the following:

1. Employee photograph mounted on the left half of the card.

2. Name of employee and name of Contractor located on the right half of the card.

Each employee shall display the photo I.D. card on outer apparel at all times when on the plant site.

Any person found on the site without the required photo I.D. card will be directed to leave the site immediately.

The cost of construction, modification, maintenance, removal and restoration of all access facilities, and existing plant roads including excavation, backfilling, select fill material, paving material, grading, drainage and other such work, and all costs associated with limited access to the site, employee parking and transportation and photo I.D. cards, except as specified otherwise shall be included in the lump sum Contract Item for Structures and Equipment and no separate payment will be made therefor.

Use of Site for Storage

Space, on the site, for storage for the Contractor shall be as directed by the Engineer. Any structures or facilities needed for storage shall be constructed by the Contractor at his own expense and no separate payment will be made therefor. All security requirements for such facilities shall be provided and maintained by the Contractor.

Upon completion of the work, and as directed, the Contractor shall clean up the areas, remove any temporary facilities and finish grade as necessary, all as approved.

SAFETY:

A. Responsibility: Employees shall immediately report any unsafe work practice or unsafe condition to their supervisor(s). The Contractor is solely responsible for the safety of its workers, and shall comply with all applicable requirements [i.e.: 29 CFR 1910 -Occupational Safety and Health Standards, 29 CFR 1926 - Safety and Health

Regulations for Construction, etc] and industry safety standards while at the work site. The fact that City personnel may bring un-safe conditions to the attention of any member of the Contractor's work force does not relieve the Contractor of this responsibility.

All Contractors' employees and sub-contractors should be given a copy of SP-130.

The Contractor shall have a designated Safety Officer within its organization. At the Pre-Construction meeting, the Contractor shall provide the name and contact information of the Safety Officer to the Engineer.

At the Pre-Construction meeting, the Contractor will be given pertinent safety related information, necessary forms and instructions (i.e.: AWTP Lockout/Tagout Procedures, AWTP Hot Work Permits, etc.) that pertain to any work that might be utilized during the contract. The Contractor shall be responsible to disseminate that information to its employees and sub-contractors. Special care shall be taken by the Contractor to ensure that any new employee or sub-contractor to the work site shall be briefed on these safety instructions.

If warranted by the project and directed by the Engineer, the Contractor shall develop and implement a comprehensive health and safety plan for its employees that will cover all aspects of onsite construction operations and activities associated with the Contract. This plan must comply with all applicable health and safety regulations and any project specific requirements specified in the Contract.

B. Incident Reporting: All accidents that result in personal injury, illness or property damage shall be immediately reported and investigated, regardless of the extent of injury, illness or property damage. Employees must report accidents within one hour (or as soon as practical) from the time of occurrence to their immediate supervisor, who in turn will report it to the City's inspector. The City inspector will record the incident in the daily report and report it to the Risk Management Division (274-5708).

C. Air-Borne Debris: All personnel in proximity to drilling, sawing, sanding, scraping, spraying, power-washing or other work being done, either in enclosed spaces or in the open, that creates dust or air-borne debris shall wear eye protection [29 CFR 1910.133] and a respirator [29 CFR 1910.134].

D. Hot Work: All welding, soldering, brazing, acetylene cutting or any other work at the AWTP or any pump station that produces high temperatures shall require a AWTP "Hot Work Permit" and may require one or more fire watches. The number and location of fire watches (if any) shall be a condition of the Hot Work Permit. A current, portable, fully charged fire extinguisher shall be located with each person performing hot work and each fire watch. The Hot Work Permit shall be signed off by the appropriate personnel and maintained in the project file.

E. Confined Spaces: OSHA defines a confined space as having limited or restricted means for entry or exit, and is not designed for continuous employee occupancy. Confined spaces include, but are not limited, to vaults, tanks, manholes, wet-wells, pipelines, utility tunnels, etc.

The Contractor shall take measures [29 CFR 1910.146 I(5)] to ensure that atmospheric conditions in confined spaces are not hazardous to occupants. This can be accomplished by forcing a sufficient amount of clean air through the confined space and testing the atmosphere by using a portable certified, calibrated, atmosphere monitor that meets OSHA requirements [29 CFR 1910.146I(5)(ii)I]. The atmosphere monitor should record oxygen content, flammable gases and vapors and toxic air contaminants, such as the Industrial Scientific TMX-412.

F. Air-Borne Gases: The AWTP is located in an industrial area and, as such, there are several different substances, either on or off site, that can escape and become dangerous fumes, such as chlorine, methanol, anhydrous ammonia, etc. The AWTP currently has nine (9) Shelter In Place (SIP) locations that are designated as safe havens in the event of release of hazardous gases. These SIP's are stocked with necessary instructions and supplies to protect City and any Contractor's personnel.

The first day on site, City personnel will show all the Contractor's personnel present where the several closest SIP's are located, explain the alarm signals and provide the current alarm testing schedule. It shall be the Contractor's

responsibility to show any future employee and/or sub-contractor that comes on site the location of the SIP's and explain the alarm signals.

In the event of an alarm, the Contractor's personnel shall immediately and hastily proceed to the nearest SIP along with the City personnel and remain there until further notice, taking guidance from and following the instruction of the senior City employee present.

G. Lockout / Tagout Policy: The AWTP Lockout / Tagout program is designed to set standards to help safeguard all employees from hazardous electrical or mechanical energy while they are performing service or maintenance on machines and equipment at the AWTP or any pump station. This program will also identify the practices and procedures to shut down and Lockout or Tagout machines and equipment. The Contractor shall be given a copy of the AWTP "LOCKOUT / TAGOUT POLICY AND PROCEDURES" instruction and shall make all of his employees and sub-contractors aware of this program.

No padlock (lockout) shall be removed except by the individual that installed it or, if not available, by a City of Tampa AWTP team leader.

No tag (tagout) shall be removed except by the individual who installed it or, if not available, by a City of Tampa AWTP team leader, except in an Emergency when the tag states "Do Not Use Unless in an Emergency". In that event, the Contractor shall notify the City of Tampa AWTP team leader who will prepare the necessary follow up report.

H. Trench Safety: Any excavation deeper than four (4) feet shall adhere to the requirements contained in 29 CFR 1926.650 thru 652 and the Florida Trench Safety Act [Florida Statutes, ss 553.60 – 553.64].

I. Open Flames: No fires shall be allowed. No open flames necessary for any construction activity shall ever be left un-attended. A current, portable, fully charged fire extinguisher shall be located with each activity requiring an open flame.

J. Sparks: Any activity lasting more than 10 continuous minutes that creates sparks, such as grinding or chipping, shall have a dedicated fire watch in attendance. A current, portable, fully charged fire extinguisher shall be located with each activity creating sparks, regardless if a fire watch is required or not.

K. First Aid: The Contractor shall furnish appropriate First Aid Kits [29 CFR 1910.151] and shall be responsible to ensure its employees are properly trained to render first aid. If injurious corrosive materials are to be utilized, eye wash and body wash facilities must be provided in the immediate area.

L. Related Costs: All costs associated with these, or any safety measures shall be included in the total lump sum contract price or the various contract item unit prices, as applicable, and no separate payment shall be made therefor.

Tampa Port Authority Access

The Tampa Port Authority has restricted access in accordance with Florida Statute 311.12. Procedures for Tampa Port Authority access are located at http://www.tampaport.com/port-operations/security . All costs to comply with these procedures shall be included in the total Price for this project, and no separate payment shall be made therefor.

Sequence of Work

A. The work within Train 1 can be completed with the basin out of service unless otherwise noted.

B. The air headers that serve the various zones within the basin also provide air to the remaining trains. The air headers shall remain in service at all times except as follows:

1. Each air header may be isolated by closing the corresponding isolation valve temporarily such that the connections at the drop legs can be completed as shown in the drawings.

# SECTION 01390

# PRE-CONSTRUCTION AUDIO VIDEO

## PART 1 - GENERAL

### 1.01 DESCRIPTION

A. Scope of Work: Prior to commencing work, the Contractor shall have a continuous color audio-video DVD recording taken along the entire length of the Project and at all proposed construction sites within the Project area to serve as a record of pre-construction conditions.

### 1.02 QUALITY ASSURANCE

A. The Contractor shall engage the services of a professional electrographer. The color audio-video DVDs shall be prepared by a responsible commercial firm known to be skilled and regularly engaged in the business or preconstruction color audio-video DVD documentation.

B. The electrographer shall furnish to the Engineer a list of all equipment to be used for the audio-video taping, i.e., manufacturer's name, model number, specifications and other pertinent information.

C. Additional information to be furnished by the electrographer is the names and addresses of two references that the electrographer has performed color audio-video taping for, on projects of a similar nature, within the last 12 months.

D. Owner’s Representative must be present during filming. Provide Owner five (5) days notice prior to start of filming.

E. No construction shall begin prior to review and approval of the DVDs covering the construction area by the Owner and Engineer. The Engineer shall have the authority to reject all or any portion of a video DVD not conforming to specifications and order that it be redone at no additional charge.

F. The Contractor shall reschedule unacceptable coverage within five (5) days after being notified. The Engineer shall designate those areas, if any, to be omitted from or added to the audio-video coverage.

G. DVD recordings shall not be made more than ninety (90) days prior to construction in any area. All DVDs and written records shall become property of Owner.

## PART 2 - PRODUCTS

### 2.01 AUDIO-VIDEO DVDS

A. Audio-video DVDs shall be new. Reprocessed DVDs will not be acceptable.

## PART 3 - EXECUTION

### 3.01 EQUIPMENT

A. All equipment, accessories, materials and labor to perform this service shall be furnished by the Contractor.

B. 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.

C. When conventional wheeled vehicles are used, the distance from the camera lens to the ground shall not be more than ten (10) feet. In some instances, audio-video DVD coverage may be required in areas not accessible by conventional wheeled vehicles. Such coverage shall be obtained by walking or-special conveyance provided by the Contractor.

D. The color video camera used in the recording system shall have a horizontal resolution of 350 lines at center, a luminance signal to noise ratio of 45 dB and a minimum illumination requirement of one (1) foot candle.

### 3.02 RECORDED INFORMATION - AUDIO

A. Each DVD shall begin with the current date, project name and municipality and be followed by the general location, i.e., viewing side and direction of progress. The audio track shall consist of an original live recording. The recording shall contain the narrative commentary of the electrographer, recorded simultaneously with his fixed elevation video record of the zone of influence of construction.

B. The Owner and Engineer reserves the right to supplement the audio portion of the taping as deemed necessary. A representative of the Owner or Engineer shall be selected to provide such narrative.

3.03 RECORDED INFORMATION - VIDEO

A. All video recordings shall, by electronic means, display on the screen the time of day, the month, day and year of the recording. This time and date information must be continuously and simultaneously generated with the actual recording.

B. Each video DVD shall have a log of that video DVD's contents. The log shall describe the various segments of coverage contained on that video DVD in terms of the names of streets or easements, coverage beginning and end, directions of coverage, video unit counter numbers, engineering stationing numbers and the date.

3.04 LIGHTING

A. All audio-video shall be done during time of good visibility. No recording 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.

3.05 SPEED OF TRAVEL

A. The rate of speed in the general direction of travel of the vehicle used during recording shall not exceed 44 feet per minute. Panning, zoom-in and zoom-out rates shall be sufficiently controlled to maintain a clear view of the object.

3.06 AREA OF COVERAGE

A. 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, ditches, mailboxes, landscaping, culverts, fences, signs, and headwalls within the area covered.

END OF SECTION

# SECTION 01650

# START-UP AND DEMONSTRATION

## PART 1 - GENERAL

### 1.01 DESCRIPTION

A. Scope of Work: Demonstrate to Owner and Engineer that the Work functions as a complete and operable system under normal and emergency operating conditions.

B. Contractor shall provide all materials, personnel, equipment and expendables as needed and as specified to perform the required start-up and demonstration tests.

C. Related Work Described Elsewhere:

1. Operating and Maintenance Data: Section 01730.

2. Equipment: Division 11.

3. Special Construction: Division 13.

4. Mechanical: Division 15.

5. Electrical: Division 16.

## PART 2 - PRODUCTS

### 2.01 START-UP PLAN

A. Submit for approval by the Engineer a detailed start-up plan outlining the schedule and sequence of all tests and start-up activities, including submittal of checkout forms, submittal of demonstration test procedures, start-up, demonstration and testing, submittal of certification of completed demonstration and training. Start-up and commissioning may not begin until the plan is approved by the Engineer.

## PART 3 - EXECUTION

### 3.01 COMPONENT TEST AND CHECK-OUT

A. Start-up Certification: Prior to system start-up, successfully complete all the testing required of the individual components of the Work. Submit six (6) copies of check out forms for each individual component or piece of equipment, signed by the Contractor or the subcontractor and the manufacturer's representative. All copies of the Operation and Maintenance Manuals must be provided before start-up may begin. These forms shall be completed and submitted before Instruction in Operation to Owner or a request for initiating any final inspections. Insert one (1) copy of this form into the applicable section of each Operation and Maintenance Manual.

B. Demonstrate to the Engineer and the Owner's representative, that all temporary jumpers and/or bypasses have been removed and that all of the components are operating under their own controls as designated.

C. Coordinate start-up activities with the Owner's operating personnel at the treatment plant site and with the Engineer prior to commencing system start-up.

### 3.02 START-UP

A. Confirm that all equipment is properly energized, that the valves are set to their normal operating condition and that the flow path through the new Work is unobstructed.

B. Slowly fill each hydrostatic structure in the process flow stream with water.

C. Initiate start-up and training in accordance with and with the use of the plant operation and maintenance manuals.

D. Observe the component operation and make adjustments as necessary to optimize the performance of the Work.

E. Coordinate with Owner for any adjustments desired or operational problems requiring debugging.

F. Make adjustments as necessary.

### 3.03 START-UP DEMONSTRATION AND TESTING

A. After all Work components have been constructed, field tested, and started up in accordance with the individual Specifications and manufacturer requirements, and after all Check-Out Forms have been completed and submitted, perform the Start-

Up Demonstration and Testing. The demonstration period shall be held upon completion of all systems at a starting date to be agreed upon in writing by the Owner or his representative. Prior to beginning the start-up demonstration testing, the Contractor shall submit a detailed schedule of operational circumstances for approval by the Engineer. The schedule of operational circumstances shall describe, in detail, the proposed test procedures for each piece of equipment. Provide similar test procedure forms for each piece of equipment or section of the Work to include all particular aspects and features of that equipment or section of the Work and as specified in the Technical Sections of the Specifications.

B. The Start-Up Demonstration Testing will be conducted for five (5) consecutive days. The Work must operate successfully during the five (5) day testing period in the manner intended. If the Work does not operate successfully, or if the start-up is interrupted due to other contracts, the problems shall be corrected and the test shall start over from day one. The party causing the interruption shall be subject to the assessment of actual damages due to delay.

C. During the start-up demonstration period, operate the Work, instruct designated plant operating personnel in the function and operation of the Work, and cause various operational circumstances to occur. As a minimum, these circumstances will include average and peak daily flows, random equipment or process failures, interlocks and bypasses. Demonstrate the essential features of the equipment and its relationship to other equipment. The approved schedule of operational circumstances and demonstration test procedures will be used as the agenda during the Start-Up Demonstration Testing period for all equipment and sections of the Work. Coordination of the demonstration test schedule will be accomplished through the Engineer.

D. Acceptability of the Work's performance will be based on the Work performing as specified under these actual and simulated operating conditions, to provide water treatment facilities functioning as intended and as defined in the Contract Documents. The intent of the start-up demonstration and testing is for the Contractor to demonstrate to the Owner and the Engineer that the Work will function as a complete and operable system under normal, as well as emergency operating conditions, and is ready for final acceptance.

E. Demonstrate the essential features of all the mechanical systems including, but not limited to, the following as they apply to the Work. Each system shall be demonstrated once only, after completion of testing.

1. Submersible Horizontal Propeller Pumps (Pumps, VFDs and Controls)

2. Propeller Mixers

3. Diffused Aeration System

4. Motor Operated Butterfly Valves
5. Mass Airflow Meters

F. Demonstrate the essential features of all electrical and instrumentation systems including, but not limited to, the following as they apply to the work:

1. Electrical systems controls and equipment.

2. Panelboards.

3. Wiring devices.

G. Upon successful completion of the Start-up, Demonstration and Testing, the Owner's personnel will receive the specified training for each system. Training of the Owner's personnel will not be considered valid unless it takes place using a system that has successfully passed the Start-up, Demonstration and Testing.

H. Upon completion of all specified operator training, the Contractor shall submit to the Engineer six (6) copies of the Certificate of Completed Demonstration Form, for each item of equipment or system in the Work, signed by the Contractor, Subcontractor, Engineer, and the Owner. Insert one (1) copy of this form in the applicable section of each Operation and Maintenance Manual. Samples of the Check Out Form and Certificate of Completed Demonstration Form are provided at the end of this Section.

CHECK OUT FORM

| | | | | | |
|---|---|---|---|---|---|
| [] | OWNER | City of Tampa | No. Copies | ____ | CHECK-OUT |
| [] | ENGINEER: | Tetra Tech | No. Copies | ____ | MEMO NO. _____ |
| [] | ARCHITECT: | _____ | No. Copies | ____ | |
| [] | CONTRACTOR: | _____ | No. Copies | ____ | |
| [] | FIELD: | _____ | No. Copies | ____ | |
| [] | OTHER: | _____ | No. Copies | ____ | |

**PROJECT DATA**

NAME: _____
LOCATION: _____
OWNER: _____
OTHER: _____

CONTRACT DATA

NUMBER: _____
DATE: _____
DRAWING NO: _____
SPECIFICATION SECTION: _____

Name of equipment checked:

Name of manufacturer of equipment:

1. The equipment furnished by us has been checked on the job by us. We have reviewed, where applicable, the performance verification information submitted to us by the Contractor.

2. The equipment is properly installed, except for items noted below.*

3. The equipment is operating satisfactorily, except for items noted below.*

4. The written operating and maintenance information, where applicable, has been presented to the Contractor, and been discussed with him in detail. Five (5) copies of all applicable operating and maintenance information and parts lists have been furnished to him.

Checked By:

_____ Name of Manufacturer's Rep.

_____ Address and Phone # of Rep.

_____ Sig./Title/Pers. Making Chk.

_____ Date Checked

_____ Name of General Contractor

_____ Authorized Sig./Title/Date

_____ Name of Subcontractor

_____ Authorized Sig./Title/Date

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

_____

_____

_____

_____

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

_____

_____

_____

_____

CERTIFICATE OF COMPLETED DEMONSTRATION FORM

| | | | | | | |
|---|---|---|---|---|---|---|
| [] | OWNER | City of Tampa | No. Copies | ____ | CERTIFICATE |
| [] | ENGINEER: | Tetra Tech | No. Copies | ____ | OF COMPLETED |
| [] | ARCHITECT: | _____ | No. Copies | ____ | DEMONSTRATION |
| [] | CONTRACTOR: | _____ | No. Copies | ____ | MEMO NO. _____ |
| [] | FIELD: | _____ | No. Copies | ____ | |
| [] | OTHER: | _____ | No. Copies | ____ | |

**PROJECT DATA**

NAME: _____
LOCATION: _____
OWNER: _____
OTHER: _____

CONTRACT DATA

NUMBER: _____
DATE: _____
DRAWING NO: _____
SPECIFICATION SECTION: _____

NOTE TO CONTRACTOR:

Submit five (5) copies of all information listed below for checking at least one (1) week before scheduled demonstration of the Work. After all information has been approved by the Engineer, give the Owner a Demonstration of Completed Systems as specified and have the Owner sign five (5) copies of this form. After this has been done, a written request for a final inspection of the system shall be made.

MEMORANDUM:

This memo is for the information of all concerned that the Owner has been given a Demonstration of Completed Systems on the work covered under this Specification Section. This conference consisted of the system operation, a tour on which all major items of equipment were explained and demonstrated, and the following items were given to the Owner:

(a) Owner's copy of Operation and Maintenance Manual for equipment or systems specified under this Section containing approved submittal sheets on all items, including the following:

(1) Maintenance information published by manufacturer on equipment items.

(2) Printed warranties by manufacturers of equipment items.

(3) Performance verification information as recorded by the Contractor.

(4) Check-Out Memo on equipment by manufacturer's representative.

(5) Written operating instructions on any specialized items.

(6) Explanation of guarantees and warranties on the system.

(b) Prints showing actual "As-Built" conditions.

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

_____
(Name of General Contractor)

By: _____
(Authorized Signature, Title and Date

_____
(Name of Subcontractor)

By: _____
(Authorized Signature, Title and Date

Operation and Maintenance Manuals, Instruction Prints, Demonstration and Instruction in Operation Received:

_____
(Name of Owner)

By: _____
(Authorized Signature/Title/Date

END OF SECTION

# SECTION 01720

# PROJECT RECORD DOCUMENTS

## PART 1 - GENERAL

### 1.01 DESCRIPTION

A. Scope of Work: Maintain at the site for the Owner one (l) record copy of:

1. Drawings.
2. Specifications.
3. Addenda.
4. Change Orders and other modifications of the Contract.
5. Engineer's Field Orders or written instructions.
6. Approved Shop Drawings, Working Drawings and Samples.
7. Field test records.

### 1.02 MAINTENANCE OF DOCUMENTS AND SAMPLES

A. Store documents and samples in Contractor's field office apart from documents used for construction.

1. Provide files and racks for storage of documents.
2. Provide locked cabinet or secure storage space for storage of samples.

B. File documents and samples in accordance with CSI format with section numbers as provided herein.

C. Maintain documents in a clean, dry, legible, condition and in good order. Do not use record documents for construction purposes.

D. Make documents and samples available at all times for inspection by the Engineer or the Owner.

E. As a prerequisite for monthly Progress payments, the Contractor is to exhibit the currently updated "Record Documents" for review by the Engineer and Owner. Payment may be withheld if record documents are not satisfactorily maintained.

1.03 MARKING DEVICES

A. Provide felt tip marking pens for recording information in the color code designated by the Engineer.

1.04 RECORDING

A. Label each document "PROJECT RECORD" with a rubber stamp having one (1) inch high letters.

B. Record information concurrently with construction progress.

1. Do not conceal any work until required information is recorded.

C. Drawings: Legibly and clearly mark, to scale, each drawing to record actual construction:

1. Location of internal utilities and appurtenances concealed in the construction, referenced to visible and accessible features of the structure.

2. Field changes of dimension and detail.

3. Changes made by Field Order or by Change Order.

4. Details not on original Contract Drawings.

5. Equipment and piping relocations.

D. Specifications and Addenda: Legibly mark each section to record:

1. Manufacturer, trade name, catalog number of Supplier of each product and item of equipment actually installed.

2. Changes made by Field Order or by Change Order.

E. Shop Drawings (Prior to substantial completion): Provide six (6) sets of Draft Record Drawings as shop drawings for review. As-built drawings will be certified by both Project Surveyor and Contractor to certify the accuracy of the documents.

F. Record Drawings shall be submitted electronically in AutoCAD format and PDF in addition to all hard copies.

1.05 SUBMITTAL

A. At Contract closeout, deliver Final Record Documents to the Engineer for the Owner including:

1. Six (6) sets of hard copies of Final Record Drawings signed and certified by Contractor and Surveyor.

2. A CD containing an AutoCad and PDF of the Final Record Drawings.

B. Accompany submittal with transmittal letter in duplicate, containing:

1. Date.

2. Project title and number.

3. Contractor's name and address.

4. Title and number of each Record Document.

5. Signature of Contractor or his authorized representative.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED

END OF SECTION

# SECTION 01730

# OPERATING AND MAINTENANCE DATA

## PART 1 - GENERAL

### 1.01 DESCRIPTION

A. Scope of Work:

1. Compile product data and related information appropriate for Owner's maintenance and operation of products furnished under Contract.

   a. Prepare operating and maintenance data as specified in this Section and as referenced in other pertinent sections of Specifications.

2. Instruct Owner's personnel in maintenance of products and in operation of equipment and systems.

### 1.02 QUALITY ASSURANCE

A. Preparation of data shall be done by personnel:

1. Trained and experienced in maintenance and operation of described products.

2. Familiar with requirements of this Section.

3. Skilled as technical writer to the extent required to communicate essential data.

4. Skilled as draftsman competent to prepare required drawings.

### 1.03 FORM OF SUBMITTALS

A. Prepare data in form of an instructional manual for use by Owner's personnel.

B. Format:

1. Size: 8-1/2 inches x 11 inches.

2. Paper: 20 pound minimum, white, for typed pages.

3. Text: Manufacturer's printed data, or neatly typewritten.

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 14 inches x 17 inches.

5. Provide fly-leaf for each separate product, or each piece of operating equipment.

a. Provide typed description of projects and major component parts of equipment.

b. Provide identified tabs.

6. Cover: Identify each volume with typed or printed title "OPERATING AND MAINTENANCE INSTRUCTIONS". List:

a. Title of Project.

b. Identity of separate structure as applicable.

c. Identity of general subject matter covered in the manual.

C. Binders:

1. Commercial quality , three D-ring type binders with durable and cleanable white plastic covers. Binders shall be presentation type with clear vinyl covers on front, back and spine. Binders shall include two sheet lifters and two, horizontal inside pockets.

2. Maximum D-ring width: 2 inches.

3. When multiple binders are used, correlate the data into related consistent groupings.

D. The CONTRACTOR shall also submit electronic copies in PDF format of each O&M manual. Files shall be readable using Adobe Acrobat Reader version 7.0.

1.04 CONTENT OF MANUAL

A. Neatly typewritten table of contents for each volume, arranged in systematic order.

1. Contractor, name of responsible principal, address and telephone number.

2. A list of each product required to be included, indexed to content of the volume.

3. List, with each product, name, address and telephone number of:

    a. Subcontractor, manufacturer and installer name, addresses and telephone numbers.

    b. A list of each product required to be included, indexed to content of the volume.

    c. Identify area of responsibility of each.

    d. Local source of supply for parts and replacement equipment including name, address and telephone number.

4. Identify each product by product name and other identifying symbols as set forth in Contract Documents.

B. Product Data:

1. Include only those sheets which are pertinent to the specific product.

2. Annotate each sheet to:

    a. Clearly identify specific product or part installed.

    b. Clearly identify data applicable to installation.

    c. Delete references to inapplicable information.

3. Operation and maintenance information as herein specified.

4. Record shop drawings as submitted and approved with all corrections made for each product.

C. Drawings:

1. Supplement product data with drawings as necessary to clearly illustrate:

    a. Relations of component parts of equipment and systems.

    b. Control and flow diagrams.

2. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.

3. Do not use Project Record Documents as maintenance drawings.

D. Written test, as required to supplement product data for the particular installation:

1. Organize in consistent format under separate headings for different procedures.

2. Provide logical sequence of instruction of each procedure.

E. Copy of each warranty, bond and service contract issued.

1. Provide information sheet for Owner's personnel, give:

a. Proper procedures in event of failure.

b. Instances which might affect validity of warranties or bonds.

1.05 MANUAL FOR MATERIALS AND FINISHES

A. Submit six (6) copies of complete manual in final form.

B. 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 reordering special manufacturing 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 which are detrimental to product.

c. Recommended schedule for cleaning and maintenance.

C. Content, for moisture protection 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.

D. Additional requirements for maintenance data: Respective sections of Specifications.

1.06 MANUAL FOR EQUIPMENT AND SYSTEMS

A. Submit six (6) copies of complete manual in final form.

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. Summary of information listed on equipment and motor data plates.

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.

3. Maintenance procedures:

a. Routine operations.

b. Guide to "trouble-shooting".

c. Disassembly, repair and reassembly.

d. Alignment, adjusting and checking.

4. Servicing and lubrication required.

5. Manufacturer's printed operating and maintenance instructions.

6. Description of sequence of operation by control manufacturer.

7. 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 by controls manufacturer.

9. Each Contractor's coordination drawings.

    a. As-installed color coded piping diagrams.

10. Charts of valve tag numbers, with location and function of each valve.

11. List of original manufacturer's spare parts, manufacturer's current prices and recommended quantities to be maintained in storage.

12. Other data as required under pertinent sections of specifications.

13. Approved record shop drawings with all corrections made, and a copy of the warranty statement, checkout memo, demonstration test procedures and demonstration test certification.

C. Content, for each electric and electronic systems, as appropriate:

1. Description of system 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.

2. Circuit directories and panelboards.

    a. Electrical service.

    b. Controls.

c. Communications.

3. As installed color coded wiring diagrams.

4. Operating procedures:

a. Routine and normal operating instructions.

b. Sequences required.

c. Special operating instructions.

5. Maintenance procedures:

a. Routine operations.

b. Guide to "trouble-shooting".

c. Disassembly, repair and reassembly.

d. Adjustment and checking.

6. Manufacturer's printed operating and maintenance instructions.

7. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.

8. Other data as required under pertinent sections of specifications.

D. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.

E. Additional requirements for operating and maintenance data: Respective sections of Specifications.

1.06 ASSET DATA SHEET

A. The final version of the Asset Data Sheet shall be provided with the final version of the O&M manual for each piece of equipment.

1.07 SUBMITTAL SCHEDULE

A. Submit two (2) copies of <u>preliminary draft</u> of proposed formats and outlines of contents of Operation and Maintenance Manuals within 90 days after Notice to Proceed.

B. Submit two (2) copies of completed data in preliminary form no later than 20 days following Engineer's review of the last shop drawing of a product and/or other

submittal, but no later than delivery of equipment. One (1) copy will be returned with comments to be incorporated into the final copies and the other copy will be retained on-site for use in any early training.

C. Submit six (6) hard copies and one (1) electronic copy of approved manual in final form directly to the offices of the Engineer, Tetra Tech, within 10 days after the reviewed copy or last item of the reviewed copy is returned.

D. Provide six (6) hard copies and one (1) electronic copy of addenda to the operation and maintenance manuals as applicable and certificates as specified within 30 days after final inspection.

1.08 INSTRUCTION OF OWNER'S PERSONNEL

A. Prior to demonstration test, fully instruct Owner's designated operating and maintenance personnel in operation, adjustment and maintenance of products, equipment and systems.

B. Operating and maintenance manual shall constitute the basis of instruction. Review contents of manual with Owner's operating and maintenance personnel in full detail to explain allT aspects of operations and maintenance.

C. Instructors shall be fully qualified personnel as outlined within the individual equipment specifications. If no specific training specifications are listed with the equipment, the Contractor shall provide the instruction with qualified Contractor personnel.

D. The Contractor shall provide a list to the Owner indicating the date, time and instructors that will be present for all training sessions.

E. The instructors shall provide for and prepare lesson scopes and handouts for up to five individuals designated by the Owner that outline the items to be covered. Separate sessions for operation and maintenance instruction shall be provided consecutively. Handouts shall be submitted to the Owner with at least one week's notice prior to the training sessions.

F. All instruction sessions shall be recorded with portable recording cameras and DVDs supplied by the Contractor. Recording shall be made by the Contractor under the direction of the Owner using DVD compatible recording equipment.

**Table 01730-A**
**Required O&M Manuals**

| Specification Section | Equipment |
|---|---|
| 09900 | Painting |
| 11209 | Submersible Horizontal Propeller Pumps |
| 11225 | Propeller Mixer |
| 11376 | Fine Bubble Diffused Aeration System |
| 13615 | Instrumentation and Control Systems |
| 13630 | Dissolved Oxygen Process Measurement Devices |
| 13635 | Ph Level Process Measurement Devices |
| 13640 | Total Suspended Solids Process Measurement Devices |
| 13645 | Dual Ammonium and Nitrate Process Measurement Devices |
| 13650 | Ammonium Process Measurement Devices |
| 13655 | Nitrate Process Measurement Devices |
| 14610 | Manual Davit Crane |
| 15050 | Butterfly Valves |
| 15050 | Motor Operated Actuators |
| 15050 | Check Valves |

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

# SECTION 02050

# DEMOLITION AND MAINTENANCE OF SERVICE DURING CONSTRUCTION

## PART 1 - GENERAL

### 1.01 DESCRIPTION

A. Scope of Work:

1. This Section includes furnishing all labor, materials, permits, notifications, equipment and incidentals required for the demolition and disposal of all materials and equipment designed for removal. Demolition includes all work necessary for the removal and disposal of masonry, steel, reinforced concrete, plain concrete, wastewater equipment, piping, electrical facilities, and any other material or equipment shown or specified to be removed. Such materials and equipment include mixers, pipe, valves, aeration equipment, supports, pull boxes, conduits, wiring, and other related appurtenances. Dust control shall be provided and provision made for safety.

2. These Specifications call attention to certain activities necessary to maintain and facilitate operation during and immediately following construction and do not purport to cover all of the activities necessary. The Contractor shall exercise due care to maintain continuous operation of the existing facilities and minimize operation inconvenience. In accordance with this requirement, a Demolition and Removal Plan shall be developed in accordance with Paragraph 1.06 and Paragraph 3.02.

3. Demolition includes, but is not limited to:

   a. Removal of piping, valves, mechanical equipment, electrical components, and various appurtenances associated with the existing treatment structure as shown on the Drawings and specified herein.

   b. Disposal of nonsalvageable material.

4. The Contractor shall examine the Contract Documents, visit the project site and determine the extent of the work affected therein, and all conditions under which the work will be performed. The Contractor shall visit the site and inspect all existing structures. Special care shall be taken to observe and record any defects, which may exist in buildings or structures adjacent to but not directly affected by the demolition work.

Prior to commencing the demolition, the Contractor shall provide the Engineer with a copy of this inspection.

Drawings of existing structures and equipment will be available for inspection by the Contractor at the office of the Engineer and Owner.

5. Demolition shall be carried out in such a manner that adjacent structures, which are to remain, shall not be endangered. The work shall be scheduled so as not to interfere with the day to day operation of the existing facilities. Doorways or passageways in existing facilities shall not be blocked.

1.02 PERMITS AND NOTICES

A. Permits and Licenses: Contractor shall obtain all necessary permits and licenses for performing the work and shall furnish a copy of same to the Owner prior to commencing the Work. The Contractor shall comply with the requirements of the permits.

B. Notices: Contractor shall issue written notices of planned demolition to companies or local authorities owning utility conduit, wires or pipes running to or through the project site. Copies of said notices shall be submitted to the Engineer.

C. Utility Services: Contractor shall notify utility companies or local authorities furnishing gas, water, electrical, telephone, cable television, or sewer service to remove any equipment owned by them in structures to be demolished and to remove, disconnect, cap, or plug their services to facilitate demolition.

1.03 CONDITIONS AND STRUCTURES

A. Conditions existing at the time of inspection for bidding purposes will be maintained by the Owner insofar as practicable, however, minor variations within the structure may occur prior to the start of demolition work.

1.04 RULES AND REGULATIONS

A. The Florida Building Code and applicable codes shall control demolition, modification, or alteration of the existing buildings or structures.

B. The use of explosives will not be permitted. The Contractor shall not bring or store any explosives on site.

1.05 DISPOSAL OF MATERIAL

A. Salvageable material shall become the property of the Owner, if the Owner requests any specific item. The Contractor shall dismantle all the materials to

such a size that they can be readily handled, and deliver any of the salvageable materials requested by the Owner to a designated storage area on-site, as directed by the Owner.

B. The following examples are the types of material of which the Owner may maintain ownership:

1. Stainless steel pipe.

2. Valves greater than 3 inches in diameter.

C. Any material that the Owner rejects shall become the Contractor's property and must be removed from the site.

D. Concrete, concrete block, and unsalvageable bricks shall be hauled to a waste disposal site by the Contractor. Care shall be taken to assure that concrete shall be broken and removed in reasonably small masses. Where only parts of a structure are to be removed, the concrete shall be cut along limiting lines with a specially designed saw so that damage to the remaining structure is held to a minimum.

E. The storage of or sale of removed items on the site will not be allowed.

1.06 SUBMITTALS

A. Submit to the Engineer at least sixty (60) days prior to beginning demolition work on the existing facility, five (5) copies of the proposed Demolition and Removal Plan for the structures and modifications as shown on the Drawings or as specified herein prior to the start of Work. Include a detailed schedule showing the coordination of bypassing, shutoff, capping and continuation of utility service as required. The Demolition and Removal Plan shall include as a minimum, the following:

1. A detailed sequence of demolition and removal work to ensure the continued maintenance of wastewater service and compliance with regulatory agency requirements, as well as the expeditious completion of the Contractor's work.

2. A list of all activities, including Owner activities, bypass activities and shutdowns, required to complete the work.

3. Evidence (by signature) of approval of the Owner's plant operator of the work plan.

4. The sequence of demolition and renovation of existing facilities shall be in accordance with the approved Demolition and Removal Plan as specified

in this Section. The Contractor is solely responsible for construction and demolition sequencing of the Work.

B. Before commencing demolition work, all modifications necessary to bypass the affected structure will be completed. Contractor shall coordinate with the Owner's personnel to determine the locations of the affected equipment, valves and fittings.

C. The above procedure must be followed for each individual demolition operation.

1.07 TRAFFIC AND ACCESS

A. Conduct demolition and modification operations, and the removal of equipment and debris to ensure minimum interference with roads, streets, and sidewalks both on-site and off-site and to ensure minimum interference with occupied or used facilities.

B. Contractor shall at all times maintain safe and convenient access to the existing site.

C. Do not close or obstruct streets or walks without permission from the Owner and Engineer. Provide alternate traffic routes around closed or obstructed access ways.

D. Special attention is directed towards maintaining safe and convenient access to the existing facilities remaining in service by plant personnel and plant associated vehicles. Relocation of the Contractor's materials, labor, or equipment due to uncoordinated interruption will be at the Contractor's expense.

1.08 DAMAGE

A. Promptly repair damage caused to adjacent facilities by demolition operations at no cost to the Owner.

1.09 UTILITIES

A. Maintain existing utilities to remain in service and protect against damage during demolition operations.

B. Do not interrupt existing utilities serving occupied or used facilities, except when authorized by the Owner and the Engineer. Provide temporary service during interruptions to existing utilities as acceptable to the Owner.

C. The Contractor shall cooperate with the Owner to shut off utilities serving structures as required by demolition operations.

D. The Contractor shall be solely responsible for making all necessary arrangements and for performing any necessary work involved in connection with the discontinuance or interruption of all public and private utilities or services under the jurisdiction of the utility companies.

E. All utilities being abandoned shall be disconnected and terminated at the service mains in conformance with the requirement of the utility companies or the municipality owning or controlling them.

1.10 POLLUTION CONTROL

A. Dust control shall be provided and provisions for safety shall be made.

B. For pollution control, use water sprinkling, temporary enclosures, and other suitable methods as necessary to limit the amount of dust and dirt rising and scattering in the air to the lowest level of air pollution practical for the conditions of work. Comply with the governing regulations.

C. Take all necessary measures and means to provide dust, dirt, debris and paint abatement methods to prevent damage to surrounding properties, on-site structures, and private property.

D. Clean on-site structures and improvements of all dust, dirt and debris caused by demolition operations as directed by the Engineer. Clean or repair all off-site property as shown on the Drawings and specified herein. Return areas to conditions existing prior to the start of work.

1.11 QUALITY CONTROL

A. Protect all existing materials and equipment to be salvaged or reused from damage.

B. No above-ground pipes, junction boxes, conduits, or wires are to be left abandoned.

C. Leave all exposed ends of all pipe and conduit or junction boxes covered and safe.

PART 2 – PRODUCTS (NOT USED)

## PART 3 – EXECUTION

### 3.01 GENERAL

A. The Contractor shall have a basic understanding of the operation of the existing wastewater treatment plant (WWTP) before preparation of the Demolition and Removal Plan to maintain plant operation and reliability during the demolition process. The following paragraphs provide a brief description of the existing plant processes.

B. During construction of the new facilities and alterations to the existing treatment facilities, the Owner will be responsible for facility operations. The plant operating staff will be responsible for the operation and maintenance of all existing facilities (i.e., tanks, buildings, etc.) until they are taken over by the Contractor for demolition, deactivation, renovation, etc.

C. In order to provide uninterrupted wastewater service, the Contractor shall provide temporary piping and/or pumping facilities as necessary to complete the work. The design of such systems shall be the responsibility of the Contractor, however, such systems shall be subject to the requirements set forth in this Section and to approval by the Engineer. If the Contractor's operations disrupt the treatment process, except for such brief periods as expressly permitted and required, the Contractor shall immediately make all repairs and replacements and do all work necessary to restore the plant to operation to the satisfaction of the Engineer at no additional cost to the Owner. Such work shall progress continuously to completion on a 24-hour per day, 7-day per week basis. The Contractor shall provide the services of emergency repair crews on call 24 hours per day.

### 3.02 MAINTENANCE OF SERVICE AND SEQUENCING

A. The proposed improvements have been designed so that the existing WWTP can remain in operation and in compliance with regulatory agency requirements throughout the construction period. This will necessitate a careful sequencing of the various work activities and provision of some temporary facilities that may include pumps, piping, line stops, sandbags, generator sets, wiring, controls, and other items. The purpose of this Paragraph is to generally describe a suggested methodology for achieving continuous wastewater service, however, other methodologies, subject to approval by the Owner, may also be acceptable. It is not the intent of this Section to list each and every detail of the temporary operation plan or to set forth a rigid schedule for the sequence of work. The Contractor shall review the requirements stated herein, fully inspect the existing facilities, determine the labor and equipment needs, and develop the submittal required under Paragraph 1.06 of this Section and, subsequently, perform the work in accordance with the approved submittals.

B. Existing Wastewater Treatment Plant: The existing treatment facilities must stay online until all new facilities are completed, tested and ready to be brought in to service, except as noted in Specification 01100, Special Project Procedures.

3.03 REMOVAL OF EXISTING PROCESS EQUIPMENT, PIPING, AND APPURTENANCES

A. Subject to the constraints of maintaining the existing plant in operation, existing equipment, non-buried valving and piping, and appurtenances not necessary for the operation of the new facility shall be removed as shown or indicated on the Drawings.

B. All equipment, piping, and appurtenances shall be cleaned, flushed, and drained. Equipment to be retained by the Owner as specified in Paragraph 1.05 above shall be dismantled sufficiently to permit thorough cleaning and draining. All valves shall be left open.

3.04 MISCELLANEOUS CONCRETE SLABS, ROADWAYS AND SIDEWALKS

A. Remove concrete slabs, roadways and sidewalks where shown on the Drawings or where necessary for the construction of the new structures or modifications of existing structures. All concrete sidewalks and curbing not required after the new plant is in operation shall be removed and disposed of as specified herein.

3.05 REQUIREMENTS PRIOR TO DEMOLITION

A. Warning signs, protection barriers and red warning lights shall be provided as necessary adjacent to the work as approved by the Engineer and shall be maintained during the demolition period.

B. Demolition work shall not be undertaken until all mechanical and electrical services affected by the work have been properly disconnected. Interconnecting piping or electrical services that are to remain in service either permanently or temporarily shall be capped, rerouted or reconnected in a manner that will not interfere with the operation of the remaining facilities.

3.06 REQUIREMENTS DURING DEMOLITION

A. All mechanical and electrical equipment shall be carefully protected against dust and debris.

B. All debris shall be removed from the structures during demolition and not allowed to accumulate in piles.

C. Safe access to and egress from all working areas shall be provided at all times with adequate protection from falling material.

D. Adequate scaffolding, shoring, bracing and protective covering shall be provided during demolition to protect personnel and equipment against injury or damage. Floor openings not used for material drops shall be covered with material substantial enough to support any loads placed on it. The covers shall be properly secured to prevent accidental movement.

E. Adequate lighting shall be provided at all times during demolition.

F. Areas below demolition work shall be closed to workmen while removal is in progress.

G. No material shall be dropped to any point lying outside the exterior walls of the structure unless the area is effectively protected.

H. No workmen shall stand on any wall to remove material except when adequate staging or scaffold protection is provided at a distance not exceeding 12 feet below the top of such walls and other reasonable precautions are taken. Whenever a workman is required to work at a height of more than 12 feet above a floor, platform, scaffold or the ground, he shall be equipped with a safety belt with a life line attached.

3.07 DISPOSAL OF MATERIAL

A. All debris, rubbish, scrap pieces, equipment, and materials resulting from the demolition shall become the property of the Contractor and shall be removed from the site, except for the items designated by the Engineer to be salvaged.

END OF SECTION

# SECTION 03310

# CONCRETE WORK

## PART 1 - GENERAL

### 1.01 SUMMARY

A. Section Includes: Labor, materials, and equipment necessary for fabrication, production, installation, and erection of items specified in this Section as shown on Drawings or listed on Schedules.

B. Related Documents: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to Work of this Section.

C. Products Installed but not Furnished under this Section:
   1. Anchor bolts.
   2. Miscellaneous metal embedments.

### 1.02 DEFINITIONS

A. Flowable Fill: Cement Stabilized Fly Ash Fill (CSFAF) consisting of cement, fly ash, and water. These Specifications classify this material as Class F mix.

B. Mass concrete refers to slabs or walls greater than 3 feet thick.

### 1.03 REFERENCES

A. ASTM:
   1. A 185 Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement.
   2. A 497 Welded Deformed Steel Wire Fabric for Concrete Reinforcement.
   3. A 615 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
   4. C 31 Test Methods of Making and Curing Concrete Test Specimens in the Field.
   5. C 33 Concrete Aggregates.
   6. C 39 Test Method for Compressive Strength of Cylindrical Concrete Specimens.
   7. C 42 Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
   8. C 94 Ready-Mixed Concrete.
   9. C 143 Test Method for Slump of Hydraulic Cement Concrete.
   10. C 150 Portland Cement.

11. C 157 Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete.
12. C 171 Sheet Materials for Curing Concrete.
13. C 172 Practice for Sampling Freshly Mixed Concrete.
14. C 173 Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
15. C 231 Test Method for Air Content of Freshly Mixed Concrete by Pressure Method.
16. C 260 Air-Entraining Admixtures for Concrete.
17. C 309 Liquid Membrane-Forming Curing Compounds for Curing Concrete.
18. C 494 Chemical Admixtures for Concrete.
19. C 578 Preformed, Cellular Polystyrene Thermal Insulation.
20. C 595 Blended Hydraulic Cements.
21. C 618 Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
22. C 881 Epoxy-Resin-Base Bonding Systems for Concrete.
23. C 989 Ground Iron Blast-Furnace Slag for Use in Concrete and Mortars.
24. C 1107 Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
25. C 1240 Silica Fume for Use as a Mineral Admixture in Hydraulic Cement Concrete.
26. D 994 Preformed Expansion Joint Filler for Concrete (Bituminous Type).
27. D 471 Test Method for Rubber Property – Effect of Liquids.
28. D 1751 Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextending and Resilient Bituminous Types).
29. E 1155 Test Method for Determining Floor Flatness and Levelness Using the F-Number System (Inch-Pound Units).

B. CE:
1. CRD-C 572 PVC Waterstop.

C. ACI:
1. 211.1 Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.
2. 222.1 Provisional Standard Test Method for Water-Soluble Chloride Available for Corrosion of Embedded Steel in Mortar and Concrete Using the Soxhlet Extractor.
3. 301 Specification for Structural Concrete.
4. 304R Guide for Measuring, Mixing, Transporting, and Placing Concrete.
5. 305R Hot Weather Concreting.
6. 306R Cold Weather Concreting.
7. 309R Guide for Consolidation of Concrete.
8. 318R Building Code Requirements for Structural Concrete and Commentary.
9. 347R Guide to Formwork for Concrete.
10. 350R Environmental Engineering Concrete Structures and Commentary.
11. 503R Use of Epoxy Compounds with Concrete.

12. SP-66 ACI Detailing Manual.

D. CRSI:
   1. Manual of Standard Practice.
   2. Placing Reinforcing Bars.

1.04 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01040, Project Coordination, covering the items included under this Section.

   1. Shop Drawings of Reinforcement: Submit original shop drawings for fabrication, bending, and placement of concrete reinforcement. Comply with Reinforcement Shop Drawing Checklist below.
      a. Reinforcement Shop Drawing Checklist:
         1) Specify ASTM number and grade of reinforcing.
         2) Show bar spacings and quantities.
         3) Specify lap lengths using table in Tetra Tech, Inc. Structural Standard Details.
         4) Specify whether bars are inside and outside or near face and far face on walls.
         5) Specify clear coverages per Placing Reinforcement Specification in Part 3.
         6) Specify bar support spacings per Tetra Tech, Inc. Standard Detail for Concrete Slabs.
         7) Show stirrup spacing.
         8) Use closed stirrups and ties with 135-degree hooks.
         9) Submit Bar Bending Schedule on Drawings.
         10) Reference major Contract Drawings. Use same section cut numbers and letters when practical.
         11) Show details for equipment pads.
         12) Show numeric elevation references on sections.
         13) Locate expansion and control joints.
         14) Organize and present sheets in logical sequence.
         15) Submit "small" submittal packages when practical.
         16) Immediately contact ENGINEER if Contract Documents are unclear.

B. Product Data: Submit data for proprietary materials and items, including admixtures, patching compounds, waterstops, joint systems, curing compounds, and other materials installed under this Section.

C. Submit samples of materials as requested by ENGINEER, including names, sources, and descriptions.

D. Mix Designs: Submit the following for all concrete classes:

1. Water/cement ratio (total gallons of water per cubic yard).
2. Brand, type, and quantity of cement.
3. Type and quantity of aggregates.
4. Type and quantity of admixtures.
5. Type, composition, and quantity of fly ash, slag (GGBFS), or silica fume.
6. Unit weight (wet density).
7. Composition strength based on 28-day compression test.

E. Submit laboratory test reports for concrete mix design, aggregates (particularly deleterious materials in coarse aggregate) and fly ash, slag (GGBFS) and silica fume (if used) 4 weeks before scheduled pouring.

1. For mass concrete, submit laboratory test report on the heat of hydration for the trial mix design if requested by ENGINEER. Trial mix design shall consist of concrete block 4-foot by 4-foot by 4-foot.

F. Quality Assurance Submittals:

1. Submit written reports to ENGINEER documenting testing and inspection results.

2. Submit mill test reports on reinforcement.

3. Submit materials certificates in lieu of laboratory test reports on other materials. Manufacturer and CONTRACTOR shall sign material certificates certifying that each material item complies with, or exceeds, specified requirements. Submit certification from admixture manufacturers that chloride content complies with specification requirements.

1.05 PROJECT CONDITIONS

A. Protect adjacent finish materials against spatter during concrete placement.

1.06 OWNER’S INSTRUCTIONS

A. Concrete Testing Service: Engage testing laboratories acceptable to ENGINEER to do material evaluation tests and to design concrete mixes.

B. Materials and installed Work may require testing and retesting at any time during progress of Work. Tests, including retesting of rejected materials for installed Work, shall be done at CONTRACTOR's expense.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

A. Subject to compliance with specified requirements, products which may be incorporated in Work include:

1. Air-Entraining Admixture:
   a. "AEA-92" or "Air-Mix," Euclid Chemical Co.
   b. "Darex II AEA" or "Daravair 1000 or 1400," Grace Construction Products.
   c. "MB AE 90" or "Micro-Air," Master Builders.
2. Water-Reducing Admixture:
   a. "Eucon WR-75," Euclid Chemical Co.
   b. "Pozzolith 220-N," Master Builders.
   c. "WRDA with Hycol" or "Daracem," Grace Construction Products.
3. Mid-range Water-Reducing Admixture:
   a. "Eucon MR," Euclid Chemical Co.
   b. "Mira 70" or "Daracem 65 or 55," Grace Construction Products.
   c. "Polyheed 997," Master Builders.
4. High-range Water-Reducing Admixture (Superplasticizer):
   a. "ADVA," "Daracem," Grace Construction Products.
   b. "Eucon 37," Euclid Chemical Co.
   c. "Rheobuild 1000 or 7161," Master Builders.
5. Water Reducing, Nonchloride Accelerator Admixture:
   a. "Accelguard 80 or 90," Euclid Chemical Co.
   b. "Daraset," Grace Construction Products.
   c. "Pozzutec 20" or "Pozzolith NC 534," Master Builders.
6. Water Reducing, Retarding Admixture:
   a. "Daratard," Grace Construction Products.
   b. "Eucon Retarder 75," Euclid Chemical Co.
   c. "Pozzolith Retarder," Master Builders.
7. PVC Waterstops:
   a. Greenstreak, Inc.
   b. Vinylex Corp.
   c. W.R. Meadows.
8. Thermoplastic Elastomeric Rubber (TPER) Waterstops:
   a. Westec Barrier Technologies, Inc.
9. Bentonite Waterstops:
   a. "Swellstop Waterstop," Greenstreak, Inc.
   b. "Volclay Waterstop," Cetco-Colloid Environmental Technologies Co.
10. Hydrophilic Waterstop:
    a. "Akwastop Gasket Waterstop," Cetco-Colloid Environmental Technologies Co.
    b. "Swellseal," De Neef Construction Chemicals, Inc.
11. Expansion and Isolation Joint Filler:

a. "Sealtight Sponge Rubber," W.R. Meadows.
b. "1300 Series Sponge Rubber," Williams Products.

12. Expansion and Isolation Joint Sealant:
    a. "Dynaseal W-517 or 907," Williams Products.
    b. "Sonolastic NP1," Sonneborn.
    c. "Vulkem 45 or 116," Mameco International.
13. Vapor Retarder:
    a. Moisture Vapor-Sensitive Applications (Class C):
        1) "Sealtight Vapor-Mat (10 mil)," W.R. Meadows, Inc.
        2) "Stego Wrap Vapor Barrier (10 mil)," Stego Industries LLC.
        3) "VaporBlock 10," Raven Industries.
    b. Critical Moisture Vapor-Sensitive Applications (Class B):
        1) "Sealtight Vapor-Mat (15 mil)," W.R. Meadows, Inc.
        2) "Stego Wrap Vapor Barrier (15 mil)," Stego Industries LLC.
        3) "VaporBlock 15," Raven Industries.
14. Perimeter and Slab Insulation:
    a. "Styrofoam High Load 40," Dow Chemical Co.
15. Cement-Polymer Patching Mortar:
    a. "EUCO Poly-Patch," Euclid Chem. Co.
    b. "Masterpatch 220" or "EMACO S88," Chemrex, Inc.
    c. "Sikatop," Sika Chem. Corp.
    d. "Thin Coat Concrete Coat," Euclid Chem. Co.
16. Nonshrink Grout:
    a. "Crystex," L&M Construction Chemicals, Inc.
    b. "Five Star Grout," U.S. Grout Corp.
    c. "Master Flow," Chemrex, Inc.
    d. "Multi-Purpose," Symons.
    e. "NS Grout," Euclid Chemical Co.
    f. "Sure-Grip Grout," Dayton-Superior.
17. Chemical Hardener:
    a. "Day-Chem Hardener," Dayton-Superior.
    b. "Lapidolith," Sonneborn.
    c. "Mastertop CST," Chemrex, Inc.
    d. "Surfhard," Euclid Chemical Co.
18. Transparent Membrane Forming Curing Compound:
    a. "Kurez DR," Euclid Chemical Co.
    b. "L&M Cure R," L&M Construction Chemicals, Inc.
    c. "Sealtight 1100-Clear," W.R. Meadows.
19. Crystalline Concrete Waterproofing:
    a. Vandex International.
    b. Xypex Chemical Corp.
20. Epoxy Bonding Compound:
    a. "Concresive Liquid LPL," Chemrex, Inc.
    b. "Duralbond," Tamms Industries.
    c. "Euco #452 or #620 Epoxy," Euclid Chemical Co.

d. "Rescon R606, R616, R631, R649," Symons Corp.
e. "Sikadur 32 Hi-Mod," Sika Chemical Corp.
f. "Thiopoxy," Grace Construction Products.

21. Fastening Systems:
    a. Medium-duty Expansion Anchors (Wedge Anchors):
        1) "Kwik-Bolt II" Hilti, Inc.
        2) "Power-Stud," Powers Fasteners, Inc.
        3) "Trubolt," ITW Ramset/Red Head.
        4) "Wedge-All," Simpson Strong-Tie Co., Inc.
    b. Heavy-duty Expansion Anchors (Sleeve Anchors):
        1) "HSL Heavy Duty Sleeve Anchor," Hilti, Inc.
        2) "Power-Bolt," Powers Fasteners, Inc.
        3) "Redi-Bolt," ITW Ramset/Red Head.
        4) "Sleeve-All," Simpson Strong-Tie Co., Inc.
    c. Heavy-duty Screw Anchors:
        1) "Large Diameter Tapcon (LDT)," ITW Ramset/Red Head.
        2) "Titen HD," Simpson Strong-Tie Co., Inc.
        3) "Wedge-Bolt," Powers Fasteners, Inc.
    d. Adhesive Anchors:
        1) "AC100/AC5.5" or "Power-Fast," Powers Fasteners, Inc.
        2) "Epcon," ITW Ramset/Red Head.
        3) "Epoxy-Tie," Simpson Strong-Tie Co., Inc.
        4) "HIT HY150/HIT-ICE," Hilti, Inc.
22. Bearing Pads:
    a. Fluorocarbon Co.
    b. Williams Products, Inc.

## 2.02 FORM MATERIALS

A. Forms for Smooth Form Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel materials, to achieve continuous, straight, smooth, exposed surfaces. Furnish largest practicable sizes to minimize joints and to conform to joint system shown on Drawings.

B. Forms for Rough Form Finish Concrete: Plywood, lumber, metal, or other acceptable material. Use lumber dressed on two edges and one side for tight fit.

C. Forms for Textured Finish Concrete: Use units with face design, size, arrangement, and configuration to match ENGINEER's control sample. Provide solid backing and form supports to stabilize textured form liners.

D. Form Coatings: Commercial formulation form-coating compounds with no more than 350 mg/ltr volatile organic compounds (VOCs) that do not bond with, stain, or adversely affect concrete surfaces, or prevent good bonding with later concrete surface treatments.

E. Forms Ties: Factory fabricated, adjustable length, removable or snap-off metal form ties, designed to prevent form deflection and to prevent spalling concrete upon removal. Provide units which shall leave no metal closer than 1-1/2 inches to surface.

1. Provide ties which, when removed, leave holes no larger than 7/8-inch or less than 1/2-inch in diameter in concrete surface.

## 2.03 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.

B. Welded Wire Fabric: ASTM A 185.

C. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Use wire bar supports complying with CRSI specifications. The use of bricks is not permitted.

1. For slabs-on-grade, use supports with sand plates or horizontal runners where base material does not support chair legs.

2. For exposed-to-view concrete surfaces, where support legs are in contact with forms, use supports with legs that are plastic-protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).

## 2.04 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I, except use Type III where applications require high-early-strength or Type II where required by ENGINEER for corrosive environments.

B. Use one brand of cement throughout Project, unless otherwise acceptable to ENGINEER.

C. Fly Ash: ASTM C 618, Type C or Type F (corrosive environments) with loss on ignition not more than 6 percent.

D. Ground Granulated Blast-Furnace Slag: ASTM C 989.

E. Silica Fume: ASTM C 1240.

F. Aggregates: ASTM C 33. Use aggregates from single source for exposed concrete.

G. Water: Potable.

H. Air-Entraining Admixture: ASTM C 260, and certified by manufacturer to be compatible with other admixtures.

I. Water-Reducing Admixture: ASTM C 494, Type A.

J. High-range Water-Reducing Admixture (Superplasticizer): ASTM C 494, Type F or Type G.

K. Water Reducing, Nonchloride Accelerator Admixture: ASTM C 494, Type E.

L. Water Reducing, Retarding Admixture: ASTM C 494, Type D.

M. Prohibited Admixtures: Calcium chloride thyocyanates or admixtures containing more than 0.1 percent chloride ions.

N. Potable Water Structures: For surfaces in contact with potable water, use only materials approved by Department of Public Health of the state that has jurisdiction.

2.05 ACCESSORIES

A. PVC Waterstops: PVC conforming to CRD-C 572. Size and type as shown on Drawings.

1. Provide factory made waterstop fabrications for all changes of direction, intersections, and transitions leaving only straight butt joint splices for field fabrication.

2. Provide hog rings or grommets spaced at 12 inches on center along length of waterstop between first and second ribs from end.

B. Bentonite Waterstops: Flexible strip of bentonite-butyl expanding rubber. Use for cast-in-place concrete structures.

C. Hydrophilic Waterstop: Flexible strip of hydrophilic expanding vinylester. Used for precast concrete structures where shown on Drawings.

D. Bituminous Joint Filler: ASTM D 1751.

E. Expansion and Isolation Joint Filler: Sponge rubber conforming to ASTM D 1752, Type I. Concrete shall be gray color with density not less than 30 pounds per cubic foot and compression deflection not more than 25 percent of thickness at 20 psi apply pressure.

F. Expansion and Isolation Joint Sealant: One part polyurethane. Concrete shall be gray color unless otherwise required by ENGINEER. Before applying, wipe surface clean with solvent supplied by manufacturer.

G. Granular Base: Evenly graded fine aggregate to provide smooth and even surface below slabs on grade. Minimum 6-inch thickness or as noted on Drawings.

H. Vapor Retarder: Polyethylene sheet, meeting or exceeding the requirements of ASTM E 1745, Class C or Class B, as indicated on Drawings.

I. Perimeter and Slab Insulation: Rigid thermal plastic foam board with 40 psi minimum compressive strength, maximum water absorption of 0.1 percent by volume, and maximum water permeability of 0.8 perm-inch meeting ASTM C 578, Type VI; 2 inches thick with adhesives as recommended by insulation manufacturer.

J. Nonshrink Grout: ASTM C 1107, factory pre-mixed, cementitious natural aggregate grout.

K. Chemical Hardener: Colorless aqueous solution containing magnesium fluosilicate and zinc fluosilicate combined with wetting agent, containing not less than 2 pounds of fluosilicates per gallon.

L. Moisture-Retaining Cover: Waterproof paper, polyethylene film, or polyethylene-coated burlap complying with ASTM C 171.

M. Transparent Membrane-Forming Curing Compound: Liquid membrane-forming curing compound complying with ASTM C 309, Type 1, Class B. Formed membrane shall be suitable for later application of cementitious coating or topping.

N. White Pigmented Membrane-Forming Curing Compound: Liquid membrane-forming curing compound complying with ASTM C 309, Type 2, Class B. Tests for moisture retention, reflectance, and drying time shall be based on a curing compound applied at 200 square feet per gallon.

O. Crystalline Concrete Waterproofing: Cementitious crystalline concrete waterproofing material that permanently fixes nonsoluble crystalline growth throughout capillary voids.

P. Epoxy Bonding Agent: ASTM C 881, two-component material suitable for use on dry or damp surfaces. Provide material Type, Grade, and Class to suit Project requirements.

Q. Bearing Pads: Vulcanized chloroprene elastomeric compound cut from molded sheet with 50 SHORE A durometer surface hardness. Elastomeric bearing pads shall conform to requirements for 100 percent virgin polychloroprene (Neoprene) bearing pads as specified by AASHTO Standard Specifications for Highway Bridges. Install in forms under poured-in-place concrete as shown on design details.

R. Mechanical Anchors: Manufactured using corrosion-resistant materials.

S. Adhesive Anchoring System: ASTM C 881, Type IV, Grade 3. Provide material Class to suit Project requirements.

2.06 PROPORTIONING AND DESIGN OF MIXES

A. Prepare design mixes for each concrete class and strength by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method is used, use independent testing facilities acceptable to ENGINEER for preparing and reporting proposed mix designs. Testing facility shall not be identical to that used for field quality control testing.

B. Fly ash shall be used to partially supplant cement content in Class A and Class S concrete, unless noted otherwise, and is optional in other classes. Replacement quantity of cement content by weight shall be not less than 15 percent for Class A and Class S concrete or more than 25 percent for all classes except Class F.

C. For concrete Class A and Class S, concrete mix design with fly ash and silica fume shall be maximum 30 percent of cement content by weight, and shall constitute no more than 20 and 10 percent, respectively, of the total weight of cementitious materials.

D. For concrete, Class S, use Portland cement Type II with fly ash, Type F.

E. Ground granulated blast furnace slag (GGBFS) shall only be permitted for mass concrete placement and as approved by ENGINEER. Replacement quantity of cement content weight shall not be less than 35 percent or more than 50 percent.

F. Design mixes to provide normal weight concrete for following classes and properties:

1. Locations for concrete classes are as follows:
   a. Class A Structural concrete (slabs, walls, columns, beams, equipment bases, and slab toppings 2 inches or greater in thickness).
   b. Class S Sulfate resistant structural concrete (slabs, walls, columns, and beams) where indicated on Drawings.
   c. Class G Grout fill for use in sweeping in final surfaces in sanitary structures and slab toppings less than 2 inches in thickness.
   d. Class P Exterior pavements (unless otherwise indicated on Drawings).
   e. Class B Sidewalks and manhole bases (unless otherwise indicated on Drawings).
   f. Cass C Fill within manholes, mud mats, fill under structures, encasement for piping below or adjacent to structures and encasement for floor drains, sewer inlets and similar items.

g. Class F Flowable fill for filling spaces as permitted and directed by ENGINEER.

2. Properties for concrete classes are as follows:

| **Concrete Class** | | **A** | **S** | **G** | **P** | **B** | **C** | **F** |
|---|---|---|---|---|---|---|---|---|
| 28-Day* Compressive Strength (f'c), psi | | 4,000 | 5,000 | 4,000 | 3,500 | 3,000 | 2,000 | 50-100 |
| Cement Content per cubic yard of concrete, sacks minimum ** | | 6 | 7 | 6 | 5.5 | 5 | 4 | 0.4-3.0 |
| Water/Cement Ratio by weight, maximum | | 0.44 | 0.40 | 0.44 | 0.44 | 0.58 | 0.75 | 0.40-0.75 |
| Air Content, percent by volume | | 5±1 | <4 | 5±1 | 6.5+±1.5 | 6.5±1.5 | NA | NA |
| Slump at point of placement, inches. | WR*** | 2-4 | 2-4 | 2-4 | 2-4 | 3-5 | 3-6 | NA |
| | MRWR | 4-6 | 4-6 | 4-6 | 4-6 | NA | NA | NA |
| | HRWR | 6-8 | 6-8 | 6-8 | 6-8 | NA | NA | NA |
| Monofilament Polypropylene, Type F1 | | Yes | Yes | Yes | NA | NA | NA | NA |

* 7-day compressive strength for high-early-strength concrete.
56-day compressive strength for mass concrete with ground granulated blast furnace slag.

** For concrete with fly ash, values are total of cement plus fly ash (except Class F concrete).

*** Slump prior to the addition of mid-range or high-range water reducers.

3. Adjustment of Concrete Mixes: Mix designs may be adjusted when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, when approved by ENGINEER, at no additional cost to OWNER. Submit laboratory test data for revised mix design and strength results to ENGINEER before using in work.
4. Admixtures:
   a. Use water-reducing admixture or high range water-reducing admixture (superplasticizer) in concrete for placement and workability.
   b. Use nonchloride accelerating admixture in concrete slabs placed at ambient temperatures below 50 degrees F (10 degrees C).
   c. Add air-entraining admixture at manufacturer's prescribed rate to result in placed concrete having total air content specified.

## 2.07 CONCRETE MIXING

A. Ready-Mix Concrete: Comply with ASTM C 94 requirements and as specified in this Section.

# PART 3 - EXECUTION

## 3.01 EXAMINATION

A. Coordinate installation of joint materials, perimeter insulation, and vapor retarders with placement of forms and reinforcing steel.

## 3.02 FORMS

A. Design, build, support, brace, and maintain formwork to support vertical and lateral, static, and dynamic loads applied to formwork until concrete structure can support applied loads. Construct formwork so that concrete members and structures are of correct size, shape, alignment, elevation, and position. Deflection of form-facing material between supports, and deflection of form supports shall not exceed 1/4 inch per 10 feet of span.

B. Design formwork to be removable without impact, shock, or damage to cast-in-place concrete surfaces and adjacent materials.

C. Construct forms to sizes, shapes, lines, and dimensions shown, and to obtain accurate alignment, location, grades level and plumb for work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features in Work. Use selected materials to obtain specified finishes. Solidly butt joints and provide backup at joints to prevent leakage of cement paste.

D. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, and recesses to prevent swelling and for easy removal.

E. Provide temporary openings at base of wall and column forms and other interior areas of formwork where it is inaccessible for cleanout, for observation before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous locations.

F. Chamfer exposed corners and edges, 3/4 inch minimum, using wood, metal, PVC or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

G. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses and chases from trades providing these items. Accurately place and securely support items built into forms.

H. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before placing concrete. Retighten forms and bracing after concrete placement to eliminate mortar leaks and to maintain proper alignment.

3.03 VAPOR RETARDER INSTALLATION

A. Following leveling and tamping of granular base for slabs on grade, place vapor retarder sheeting where shown directly under concrete slab, unless otherwise indicated on Drawings, with longest dimension parallel with direction of pour.

B. Lap joints 6 inches minimum and seal with appropriate tape as recommended by manufacturer.

C. Seal around all duct, pipe, or wire penetrations using appropriate tape and/or prefabricated boots.

D. Damaged areas shall be repaired by placing a piece of vapor retarder material over the damaged area with a 6-inch minimum lap on each side. The perimeter of the repair shall be sealed using an appropriate tape.

3.04 PERIMETER AND SLAB INSULATION

A. Place perimeter and floor slab insulation at locations shown on Drawings.

3.05 PLACING REINFORCEMENT

A. Comply with CRSI recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports, and as specified in this Section.

1. Avoid cutting or puncturing vapor retarder during reinforcement placement and concreting operations.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.

C. Accurately position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers.

D. Place reinforcement to obtain clear cover space for concrete protection:

1. Footings and slabs cast over mud mats, supported slabs, beams, girders, columns, and walls, both interior and exterior unless noted otherwise: 2 inches.

2. Footings and slabs cast against and permanently exposed to earth: 3 inches.

E. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Direct wire tie ends into concrete, not toward exposed concrete surfaces.

F. Field bending of reinforcement:

1. Field bending of plain reinforcement shall be performed using an approved and appropriate sized portable hydraulic device that makes ACI-approved radius bends. No other field bending method shall be permitted.
2. No field bending shall be permitted for epoxy coated reinforcement.

G. Install welded wire fabric in as long lengths as practical. Lap adjoining pieces one full mesh and lace splices with wire.

## 3.06 MASS CONCRETE PLACEMENT

A. The maximum temperature differential (MTD) between the interior and exterior concrete surfaces should not exceed 35 degrees F.

B. To control the heat of hydration during the placement and curing process, the following shall be observed:

1. When proportioning mass concrete mix design, the use of ground granulated blast furnace slag (GGBFS) may be considered.

2. Internal heat of concrete could be removed using an appropriate combination of cooling coils, adding cooled water to the mix, and spraying aggregate for evaporative cooling effect.

3. Insulation shall be provided for the exterior surface of concrete to prevent rapid cooling.

4. Concrete pours shall be placed in vertical lifts not exceeding 24 inches. Revibrate previously deposited concrete when new lifts are placed.

5. CONTRACTOR shall engage the services of a qualified testing laboratory to monitor the internal and surface temperature for at least 7 days after placement is completed.

3.07 JOINTS

A. Locate and install construction joints as shown or, if not shown, locate so as not to impair strength and appearance of structures, at intervals not to exceed 50 feet. For construction joints in water-containing structures or tanks or in water-restraining structures, use watertight joints.

B. Continue reinforcement across construction joints, unless otherwise noted. Mechanical inserts with threaded studs are not accepted as substitutes for through-dowels.

C. Locate construction joints in floor system at or near middle of span in slabs, beams, or girders unless beam intersects girders at this point. Then, where not shown on Drawings, joints in girders shall be offset distances twice the width of beams, and provisions made for shear by web reinforcement across joints.

D. Provide watertight joints to prevent water seepage. Take special care in finishing surfaces to which succeeding concrete is bonded. Provide waterstops in joints if shown. Install waterstops to form continuous diaphragm in each joint. Make provisions to support and protect exposed waterstops during progress of work. Fabricate field joints in waterstops according to manufacturer's printed instructions.

E. Provide isolation joints in slabs-on-ground at points of contact between slabs-on-ground and vertical surfaces of column pedestals, foundation walls, and grade beams.

F. Contraction (Control) Joints in Slabs-on-Ground: Construct contraction (control) joints in slabs-on-ground to form panels of patterns as shown. Use saw cuts 3/16 inch by 1/4 slab depth or inserts 1/4-inch wide by 1/4 of slab depth unless otherwise noted.

1. If joint pattern is not shown, provide joints at 15 feet at most in either direction, with locations to conform to bay spacing wherever practical (at column centerlines, half-bays, third-bays).

2. Form contraction joints by inserting pre-molded plastic, hardboard, or fiberboard strip into fresh concrete until top surface of strip is flush with slab surface. Tool slab edges round on each side of insert. After concrete has cured, remove inserts and clean groove of loose debris.

3. Cut contraction joints in unexposed floor slabs by saw cuts as soon as practical after slab finishing when it can be safely done without dislodging aggregate.

## 3.08 INSTALLATION OF EMBEDDED ITEMS

A. Set and build into Work anchorage devices and other embedded items required for other work that are attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of attachment items.

B. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain set elevations and contours in finished slab surface. Provide and secure units sufficiently strong to support screed strips by use of strike-off templates or accepted compacting screeds.

C. Conduits and pipes of aluminum shall not be embedded in structural concrete unless they are effectively coated or covered to prevent aluminum-concrete reaction or electrolytic action between aluminum and steel.

D. PVC Waterstops:

1. Field butt splices shall be heat fused using a Teflon-coated thermostatically controlled waterstop splicing iron at approximately 380 degrees F following manufacturer’s recommendations. Lapping of waterstop or use of adhesives shall not be allowed.

2. Center the waterstop in joint and secure waterstop in correct position using hog rings or grommets spaced at 12 inches on center along length of waterstop and wire tie to adjacent reinforcing steel. Do not drive nails or otherwise puncture additional holes in the waterstop when forming.

E. Bentonite and Hydrophylic Waterstops:
1. Adhere waterstop to substrate using manufacturer’s recommended adhesive.
2. Tightly butt ends of waterstop together to form a continuous waterstop. Do not lap waterstop.
3. Verify that minimum concrete per manufacturer’s recommendations will occur along waterstop’s entire length. Do not install waterstop in keyways.
4. Follow manufacturer’s recommended installation procedures.

## 3.10 PREPARATION OF FORM SURFACES

A. Clean re-used forms of concrete matrix residue, repair and patch to return forms to acceptable surface condition.

B. Coat contact surfaces of forms with form-coating compounds before placing reinforcement.

C. Thin form-coating compounds only with acceptable thinning agents, quantity, and under conditions of form-coating compound manufacturer's directions. Do not allow

excess form-coating material to accumulate in forms or to come into contact with in-place concrete surfaces against which fresh concrete is placed. Apply in compliance with manufacturer's instructions.

D. Coat steel forms with non-staining, rust-preventive form oil to protect against rusting. Rust-stained steel formwork is not acceptable.

## 3.11 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation, reinforcing steel, waterstop installation, and other embedded or cast-in items.

1. Notify other crafts to permit installation of their work.

2. Cooperate with other trades in setting their work.

3. Moisten wood forms immediately before placing concrete where form coatings are not used.

4. Apply temporary protective covering to lower 2 feet of finished walls where adjacent floor slabs are poured to guard against spattering during slab placement.

B. Comply with ACI 304R and as specified in this Section.

C. Discharge Concrete at Site within 1-1/2 hours after cement is added to water or aggregates. When air temperature exceeds 85 degrees F, the discharge time shall be less than 45 minutes. The 45-minute requirement may be waived with the use of a water reducing, retarding admixture and approval of ENGINEER.

D. Provide trip ticket in duplicate for each ready-mixed concrete load delivered, stating truck number, Project name, CONTRACTOR and producer, batching time, total yards of concrete and material contained therein. Show ticket to ENGINEER upon request. Fill in concrete discharge time and turn over to ENGINEER trip ticket copies at end of each day.

E. Deposit concrete continuously or in layers so that no concrete is placed on concrete which has hardened sufficiently to cause seams or planes of weakness. If section cannot be placed continuously, provide construction joints as specified. Deposit concrete as nearly as practical to its final location to avoid segregation.

F. When depositing by chute, provide equipment of size and design to ensure continuously flowing concrete. Provide discharge end of chute with baffle plate to prevent segregation. Position chute so that concrete need not flow more than 5 feet horizontally.

G. Do not drop concrete from chute end distances greater than 3 times the deposited layer thickness, nor more than 5 feet. Where distance from chute end to surface of concrete exceeds these distances, use spout and maintain lower end as near to deposit surface as practical. When operations are intermittent, discharge chutes into hoppers.

H. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 24 inches to avoid inclined construction joints. Where placement involves several layers, place each layer while preceding layer is still plastic to avoid cold joints.

1. Fill bottom of wall space with 2 to 4 inches of cement slurry immediately before depositing concrete in walls. Use cement slurry composed of 1 part Portland cement, 2 parts fine aggregate, and sufficient water (but not to exceed 0.45 parts) for 7-inch slump mixture.

2. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping. Use equipment and procedures for concrete consolidation in accordance with ACI recommended practices.

3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible machine effectiveness. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into concrete layers that have begun to set. At each insertion, limit duration to time necessary to consolidate concrete and complete reinforcement embedment and other embedded items without causing mix segregation. Keep vibrators away from waterstops to prevent displacement.

I. Placing Concrete Slabs: Deposit and consolidate concrete slabs in continuous operations between construction joints until panel or section placement is complete.

1. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.

2. Bring slab surfaces to correct level with straightedge and strikeoff. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces before beginning finishing operations.

3. Maintain reinforcing in proper position during concrete placement operations.

4. Maintain waterstop in proper position during concrete placement operations.

5. Concrete Placement against Expanding Bentonite Waterstop. Direct concrete flow away from bentonite water stops. If flow cannot be away from bentonite, direct flow parallel to waterstop.

6. Moisten soil when depositing concrete directly on granular soil.

J. Cold Weather Placing: Protect concrete work from physical damage or reduced strength attributed to frost, freezing actions, or low temperatures by using techniques in ACI 306R and as specified in this Section.

1. When air temperature has fallen to, or is to fall below 40 degrees F, uniformly heat water and aggregates before mixing to obtain concrete mixture temperature not less than 50 degrees F, and not more than 80 degrees F at placement point.

2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

3. Do not use calcium chloride, salt and other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs.

K. Hot Weather Placing: When air temperature is above 85 degrees F, conditions could exist that would seriously impair quality and concrete strength; place concrete in compliance with ACI 305R and as specified in this Section.

1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 85 degrees F. Chill mixing water or use chopped ice to control temperature. If using ice, water equivalent of ice is included in total mixing water quantity. Using liquid nitrogen to cool concrete is CONTRACTOR's option.

2. Cover reinforcing steel with water-soaked burlap, if steel becomes too hot, to reduce steel temperature so not to exceed ambient air temperature immediately before embedment in concrete.

3. Fog spray forms, reinforcing steel, and subgrade just before placing concrete.

4. Use water-reducing retarding admixture (Type D) when required by high temperatures, low humidity, or other adverse placing conditions.

## 3.12 FINISH OF FORMED SURFACES

A. Rough Form Finish: Use for formed concrete surfaces not exposed to view in finish Work during normal operation or maintenance, or by other construction and not covered with coating or covering material applied directly to concrete. This concrete surface has texture imparted by form-facing material. Tie holes and defective areas are repaired and patched, and fins and other projections exceeding 1/4-inch in height are rubbed down or chipped off.

B. Smooth Form Finish: Use for formed concrete surfaces exposed-to-view, during normal operation or maintenance, or are covered with coating or covering material applied directly to concrete, including waterproofing, dampproofing, painting, or other similar system. This is as-cast concrete surface obtained with selected form material, arranged orderly and symmetrically with minimum seams. Repair and patch defective

areas. Remove and smooth fins or other projections completely. Fill major air void holes.

C. Grout Cleaned Finish: Provide grout-cleaned finish to scheduled formed concrete surfaces that are painted, stained, or waterproofed after receiving smooth form finish treatment.

1. Combine 1 part Portland cement to 1-1/2 parts fine sand by volume, and mix with water to consistency of thick paint. Proprietary additives may be used at CONTRACTOR's option. Blend standard Portland cement and white Portland cement, quantities determined by trial patches, so that dry grout color matches adjacent surfaces.

2. Thoroughly wet concrete surfaces and apply grout to coat surfaces and fill small holes. Remove excess grout by scraping and rubbing with clean burlap. Keep damp by fog spray for 36 hours after rubbing.

D. Related Unformed Surfaces: At horizontal offsets and similar unformed surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with texture matching adjacent formed surfaces. Continue surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless shown otherwise.

## 3.13 MONOLITHIC SLAB FINISHES

A. Scratch Finish: Apply scratch finish to monolithic slab surfaces that are to receive concrete floor topping or mortar setting beds for tile, Portland cement terrazzo, and other bonded applied cementitious finish flooring material, and as otherwise shown.
1. After placing slabs, plane surface to tolerances for floor flatness (FF) of 15 and floor levelness (FL) of 13 in accordance with ASTM E 1155.
2. Slope surfaces uniformly to drains. After leveling, roughen surface before final set with stiff brushes, brooms, or rakes.

B. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as specified, and slab surfaces which are covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo, and as otherwise shown.

1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit power-driven float operation. Consolidate surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units.

2. Check and level surface plane to tolerances of floor flatness (FF) of 18 and floor levelness (FL) of 15 in accordance with ASTM E 1155.

3. Cut down high spots and fill low spots.

4. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to uniform, smooth, granular texture.

C. Trowel Finish: Apply trowel finish to monolithic slab surfaces exposed-to-view, and slab surfaces covered with resilient flooring, carpet, ceramic or quarry tile, paint, or other thin film finish coating system.

1. After floating, begin first trowel finish operation using power-driven trowels. Begin last troweling when surface produces ringing sound when trowel moves over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance.

2. Check and level surface plane to tolerances of floor flatness (FF) of 20 and floor levelness (FL) of 17 in accordance with ASTM E 1155.

3. Grind smooth surface defects that would telegraph through applied floor covering system.

D. Trowel and Fine Broom Finish: Where ceramic or quarry tile is installed with thin-set mortar, apply trowel finish as specified, then immediately follow with slightly scarifying surface by fine brooming.

E. Nonslip Broom Finish: Apply non-slip broom finish to exterior concrete platforms, steps, ramps, and elsewhere as noted.

1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required finish with ENGINEER before application.

F. Chemical-Hardener Finish: Apply chemical-hardener finish to interior concrete floors and to exposed exterior top of supported slabs and domes, water-containing floors excepted. Apply liquid chemical-hardener after curing and drying of concrete surfaces.

1. Apply chemical hardeners, 3 coats, according to manufacturer's printed instructions.

2. After chemical-hardener final coat has dried, remove surplus hardener by scrubbing and mopping with water.

## 3.14 CONCRETE CURING AND PROTECTION

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Start curing as soon as free water has disappeared from concrete surface after placing and finishing. Maintain curing as follows:

1. All concrete unless otherwise noted: 7 days.
2. High-early-strength concrete: 3 days.
3. Mass concrete with ground granulated blast furnace slag: 14 days.

B. Curing Methods: Cure concrete for water-retaining structures by moist curing. Cure concrete for other structures by curing compound, moist curing, moisture-retaining cover curing, or combinations thereof.

C. Provide Moist Curing by following methods:
1. Keep concrete surface continuously wet by covering with water.
2. Continuous water-fog spray.
3. Covering concrete surface with specified absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to cover concrete surfaces and edges, with 4 inches lap over adjacent absorptive covers.

D. Provide Moisture-Retaining Cover Curing as follows:

1. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practical width with sides and ends lapped 3 inches and sealed by waterproof tape or adhesive.

2. Immediately repair holes or tears during curing period using cover material and waterproof tape.

E. Provide Curing Compound as follows:

1. Apply specified curing compound to concrete slabs as soon as last finishing operations are complete (within 2 hours). Apply uniformly in continuous operation by power-spray or roller according to manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain coating continuity and repair damage during curing period.

2. Transparent curing compound shall be used for structural concrete (Class A concrete). White curing compound shall be used for exterior pavements (Class P concrete) and sidewalks (Class B concrete).

3. Do not use membrane curing compounds on surfaces that are covered with coating material applied directly to concrete, liquid floor hardener, waterproofing, dampproofing, membrane roofing, flooring (ceramic or quarry tile, glue-down carpet), painting, and other coatings and finish materials, unless otherwise acceptable to ENGINEER.

F. Curing Formed Surfaces: Cure formed concrete surfaces, including beam undersides, supported slabs and other similar surfaces by moist curing with forms in place for full curing period. If form removal occurs before curing period is up, continue curing by methods specified above as applicable.

G. Curing Unformed Surfaces: Cure unformed surfaces, including slabs, floor topping, and other flat surfaces, by application of appropriate curing method.

3.16 FORM REMOVAL

A. Vertical Forms not supporting concrete weight may be removed when concrete has sufficiently set to resist damage from removal operation.

B. Other forms shall be left in place until concrete has attained strength to support its own weight and construction live loads, unless removed in sections, and each structural section immediately reshored.

C. Time Periods: Forms remain in place as shown in table below. If form removal occurs before time shown in the table, apply curing procedures previously specified.

Minimum Time Forms are to Remain in Place:

| | Average Air Temperature* During Period | |
|---|---|---|
| Part of Structure | 40 - 50 degrees F | 50 degrees F |
| Walls, columns and sides of beam (hours) | 72 | 24 |
| Bottom forms for slabs, beams arches not reshored (days) | 12 | 7 |
| Bottom forms for slabs, beams and arches if reshored (days) | 7 | 4 |

* Air temperature near form.

3.18 RE-USE OF FORMS

A. Clean and repair surfaces of forms to be re-used in Work. Split, frayed, delaminated, or damaged form-facing materials are not acceptable for exposed surfaces. Apply new form coating compound as specified for new formwork.

B. When extending forms for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces.

## 3.19 MISCELLANEOUS CONCRETE ITEMS

A. Fill-in holes and openings left in concrete structures for work by other trades, unless otherwise shown or directed. Do fill in after other trades' work is in place. Mix, place, and cure concrete to blend with in-place construction. Provide other miscellaneous concrete filling shown to complete Work.

B. Concrete Curbs: Provide concrete curbs wherever shown on Drawings. Open stairwells, floor openings, and balcony edges usually require curbs. Construct curbs as detailed, with 1-inch radius top edges. Coves are not required at intersections with structural floors. Coves are required at intersections with top course floor finishes or monolithic floor finishes.

C. Removal of Existing Concrete: Remove existing concrete where shown or required. Neatly finish concrete edges remaining in place and exposed to view in finished structure with cement mortar.

   1. Concrete cutting shall be done competently without injury to remaining portions of structures.

D. Bonding New to Old Concrete: Where shown on Drawings, existing concrete surfaces against which new concrete is placed shall be thoroughly cleaned and brush-coated with bonding agent. Follow manufacturer's directions, especially on material working time.

E. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with approved Shop Drawings from manufacturer-furnishing machines and equipment.

   1. Grout baseplates and foundations using specified and approved nonshrink grout.

## 3.20 CONCRETE SURFACE REPAIRS

A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after form removal.

   1. Cut out honeycomb, rock pockets, voids over 1/4-inch in dimension, and holes left by tie rods and bolts, down to solid concrete but no less than 1 inch deep. Make cuts perpendicular to concrete surface. Thoroughly clean, dampen with water, and brush-coat patched area with specified bonding agent. Place patching mortar after bonding compound has set as recommended by manufacturer.

   2. For exposed to view surfaces, blend white Portland cement and standard Portland cement so, when dry, patching mortar matches surrounding color. Provide test

areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.

B. Repair of Formed Surfaces: Remove and install new concrete having defective surfaces if defects are irreparable to satisfaction of ENGINEER. Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets; fins, and other projections on surface, and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, fill with dry pack mortar, or precast cement cone plugs secured in place with bonding agent.

1. Repair concealed formed surfaces, where practical, containing defects which affect concrete durability. If defects are irreparable, remove and install new concrete.

C. Repair of Unformed Surfaces: Test unformed surfaces for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as specified in this Section. Test unformed surfaces sloped to drain for slope trueness using templates having required slope.

1. Repair finished unformed surfaces containing defects which affect concrete durability. Defects include crazing, cracks more than 0.01-inch wide or which penetrate to reinforcement or completely through nonreinforced sections regardless of width, spalling, pop-outs, honeycomb, rock pockets, and other objectionable conditions.

2. Correct high areas in unformed surfaces by grinding, after concrete has cured 14 days.

3. Correct low areas in unformed surfaces during or immediately after surface finishing operations by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to ENGINEER.

4. Repair defective areas, except random cracks and single holes not exceeding 1-inch diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with 3/4-inch clearance around. Dampen concrete surfaces in contact with patching concrete and apply bonding compound. Mix patching concrete to provide same concrete type or class as original concrete. Place, compact and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

D. Repair isolated random cracks and single holes not over 1-inch in diameter by dry-pack method. Groove top of cracks and cut out holes to sound concrete. Clean out dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Mix dry-pack, consisting of 1 part Portland cement to 2-1/2 parts fine

aggregate passing No. 16 mesh sieve, using only enough water as specified for handling and placing. Place dry-pack after bonding compound has set per manufacturer's instructions. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for not less than 72 hours.

E. Repair Leaking Cracks: Where practical, seal off cracks on water contact face with waterproofing or dampproofing material. If this is not practical or if leakage persists, then repair cracks on exposed faces by routing out square groove not less than 1-inch wide by 1-inch deep, applying slurry bond coat and filling with stiff nonshrink mortar. Bond coat and mortar shall be cementitious crystalline concrete waterproofing material. Follow manufacturer's application and curing instructions. Match repair patch finish in color and texture to original.

F. Structural Repairs: Do structural repairs with prior approval by ENGINEER for method and procedure using specified epoxy adhesive and mortar.

G. Repair Methods: ENGINEER may allow use of other nonspecified methods subject to review and acceptance by ENGINEER.

## 3.21 QUALITY CONTROL TESTING DURING CONSTRUCTION

A. Provide qualified personnel and employ testing laboratory, approved by ENGINEER, to do tests and to submit test reports.

B. Sampling Fresh Concrete: ASTM C 172, except modified for slump and air-content tests to comply with ASTM C 94.

1. Slump: ASTM C 143, one each time compression test specimens are made; additional tests when concrete consistency seems to have changed.

2. Air Content: ASTM C 231, pressure method, one each time compression test specimens made.

3. Concrete Temperature: Test hourly when air temperature is 40 degrees F and below, and when 80 degrees F and above; and each time compression test specimens are made.

4. Compression Test Specimen: ASTM C 31, four standard cylinders for each compressive strength test set, unless otherwise directed. Mold and store cylinders for laboratory-cured test specimens.

5. Compressive Strength Tests: ASTM C 39, one set for each day's pour exceeding 5 cubic yards plus additional set for each 100 cubic yards over and above first 50 cubic yards of each concrete class placed in 1 day; 1 specimen tested at 7 days, 2 specimens tested at 28 days, and 1 specimen retained in reserve for later testing if required.

C. Test Results: Report test results in writing to ENGINEER and CONTRACTOR within 24 hours after tests. Compressive strength test reports shall contain Project identification name and number, concrete placement date, concrete testing service name, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and break type for both 7-day tests and 28-day tests.

D. Acceptance: Concrete strength shall be considered satisfactory if averages of 3 consecutive strength test results equal or exceed specified 28-day compressive strength (f'c), and no individual strength test result falls below specified compressive strength by more than 500 psi.

E. Failure to Meet Requirements:

1. Should 7-day compressive strengths shown by test specimens fall below 65 percent of required 28-day strength (f'c), ENGINEER will have the right to require changes in proportions for remaining Work. Furthermore, ENGINEER will have the right to require additional curing, as specified in this Section, on those portions or structures represented by failed test specimens.

2. Should 28-day compressive strengths (f'c) test results fail to meet required strength, core-boring tests conforming to ASTM Standard C 42 shall be made at CONTRACTOR's expense within 60 days of that concrete placement.

F. At locations where concrete quality is deemed questionable by ENGINEER, core-boring tests shall also be made at CONTRACTOR's expense.

G. Concrete is acceptable if average strength of 3 cores is at least 85 percent and no single core is less than 75 percent of required minimum allowable 28-day compressive strengths (f'c). If core-boring test results fail to meet strength requirements, ENGINEER will have right to require strengthening or replacing those portions of structures which failed to develop specified strength.

H. Provide additional curing when ordered by ENGINEER because of failure to meet requirements. It shall be done at CONTRACTOR's expense, and no claim for extra compensation for additional curing will be allowed. Additional curing shall extend period of protection. Additional curing is limited to 60 days.

I. Additional Tests: Testing service shall make additional in-place concrete tests when test results suggest specified concrete strengths and other characteristics have not been attained. Testing service may conduct tests to determine adequacy by cored cylinders complying with ASTM C 42, or by other approved methods. CONTRACTOR shall pay for additional tests when unacceptable concrete is verified.

END OF SECTION

# SECTION 03930

# REPAIR EXISTING CONCRETE STRUCTURES

## PART 1 - GENERAL

### 1.01 SUMMARY

A. Section Includes: Extent of repair of existing concrete structures shown on Drawings and specified, and includes patching loose, spalled, and unsound concrete, grouting cracks, removing debris resulting from Work, and other Work required to produce a neat and complete job.

### 1.02 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01040, Project Coordination, covering the items included under this Section. Shop Drawing submittals shall include:

1. Product data for proprietary materials and items, including patching compounds and others requested by ENGINEER.

2. Samples of materials as requested by ENGINEER, including names, sources, and descriptions.

B. Material certificates in lieu of laboratory test reports on other materials. Manufacturer and CONTRACTOR shall sign material certificates certifying that each material item complies with, or exceeds, specified requirements.

### 1.03 QUALITY ASSURANCE

A. Codes and Standards:

1. Comply with provisions of following codes, specifications, and standards, except where more stringent requirements are shown or specified:

a. ACI 224, Causes, Evaluation, and Repair of Cracks.

b. ACI 201, Chapter 6, "Repair of Concrete."

B. Materials and installed work may require testing and retesting at any time during progress of Work. Tests, including retesting of rejected materials for installed Work, shall be done at CONTRACTOR's expense.

### 1.04 PROJECT CONDITIONS

A. Protect adjacent finish materials against spatter during patching operations.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

A. Submit to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:
   1. Cement-Polymer Patching Mortar:
      a. "EUCO Poly-patch," Euclid Chem. Co.
      b. "Sikatop," Sika Chem. Corp.
      c. "Masterpatch 220 EMACO S88," Masterbuilders, Inc.
      d. "Thin Coat Concrete Coat," Euclid Chem. Co.
   2. Moisture-Insensitive Two-Component Epoxy-Resin System:
      a. "EUCO Epoxy No. 452 LV," Euclid Chem. Corp.
      b. "Sikadur Hi-Mod LV," Sika Chem. Corp.
      c. "Concresive Standard LV," Masterbuilders, Inc.

### 2.02 PATCHING MATERIALS

A. Patching up to 2-inch Deep: Cement-polymer patching mortar suitable for the particular patching application.

B. Patching over 2-inches Deep: Class A concrete with the use of any epoxy bonding agent applied at the bonding surfaces, unless otherwise noted.

C. Grouting of Cracks and Coating of Reinforcement: Moisture-insensitive 2-component epoxy-resin system conforming to ASTM Specification C 881, Type II, Grade 2.

## PART 3 - EXECUTION

### 3.01 SURFACE PREPARATION

A. Existing Concrete or Masonry: Remove unsound material before applying repair. Chip or scarify repair areas to extent necessary to expose sound substrate. Taper edges to leave no square shoulders at perimeter of cavity. Remove loose material from areas being patched.

1. Sandblast existing surfaces that do not require chipping to remove paint, oil, grease, or other contaminants and to provide roughened surface for proper bonding of patch material.

B. Steel: Clean steel surfaces by abrasive blasting, SSPC SP6, Commercial Blast Cleaning.

3.02 PATCHING

A. Preparation: Remove all loose, spalled, and unsound concrete by chipping. Cut edges of repair areas to 1/4-inch-deep minimum. Thoroughly clean dirt, oil, dust, or foreign matter from repair surfaces by sandblasting or other approved means.

B. Rusted Reinforcement: Thoroughly clean by sandblasting all corroded and rusted reinforcement. Wherever a reinforcing bar has lost more than 30 percent of its cross-sectional area, place a new bar of the same size parallel to it using 24-bar diameters lapped length at each end. When a bar has exposed 50 percent or more of its perimeter, chip out the concrete around the bar to provide a minimum of 1-inch gap all around so the bar can be completely encased in new mortar. Immediately following sandblasting, coat all exposed reinforcement with an epoxy-resin system.

C. Epoxy Bonding Agent: The patching material must be applied within the working time of the bonding agent. Use bonding agent only on surfaces not requiring formwork or when the patching material can be applied within manufacturer’s recommended working time.

D. Mortar Patching: Prepare the cement mortar per manufacturer's recommendations. Apply mortar with a spatula pressed tight against existing surfaces and filling all voids. Build up mortar to original lines in one or more layers, with each layer thickness not to exceed that recommended by the manufacturer, and finished smooth with a steel trowel.

E. Grouting Cracks: Neat epoxy-resin adhesive shall be pressure-injected into horizontal, vertical, and overhead cracks. Faces of cracks shall first be sealed to prevent leakage.

F. For pressure-injection grouting, insert one-way valves in clean drilled holes on the face of crack (drill and clean holes before sealing crack faces). Inject adhesive with caulking gun, maintaining slow, steady pressure until crack is filled.

G. All workers shall have sufficient experience on concrete repair work to be familiar with the use of these materials and methods of operation.

H. To ensure the quality of the finished work, ENGINEER may require CONTRACTOR to replace workers who, in his judgment, are not capable or qualified to perform this

Work. CONTRACTOR, upon receipt of the written notification from ENGINEER, shall immediately comply with this request at no additional cost to OWNER.

3.03 PLACING REINFORCEMENT

A. Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars" for details and methods of reinforcing placement and supports.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond to patching material.

C. Accurately position, support, and secure reinforcement against displacement by construction or patching operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers.

D. Place reinforcement to obtain minimum coverings for reinforcement protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during patching operations. Set wire ties to direct ends into concrete, not toward exposed surfaces.

3.04 SURFACE FINISHES

A. Patching: Provide finish to match adjacent concrete surfaces unless otherwise noted.

3.05 CURING AND PROTECTION

A. Protect freshly placed material from premature drying and excessive cold or hot temperatures.

B. Patching up to 2 Inches Deep: Perform curing as recommended by patching mortar manufacturer.

C. Patching over 2 Inches Deep: Perform curing of Class A concrete as specified in Section 03310.

3.06 REPAIR OF DEFECTS

A. Repair patch areas that lack uniformity or have honeycomb, rock pockets, voids over 1/4-inch in diameter, and holes left by tie rods and bolts as specified in Section 03310.

END OF SECTION

# SECTION 05140

# STRUCTURAL ALUMINUM

## PART 1 - GENERAL

### 1.01 SUMMARY

A. Section Includes: Extent of structural aluminum work as shown on Drawings, including Schedules, Notes, and Details.

B. Source Quality Control: Materials and fabrication procedures are subject to inspection and tests conducted by a qualified inspection agency in mill shop and field. Such inspections and tests will not relieve CONTRACTOR of responsibility for providing materials and fabrication procedures in compliance with specified requirements.

C. Details shown are typical; similar details apply to similar conditions unless otherwise indicated. Verify dimensions at Site whenever possible without causing delay in Work.

D. Connections which are not designed shall be detailed such that the minimum connection capacity is equal to or greater than 1/2 the member capacity.

### 1.02 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01040, Project Coordination, covering the items included under this Section. Shop Drawing submittals shall include:

1. Submit manufacturer's specifications and installation instructions.

2. Submit Shop Drawings prepared under supervision of a registered Professional Engineer, including complete details and schedules for fabrication and assembly of structural members, procedures, and diagrams. Include details of cuts, connections, camber, holes, welds, and other pertinent data.

3. Provide setting Drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed as Work of this Section.

### 1.03 QUALITY ASSURANCE

A. Codes and Specifications:

1. Aluminum Association (AA), "Specifications for Aluminum Structures."

2. ASTM B 221, Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes.

3. ASTM B 483, Specification for Aluminum and Aluminum-Alloy Drawn Tubes for General Purpose Applications.

4. American Welding Society (AWS) D1.0, "Code for Arc and Gas Welding."

B. Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedure."

1. Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests.

2. If recertification of welders is required, retesting shall be CONTRACTOR's responsibility.

3. Parts shall be welded with an inert gas shielded arc or resistant welding process. No welding process that requires a welding flux shall be used.

1.04 DELIVERY, STORAGE, AND HANDLING:

A. Deliver materials to Site at such intervals to ensure uninterrupted progress of Work.

1. Deliver anchor bolts and anchorage devices, which are embedded in cast-in-place concrete, in ample time not to delay work.

B. Store materials to permit easy access for inspection and identification. Do not store materials in such a manner that would cause distortion or damage.

PART 2 - MATERIALS

2.01 PRODUCTS

A. Tubes and Shapes: Type 6061-T6.

B. Aluminum Bolts: Type 7075-T73.

C. Aluminum Nuts: Type 6061-T6.

D. Embedded Anchors: ASTM A 307 hot-dip galvanized.

E. Electrodes for Welding comply with AWS Code.

2.02 FABRICATION

A. Fabricate and assemble structural assemblies in shop to greatest extent possible. Mark and match-mark materials for field assembly.

B. Welded Construction: Comply with AWS code for procedures, appearance, and quality. Weld continuously along the entire area of contact except where tack welding is indicated.

## PART 3 - ERECTION

### 3.01 GENERAL

A. Employ a land surveyor for accurate erection of structural members. Check elevations of concrete bearing surfaces, and locations of anchor bolts and similar devices before erection Work proceeds, and report discrepancies to ENGINEER. Do not proceed with erection until corrections have been made.

B. Temporary shoring and bracing shall be provided with sufficient strength to bear imposed loads and ensure stability.

C. Field Assembly: Set structural frames accurately to lines and elevations indicated.

D. Splice members only where indicated and accepted on Shop Drawings.

E. Do not enlarge unfit holes by burning or by use of drift pins except in secondary members. Ream holes that must be enlarged to admit bolts.

F. Aluminum surfaces in contact with concrete, grout or dissimilar metals will be protected with a coat of bituminous paint or other approved material.

END OF SECTION

# SECTION 05520

# HANDRAILS AND RAILINGS

## PART 1 - GENERAL

### 1.01 SUMMARY

A. Extent of handrails and railings is indicated on Drawings and includes miscellaneous handrails and railing systems not included in other Sections of these Specifications.

B. Types of handrails and railing systems required in this Section include:

1. Aluminum pipe handrails and railing systems.

C. Products Furnished but not Installed under this Section: Include inserts and anchors pre-set in masonry and concrete for anchorage of handrails and railing systems.

D. Related Documents: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1, apply to Work of this Section.

### 1.02 DEFINITIONS

A. Definitions in ASTM E 985 for railing-related terms apply to this Section.

### 1.03 SYSTEM DESCRIPTION

A. Structural Performance of Handrails and Railing Systems: Design, engineer, fabricate, and install handrails and railing systems to withstand the following structural loads without exceeding the allowable design working stress of the materials for handrails, railing systems, anchors, and connections. Apply each load to produce the maximum stress in each of the respective components comprising handrails and railing systems.

1. Top Rail of Guardrail Systems: Capable of withstanding the following loads applied as indicated:
   a. Concentrated load of 200 pounds-force applied at any point nonconcurrently, vertically downward or horizontally.

   b. Uniform load of 50 pounds-force per linear foot applied nonconcurrently, vertically downward or horizontally.

   c. Concentrated and uniform loads above need not be assumed to act concurrently.

2. Handrails Not Serving as Top Rails: Capable of withstanding the following loads applied as indicated:
   a. Concentrated load of 200 pounds-force applied at any point nonconcurrently-concurrently, vertically downward or horizontally.

   b. Uniform load of 50 pounds-force per linear foot applied nonconcurrently-concurrently, vertically downward or horizontally.

   c. Concentrated and uniform loads above need not be assumed to act concurrently.

1.04 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01040, Project Coordination, covering the items included under this Section. Shop Drawing submittals shall include:

1. Shop Drawings showing details of fabrication and installation for each type and material of handrail and railing system required including plans, elevations, sections, profiles of rails, fittings, connections, and anchors.

2. Manufacturer's technical data for products and processes used in handrails and railing systems, including finishes and grout.

3. Provide templates for anchor and bolt installation by others.

4. Include structural computations evidencing compliance of handrails and railing systems with design loadings indicated.

B. Samples: Prepare samples of each type of metal finish required on metal of same thickness and alloy indicated for final Work. Where finish involves normal color and texture variations, include sample sets composed of 2 or more units showing limits of such variations expected in completed work.

C. Test reports from independent testing laboratory evidencing compliance of handrails and railing systems with ASTM E 985.

1.05 QUALITY ASSURANCE

A. Single Source Responsibility: Obtain handrails and railing systems of each type and material from a single manufacturer.

B. Design Responsibility: Engage a qualified Professional Engineer to prepare or supervise the preparation of structural computations for handrails and railing systems to determine compliance with structural performance requirements indicated.

C. Engineer Qualifications: A Professional Engineer who is licensed to practice in jurisdiction where Project is located and who is experienced in providing structural engineering services of the kind required for Work of this Section.

1.06 STORAGE

A. Store handrails and railing systems in clean, dry location, away from uncured concrete and masonry, protected against damage of any kind. Cover with waterproof paper, tarpaulin, or polyethylene sheeting; allow for air circulation inside the covering.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:

1. Aluminum Pipe Railing System:

a. Aluminum Tube Railings, Inc.
b. Architectural Art Mfg., Inc.
c. Blum: Julius Blum & Co., Inc.
d. Blumcraft of Pittsburgh.
e. Braun, J.G. Braun Co.
f. Craneveyor Corp.
g. Lifeguard Corp.
h. Newman Bros., Inc.
i. Potts Mfg. Div., Flight Systems.
j. Sterling Factories, Inc.
k. Superior Aluminum Products, Inc.
l. Tri-Tech, Inc.
m. TSCO International, Tube Specialties Co., Inc.
n. Wagner: R & B Wagner, Inc.
o. York Metal Fabricators, Inc.

2.02 METALS

A. Comply with standards indicated for forms and types of metals indicated or required for handrail and railing system components.

B. Aluminum: Provide alloy and temper recommended by aluminum producer or finisher for type of use and finish indicated, and with not less than the strength and durability properties of the alloy and temper designated below for each aluminum form required.

1. Extruded Bar and Shape: ASTM B 221, 6063-T6.
2. Extruded Pipe and Tube: ASTM B 429, 6063-T6.
3. Die and Hand Forgings: ASTM B 247, 6061-T6.
4. Castings: ASTM B 26, 356-T6.

## 2.03 MISCELLANEOUS MATERIALS

A. Nonshrink, Nonmetallic Grout: Pre-mixed, factory packaged, nonstaining, noncorrosive, nongaseous grout complying with CE CRD-C621. Provide grout specifically recommended by manufacturer for interior and exterior applications of type specified in this Section.

B. Welding Electrodes and Filler Metal: Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded, complying with applicable AWS specifications, and as required for color match, strength, and compatibility in fabricated items.

C. Fasteners: Use fasteners of same basic metal as the fastened metal unless otherwise indicated. Do not use metals which are corrosive or incompatible with materials joined.

1. Provide concealed fasteners for interconnection of handrail and railing components and for their attachment to other work, except where exposed fasteners are unavoidable or are the standard fastening method for handrail and railing system indicated.

2. Provide Phillips flat-head machine screws for exposed fasteners, unless otherwise indicated.

D. Anchors and Inserts: Provide anchors of type, size, and material required for type of loading and installation condition shown, as recommended by manufacturer, unless otherwise indicated. Use nonferrous metal of hot-dipped galvanized anchors and inserts for exterior locations and elsewhere as required for corrosion resistance. Use toothed steel or expansion bolt devices for drilled-in-place anchors.

E. Bituminous Paint: SSPC-Paint 12 (cold-applied asphalt mastic).

F. Zinc Chromate Paint: FS TT-P-645.

## 2.04 FABRICATION

A. Fabricate handrails and railing systems to design, dimensions, and details shown. Provide handrail and railing members in sizes and profiles indicated, with supporting posts and brackets of size and spacing shown, but not less than required to comply with requirements indicated for structural performance.

B. Shop Assembly: Pre-assemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

C. Nonwelded Connections: Fabricate railing systems and handrails for interconnection of members by means of railing manufacturer's standard concealed mechanical fasteners and fittings unless otherwise indicated. Fabricate members and fittings to produce flush, smooth, rigid hairline joints.

D. Fabricate splice joints for field connection using epoxy structural adhesive where this represents manufacturer's standard splicing method.

E. Welded Connections for Aluminum Pipe: Fabricate aluminum pipe handrails and railing systems for interconnection of members by concealed internal welds, which eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.

F. Toe Boards: Where indicated, provide toe boards at railing systems around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details shown or, if not shown, use manufacturer's standard section, if available, to provide toe boards 4 inches high.

G. Brackets, Flanges, Fittings, and Anchors: Provide manufacturer's standard wall brackets, flanges, miscellaneous fittings and anchors for interconnection of handrail and railing members to other work, unless otherwise indicated.

1. Provide inserts and other anchorage devices for connecting handrails and railing systems to concrete or masonry work. Fabricate anchorage devices which are capable of withstanding loadings imposed by handrails and railing systems. Coordinate anchorage devices with supporting structure.

2. For railing posts set in concrete provide preset sleeves of steel, not less than 6 inches long and inside dimensions not less than 1/2 inch greater than outside dimensions of post, with steel plate forming bottom closure.

3. Provide slip-fit metal sockets to receive removable railing posts. Fabricate sockets for a close fit with posts and to limit deflection of post without lateral load, measured at top, not to exceed 1/12 of post height. Design and fabricate socket covers to resist accidental dislodgement.

## 2.05 METAL FINISHES

A. Comply with NAAMM "Metal Finishes Manual" for recommendations and designations of finishes, except as otherwise indicated.

B. Aluminum Finishes:

1. Class I Clear Anodized Finish: AA-M32C22A41 (medium satin directional textured mechanical finish; chemical etch, medium matte; 0.7 mil minimum thick clear anodic coating) complying with AAMA 607.1.

## PART 3 - EXECUTION

### 3.01 PREPARATION

A. Coordinate setting Drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as sleeves, concrete inserts, anchor bolts, and miscellaneous items having integral anchors which are to be embedded in concrete as masonry construction. Coordinate delivery of such items to Site.

B. Field Measurements: Take field measurements prior to fabrication.

### 3.02 INSTALLATION

A. Fit exposed connections accurately together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installation of handrails and railing systems. Set Work accurately in location, alignment, and elevation, plumb, level, true, and free of rack, measured from established lines and levels. Do not weld, cut or abrade surfaces of handrails and railing components which have been coated or finished after fabrication and are intended for field connection by mechanical means without further cutting or fitting.

C. Field Welding: Comply with applicable AWS specification for procedures of manual shielded metal arc welding, for appearance and quality of welds made, and for methods used in correcting welding work. Weld connections which are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Grind exposed joints smooth and restore finish to match finish of adjacent rail surfaces.

D. Corrosion Protection: Coat concealed surfaces of aluminum, which will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint or zinc chromate primer.

1. Adjust handrails and railing systems prior to anchoring to ensure matching alignment at abutting joints. Space posts at intervals indicated but not less than that required by design loadings.

3.03 ANCHORING POSTS

A. Concrete-Anchored Posts in Sleeves: Insert posts in pre-set sleeves cast into concrete and fill annular space between posts and sleeve solid with nonshrink, nonmetallic grout, mixed and placed to comply with grout manufacturer's directions.

3.04 RAILING CONNECTIONS

A. Welded Connections: Use fully welded joints for permanently connecting railing components by welding. Cope or butt components to provide 100 percent contact or use manufacturer's standard fittings designed for this purpose.

3.05 ANCHORING RAILING ENDS

A. Anchor railing ends into concrete or masonry with manufacturer's standard fittings designed for this purpose unless otherwise indicated.

B. Anchor railing ends to metal surfaces by welding using manufacturer's standard fittings unless otherwise indicated.

3.06 ATTACHMENT OF HANDRAILS TO WALLS

A. Secure handrails to walls with manufacturer's standard wall brackets and end fittings, unless otherwise indicated.

1. For concrete, use drilled-in expansion shields and concealed hanger bolts unless otherwise indicated.

3.07 PROTECTION

A. Protect finishes of railing systems and handrails from damage during construction period by use of temporary protective coverings approved by railing manufacturer. Remove protective covering at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period so that no evidence remains of correction Work. Return items which cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units as required.

END OF SECTION

# SECTION 05531

# BAR GRATINGS

## PART 1 - GENERAL

### 1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.02 SUMMARY

3.01 Section includes metal bar gratings and metal frames and supports for gratings.

A. Related Requirements:

1. Section 05140 "Structural Aluminum" for structural-steel framing system components.

2. Section 05520 "Handrails and Railings" for metal pipe and tube handrails and railings.

### 1.03 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for gratings, grating frames, and supports. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

### 1.04 ACTION SUBMITTALS

A. Product Data: For the following:

1. Clips and anchorage devices for gratings.
2. Paint products.

B. Shop Drawings: Include plans, sections, details, and attachments to other work.

C. Delegated-Design Submittal: For gratings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.05 INFORMATIONAL SUBMITTALS

A. Mill Certificates: Signed by manufacturers of stainless steel certifying that products furnished comply with requirements.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.06 QUALITY ASSURANCE

A. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.07 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with gratings by field measurements before fabrication.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Alabama Metal Industries Corporation; a Gibraltar Industries company.
2. All American Grating.
3. BarnettBates Corporation.
4. Fisher & Ludlow; Division of Harris Steel Limited.
5. Grating Pacific, Inc.
6. Grupo Metelmex, S.A. de C.V.
7. IKG Industries; a division of Harsco Corporation.
8. Marwas Steel Co.; Laurel Steel Products Division.
9. Ohio Gratings, Inc.
10. Seidelhuber Metal Products; Division of Brodhead Steel Products.

2.02 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, registered in the State of Florida to design gratings.

B. Structural Performance: Gratings shall withstand the minimum effects of gravity loads and the following loads and stresses within limits and under conditions indicated or as required on the structural drawings:

1. Floors: Uniform load of 250 lbf/sq. ft. or concentrated load of 3000 lbf, whichever produces the greater stress.

2. Limit deflection to L/360 or 1/4 inch, whichever is less.

C. Seismic Performance: Gratings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Component Importance Factor: 1.5.

2.03 ALUMINUM

A. General: Provide alloy and temper recommended by aluminum producer for type of use indicated, with not less than the strength and durability properties of alloy, and temper designated below for each aluminum form required.

B. Extruded Bars and Shapes: ASTM B 221, alloys as follows:

1. 6061-T6 or 6063-T6, for bearing bars of gratings and shapes.

2. 6061-T1, for grating crossbars.

C. Aluminum Sheet: ASTM B 209, Alloy 5052-H32.

2.04 FASTENERS

A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners. Select fasteners for type, grade, and class required.

B. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts, and, where indicated, flat washers; ASTM F 593 for bolts and ASTM F 594 for nuts, Alloy Group 1.

C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563 and, where indicated, flat washers.

D. Post-Installed Anchors: Torque-controlled expansion or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

1. Material: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.05 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with section 09900 “Painting”

## 2.06 FABRICATION

A. Shop Assembly: Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.

D. Fit exposed connections accurately together to form hairline joints.

E. Welding: Comply with AWS recommendations and the following:

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.

F. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.

1. Fabricate toeplates to fit grating units and weld to units in shop unless otherwise indicated.

2. Fabricate toeplates for attaching in the field.

3. Toeplate Height: 4 inches unless otherwise indicated.

G. Removable Grating Sections: Fabricate with banding bars attached by welding to entire perimeter of each section. Include anchors and fasteners of type indicated or, if not indicated, as recommended by manufacturer for attaching to supports.

1. Provide no fewer than four weld lugs for each heavy-duty grating section, with each lug shop welded to two bearing bars.

2. Provide no fewer than four saddle clips for each grating section containing rectangular bearing bars 3/16 inch or less in thickness and spaced 15/16 inch or more o.c., with each clip designed and fabricated to fit over two bearing bars.

3. Provide no fewer than four weld lugs for each grating section containing rectangular bearing bars 3/16 inch or less in thickness and spaced less than 15/16 inch o.c., with each lug shop welded to three or more bearing bars. Interrupt intermediate bearing bars as necessary for fasteners securing grating to supports.

4. Provide no fewer than four flange blocks for each section of aluminum I-bar grating, with block designed to fit over lower flange of I-shaped bearing bars.

5. Furnish threaded bolts with nuts and washers for securing grating to supports.

6. Furnish self-drilling fasteners with washers for securing grating to supports.

7. Furnish Type 316 stainless steel flange clamp with stainless steel bolt for securing grating to supports. Furnish as a system designed to be installed from above grating by one person.

    1) Kee Industrial Products, Inc.; Grating Clip.
    2) Lindapter North America, Inc.; Grate-Fast.

H. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.

1. Edge-band openings in grating that interrupt four or more bearing bars with bars of same size and material as bearing bars.

I. Do not notch bearing bars at supports to maintain elevation.

2.07 GRATING FRAMES AND SUPPORTS

A. Fabricate from metal shapes, plates, and bars of welded construction to sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.

1. Unless otherwise indicated, fabricate from same basic metal as gratings.

2. Equip units indicated to be cast into concrete or built into masonry with integrally welded anchors. Unless otherwise indicated, space anchors 24 inches o.c. and provide minimum anchor units in the form of steel straps 1-1/4 inches wide by 1/4 inch thick by 8 inches long.

2.08 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I.

PART 3 - EXECUTION

Shop prime with primers specified in Section 09900 “Painting”.

3.02 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.

D. Fit exposed connections accurately together to form hairline joints.

1. 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 the surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

E. Attach toeplates to gratings by welding at locations indicated.

F. Field Welding: Comply with AWS recommendations and the following:

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.

G. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.03 INSTALLING METAL BAR GRATINGS

A. General: Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.

B. Attach removable units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.

C. Attach nonremovable units to supporting members by welding where both materials are same; otherwise, fasten by bolting as indicated above.

3.04 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

END OF SECTION

# SECTION 09900

# PAINTING

## PART 1 - GENERAL

### 1.01 DESCRIPTION OF WORK

A. The Contractor shall furnish all materials, labor, services, equipment, and incidentals required to provide a protective coating system for the surfaces listed herein and not otherwise excluded. The work shall include furnishing samples of paints and color charts.

B. The work includes painting and finishing of interior and exterior exposed items and surfaces such as pipes, fittings, valves, pipe supports, equipment, and all other work obviously required to be painted unless otherwise specified herein or on the Drawings. The omission of minor items in the schedule of work shall not relieve the Contractor of his obligation to include such items where they come within the general intent of the Specifications as stated herein. The following major items of the Project shall be coated:

1. Submerged surfaces of any ferrous metal and aluminum components of equipment, piping, fittings, valves, pipe supports and accessories (except stainless steel).

2. Exposed ferrous surfaces of equipment, pumps, motors, and ferrous or galvanized metal piping, fittings, valves, pipe supports and accessories (except stainless steel).

3. Exposed surfaces of PVC components of piping, fittings, valves, electrical conduit, and equipment.

4. Exposed exterior surfaces of all metallic piping, fittings, and valves located on the interior and exterior of structures.

5. Embedded aluminum or aluminum in contact with dissimilar metals or in contact with corrosive atmospheres.

C. "Paint" as used herein means all coating systems, materials, including primers, emulsions, enamels, epoxies, sealers and fillers, and other applied materials whether used as a prime, intermediate, or finish coats.

D. The following items will not be painted unless otherwise noted:

1. Any code-requiring labels, such as Underwriters' Laboratories and Factory Mutual, or any equipment identification, performance rating, name or nomenclature plates.

2. Any moving parts of operating units, such as valve operators, linkages, sensing devices, and motor shafts.

3. Aluminum or fiberglass handrails, walkways, toeboards, windows, louvers, grating, checker plate, hatches, and stairways.

4. Stainless steel angles, tube, pipe, etc.

5. Products with polished chrome, aluminum, nickel, or stainless steel finish.

6. Stainless steel, brass, bronze, and aluminum other than exposed utility tubing.

7. Flexible couplings, lubricated bearing surfaces, insulation, and plastic pipe or duct interiors.

8. Plastic switch plates and receptacle plates.

9. Signs and nameplates.

10. Finish hardware.

11. Packing glands and other adjustable parts, unless otherwise indicated.

12. Portions of metal, other than aluminum, embedded in concrete. This does not apply to the back face of items mounted to concrete or masonry surfaces which shall be painted before erection. Aluminum to be embedded in, or in contact with, concrete shall be coated to prevent electrolysis.

1.02 RELATED WORK

A. Paint piping and equipment for identification purposes in accordance with Section 09905: Piping and Equipment Identification System.

1.03 QUALITY ASSURANCE

A. Provide the best quality grade of the various types of coatings as regularly manufactured by approved paint material manufacturers. Materials not

displaying the manufacturer's identification as a standard, best-grade product will not be acceptable.

B. Provide undercoat paint produced by the same manufacturer as the finish coats. Undercoat and finish coat paints shall be compatible. Use only thinners approved by the paint manufacturer, and use only within recommended limits.

C. Painting shall be accomplished by experienced painters specializing in industrial painting familiar with all aspects of surface preparations and applications required for this project. Work shall be done in a safe and workmanlike manner.

D. Standards

1. ASTM.
2. OSHA.
3. NFPA.
4. SSPC.
5. NACE.
6. NSF.
7. AWWA.

1.04 SUBMITTALS

A. Materials and Shop Drawings: Submit to the Engineer as provided in Section 01040: Project Coordination, shop drawings, manufacturer's specifications, and data on the proposed paint systems and detailed surface preparation, application procedures and dry film thickness (DFT).

B. Schedule

1. All painting shall be in accordance with the schedules included in this specification.

2. The Contractor shall submit for approval a complete typewritten Schedule of Painting Operations within 90 days after the Notice to Proceed. This Schedule is imperative so that the various fabricators or suppliers may be notified of the proper prime coat to apply. It shall be the Contractor's responsibility to properly coordinate the fabricators' or suppliers' surface preparation and painting operations with these Specifications. This Schedule shall be in accordance with the recommendations of the paint manufacturer and shall include for each surface to be painted, the brand name, generic type, solids by volume, application method, the coverage and the number of coats in

order to achieve the specified dry film thickness, and color charts. The total mil thickness of all coatings shall not be less than the schedule included in this Section. When the Schedule has been approved, the Contractor shall apply all material in strict accordance with the approved Schedule and the manufacturer's instructions. Wet and dry paint film gauges may be utilized by the Owner or Engineer to verify the proper application while work is in progress.

3. It is the intent of this Section that as much as possible all structures, equipment, and piping utilize coating systems specified herein supplied by a single manufacturer. All exceptions must be noted on the Schedule. For each coating system, only one (1) manufacturer's product shall be used.

C. Samples- Painting

1. Paint colors will be selected by the Owner or Engineer. Compliance with all other requirements is the exclusive responsibility of the Contractor.

2. Samples of each finish and color shall be submitted to the Owner or Engineer for approval before any work is started. Specimens, approximately 8 by 10 inches in size, shall be prepared and submitted to the Engineer. The minimum number of specimen custom mixed colors submitted shall be 6 not including color coding colors.

3. Paint and other materials shall be of the type and quality of the manufacturer on which the coating schedule is based. All coats of paint for any particular surface and thinners used shall be from the same manufacturer. The treatment of the surface to be painted and the application of paint shall be in accordance with the instructions of the manufacturer and as approved by the Engineer.

4. A supplementary schedule of paint products shall be submitted, with mil thickness, to cover all paint applied. The schedule shall be in accordance with the recommendations of the manufacturer of the paint. The total mil thickness of all coatings shall be not less than the schedule included in this section.

5. Samples shall be prepared so that an area of each sample indicates the appearance of the various coats. For example, where three (3) coat work is specified, the sample shall be divided into three (3) areas:

a. One (1) showing the application of one (1) coat only.

b. One (1) showing the application of two (2) coats.

c. One (1) showing the application of all three (3) coats.

6. Such samples when approved in writing shall constitute a standard, as to color and finish only, for acceptance or rejection of the finish work.

7. For piping, valves, equipment and miscellaneous metal work, provide sample chips or color charts of all paint selected showing color, finish, and general characteristics.

8. Rejected samples shall be resubmitted until approved.

D. The Contractor shall submit to the Owner, immediately upon completion of the job, certification from the manufacturer indicating that the quantity of each coating purchased was sufficient to coat all surfaces, in accordance with the requirements of this Section. Such certification shall make reference to square footage figures provided to the manufacturer by the Contractor.

1.05 DELIVERY, HANDLING AND STORAGE

A. Paints, stains, varnish, or ingredients of paints to be mixed on the job shall be prepared, packed and labeled, and guaranteed by an approved manufacturer. All material shall be delivered to the site in original, unbroken containers. Only paint of approved manufacturers shall be delivered and stored at the site.

B. The manner of and place for storing the painting materials at the site shall be as approved by the Engineer. The storage space shall be kept clean at all times. Every precaution shall be taken to eliminate fire hazards.

C. Deliver all materials to the job site in original, unopened packages and containers bearing manufacturer's name and label in accordance with Section 01600: Materials and Equipment.

1. Provide labels on each container with the following information:

a. Name or title of material.

b. Fed. Spec. number if applicable.

c. Manufacturer's stock number, date of manufacture and expiration date (shelf life).

d. Manufacturer's formula or specification number.

e. Manufacturer's batch number.

f. Manufacturer's name.

g. Generic type.

h. Contents by volume, for major pigment and vehicle constituents.

i. Application instructions: thinning, ambient conditions, etc.

j. Color name and number.

2. Containers shall be clearly marked to indicate any hazards connected with the use of the paint and steps which should be taken to prevent injury to those handling the product.

D. All containers shall be handled and stored in such a manner as to prevent damage or loss of labels or containers.

E. Used rags shall be removed from the buildings every night and every precaution taken against spontaneous combustion.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

A. All paint shall be manufactured by one of the suppliers listed in the coating schedule unless otherwise directed by the Engineer.

B. The coating systems list a product by name to establish a standard of quality; other products of the same generic types may be submitted to the Engineer for approval as described in Paragraph 1.04., herein. When other than the specified coating system is proposed, the Contractor shall submit a typewritten list giving the proposed coatings, brand, trade name, generic type and catalog number of the proposed system for the Engineer's approval.

C. Paint used in successive field coats shall be produced by the same manufacturer. Paint used in the first field coat over shop painted or previously painted surfaces shall cause no wrinkling, lifting, or other damage to underlying paint. Shop paint shall be of the same type and manufacture as used for field painting by the Contractor.

D. Emulsion and alkyd paints shall contain a mildewcide and both the paint and mildewcide shall conform to OSHA and Federal requirements, including Federal Specification TT-P- 19.

E. Finish coats containing lead shall not be allowed. Oil shall be pure boiled linseed oil.

F. Rags shall be clean painter's rags, completely sterilized.

2.02 COATING SCHEDULE

A. All painting shall be in accordance with the following schedule, unless otherwise directed by the Engineer. The number of coats shall not be less than the number shown on the schedule.

| COATING SCHEDULE | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Coats | | | | | | | |
| Class of Work - Metal Surfaces | Pretreatment | | Primer | | Intermediate | | Finish | |
| | PPG | Tnemec | PPG | Tnemec | PPG | Tnemec | PPG | Tnemec |
| Copper Piping | --- | N/A | --- | A | K | A | K | --- |
| Electrical Conduit | A or N | N/A | C | A | K | A | K | --- |
| Steel Pipe, Valves, and Fittings | N | N/A | N | A | K | --- | K | --- |
| Ductile Iron Pipe, Valves, and Fittings (Not Buried) | --- | N/A | E | F(1) | K | A | K | C |
| Miscellaneous Steel and Ironwork | N | --- | N | E(1) | K | A | K | C |
| Machinery, Interior, and Nonsubmerged | --- | --- | C | G(2) | K | A | K | A |

Notes: (1) Shop applied
(2) Shop or field applied

1. The designations in the following list are given solely for the purpose of indicating the type and quality of materials desired. Approved equivalent material of other manufacturers may be substituted. All coats of paint for any particular surface shall be from the same manufacturer.

| ALPHABETICAL DESIGNATIONS OF PRODUCTS | | | |
|---|---|---|---|
| Symbol | PPG Product Name and Number | Tnemec Product Name and Number | Minimum Dry Film Thickness Mils per Coat |
| A | Henkel's PPG Alumiprep 33 | Tnemec Series 66HS | N/A |
| C | PPG's Multi-Prime Fast Dry Alkyd 94-258 | Tnemec Series 1095 | 2.0 |
| E | PPG's Pitt-Tech Primer 90-712 | Tnemec Series 90-97 Tnemec Zinc | 1.5 |
| F | Not Applicable | Tnemec Series N140-1211 | N/A |
| G | PPG's Perma Crete Pigmented Bonding Coat | Tnemec Series 1 | N/A |

| ALPHABETICAL DESIGNATIONS OF PRODUCTS | | | |
|---|---|---|---|
| **Symbol** | **PPG Product Name and Number** | **Tnemec Product Name and Number** | **Minimum Dry Film Thickness Mils per Coat** |
| H | PPG's Acri-Shield Flat 100% Acrylic Exterior 519 | N/A | 2.0 |
| I | PPG's Pitt-Tech DTM Gloss Finish 90-374 | N/A | 1.5 |
| K | PPG's Amerlock 2 Epoxy Coating | N/A | 5.0 |
| N | PPG's PittBull Cold galvanized Spray 55-653 | N/A | 1.5 |

2. This paint schedule may vary to suit the current product recommendations of the manufacturer's technical representative.

PART 3 - EXECUTION

3.01 SHOP PAINTING

A. Surface Preparation - All ferrous metal to be primed in the shop shall have all rust, dust and scale, as well as all other foreign substances, removed by sandblasting or pickling in accordance with SSPC-SP5 or SP8, respectively. Alternatively, ferrous metal to be primed in the shop shall be cleaned per 150 Standards with the cleanliness before painting measured according to the Brestle Method 150-8502-6 within maximum acceptable valves of 50 $mg/m^2$. Cleaned metal shall be primed or pretreated immediately after cleaning to prevent new rusting. Under no circumstances will cleaned metal be allowed to sit overnight before priming, or pretreatment and priming. All nonferrous metals shall be solvent cleaned prior to the application of primer. In addition, galvanized surfaces which are to be topcoated shall first be degreased then primed.

B. Materials Preparation

1. Mix and prepare painting materials in strict accordance with manufacturer's recommendations and directions, stirring materials before and during application to maintain a mixture of uniform density, free of film, dirt and other foreign materials.

2. No thinners shall be used except those specifically mentioned and only in such quantity as directed by the manufacturer in his instructions. If thinning is used, sufficient additional coats shall be applied to assure the required dry film thickness is achieved. The manufacturer's recommended thinner or clean-up solvent shall be used for all clean-

up. Application by brush, spray, airless spray or roller shall be as recommended by the manufacturer for optimum performance and appearance.

C. Applications

1. All painting shall be done by skilled and experienced craftsmen and shall be of highest quality workmanship. Coating systems shall be as specified herein.

2. Apply paint in accordance with the manufacturer's directions. Use applicators and techniques best suited for the type of material being applied.

3. All paint and coatings materials shall be stored under cover and at a temperature within 10°F of the anticipated application temperature and at least 5°F above the dew point.

4. Apply additional coats when undercoats, stains, or other conditions show through the final coat of paint, until the paint film is of uniform finish, color, and appearance.

5. Paint shall be applied in a neat manner with finished surfaces free of runs, sags, ridges, laps, and brush marks. Each coat shall be applied in a manner that will produce an even film of uniform and proper thickness.

6. Paint back sides of access panels and removable or hinged covers to match the exposed surfaces.

7. Equipment manufacturer or supplier shall provide touch-up paint for items with shop applied finish coats.

8. Where specified in the individual Sections, primer coat(s) shall be applied in the shop by the equipment manufacturer. The shop coats shall be as specified and shall be compatible with the field coat or coats.

D. Certification: The Contractor shall obtain from the equipment manufacturer or supplier, prior to shipment of equipment, a written certification that surface preparation, coating brand, material, DFT, and application method complied with this Section.

## 3.02 SURFACE PREPARATION

A. Prior to painting, all surfaces shall be prepared and cleaned in strict accordance with the paint manufacturer’s recommendations and as directed by the Engineer. Surfaces shall be dry before any paint is applied. Special surface preparation

work shall be as directed by the manufacturer of the paint specified to be applied to the surface.

B. All dirt, rust, scale, splinters, loose particles, disintegrated paint, grease, oil, and other deleterious substances shall be removed from all surfaces which are to be coated.

C. Hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items and surfaces not to be painted which are in contact with or near surfaces to be painted shall be removed, masked, or otherwise protected prior to surface preparation and painting operations. Refer to Paragraph 3.09B.

D. Before commencing work, the painter must make certain that surfaces to be covered are in proper condition and must obtain Engineer's approval to proceed. Should the painter find such surfaces impossible of acceptance, he shall report such fact to the Engineer. The application of paint shall be held as an acceptance of the surfaces and working conditions and the painter will be held responsible for the results reasonably expected from the materials and processes specified.

E. Program the cleaning and painting so contaminants from the cleaning process will not fall onto wet, newly-painted surfaces.

F. Ferrous Metal Surfaces

1. Remove any oil or grease from surfaces to be coated with clean rags soaked in toluol or other solvent recommended by coating manufacturer in accordance with SSPC specifications. Any chemical contamination shall be eliminated by means of neutralization or flushing or both prior to additional surface preparation.

2. For immersion service, all sharp edges and welds shall be ground smooth to a rounder contour, all weld splatter shall be removed, and all pits and dents shall be filled, and all imperfections shall be corrected prior to sandblasting.

3. For non-immersion service, all sharp edges and welds shall be ground, all weld splatter shall be removed, all pits and dents shall be filled, and all imperfections shall be corrected prior to sandblasting.

4. For immersion service, all surfaces to be coated shall be sandblasted to white metal in accordance with Steel Structures Painting Council Specification SP-5. A white metal blast is defined as removing all rust, scale, paint, etc., to a clean white metal which has a uniform

gray-white appearance. No streaks or stains or rust or any other contaminants are allowed. The proper abrasive to obtain the specified surface profile (anchor pattern) designated in the coating manufacturer's most recent printed application instructions shall be used. After sandblasting, dust and spent sand shall be removed from the surfaces by brushing or vacuum cleaning. The prime coat shall be applied as soon as possible after the blasting preparation is finished and always before the surface starts to rust. No sandblasted surface shall stand overnight before coating.

5. For non-immersion service, or wherever specified in the coating manufacturer's most recent printed application instructions for other services, all surfaces to be coated shall be sandblasted to near white metal in accordance with Steel Structures Painting Council Specification SP-10. A near white metal blast is defined as removing all rust, scale, paint, etc., except for very light shadows, very slight streaks or slight discolorations caused by rust stain, mill scale oxides, or slight, tight residues of paint or coatings that may remain. The proper abrasive to obtain the specified surface profile (anchor pattern) designated in the coating manufacturer's most recent printed application instructions shall be used. After sandblasting, dust and spent sand shall be removed from the surfaces by brushing or vacuum cleaning. The prime coat shall be applied as soon as possible after the blasting preparation is finished and always before the surface starts to rust. No sandblasted surface shall stand overnight before coating.

6. Where blast cleaning is done in the field, only "virgin" sand, grit, or abrasive will be used.

7. Inaccessible areas, such as skip-welded lap joints, or in between back-to- back angle iron bracing, shall be coated before assembly to prevent corrosive action from taking place in these inaccessible areas. All surface voids shall be seal-welded. Sharp corners and edges shall be ground to a smooth contour and welds prepared as described above.

G. Galvanized Steel and Non-Ferrous Metal

1. Galvanized steel and aluminum will only be coated when so specified.

2. Surfaces shall be clean and dry. Remove dust and dirt by blowing off the surface with high pressure air or wiping clean with dry rags. Oil, grease and protective mill coatings shall be removed by solvent cleaning in accordance with SSPC-SPl.

3. White rust should be removed from galvanized steel or aluminum by

hand or power brushing. Care should be taken not to damage or remove the galvanizing. Rust should be removed from old galvanized steel by Hand or Power Tool Cleaning in accordance with SSPC-SP2 or SP3.

4. Other surface preparation as outlined in the coating manufacturer's latest written application instructions shall be observed for more demanding exposures.

H. Stainless Steel

1. Stainless steel will only be coated when so specified, or when it is adjacent to areas to be coated such as piping supports, anchor bolts or flange bolts.

2. Stainless steel requires only solvent cleaning prior to coating using any one of the methods in SSPC-SP1. Only solvents and cleaning solutions containing less than 200 ppm of halogens should be used to prevent stress corrosion cracking.

3. Stainless steel may be whip-blasted to provide a surface profile to increase the mechanical bond of the coating system. The height of the profile and the texture required shall be defined for the operator and as a standard for the acceptance of the work. Pictorial standards for the surface cleanliness of carbon steel are not applicable to stainless steel, since there are no corrosion products or mill scale to remove from the surface.

4. Abrasive blast cleaning procedures outlined by Steel Structures Painting Council for carbon steel may also be used for stainless steel. Only very hard silica sand or other abrasive media shall be used for a fast cutting action and to obtain a sharp angular profile.

I. PVC or Other Plastic Piping

1. Solvent clean.

2. If recommended by manufacturer, lightly abrade surface with medium grade sandpaper. Remove dust by wiping with clean rags.

3.03 MATERIALS PREPARATION

A. Mix and prepare painting materials in strict accordance with manufacturer's recommendations and directions, stirring materials before and during application to maintain a mixture of uniform density, free of film, dirt, and other foreign materials.

B. All surfaces shall be cleaned in accordance with Steel Structures Painting

Council standards SSPC - SP1 Solvent Cleaning for removal of grease and oil. This standard allows for pressure washing, detergent cleaning, etc. Additional rust, loose paint, loose mill scale, etc., shall be removed in accordance with SSPC - SP2 Hand Tool Cleaning or SSPC - SP3 Power Tool Cleaning. All welds, beads, blisters or protuberances, other than identification markings shall be ground smooth. Pits and dents shall be filled with a suitable product as approved by the Engineer, and other imperfections shall be removed. Painted edges shall be sanded smooth with adjacent bare metal surfaces.

C. Where aluminum surfaces come in contact with incompatible metals, lime, mortar, concrete or other masonry materials, these areas shall be given two coats of asphalt varnish conforming to Fed. Spec. TT-V-51F.

D. Except where otherwise specified, thinning shall be done only if necessary for the workability of the coating material and then, only in accordance with the coating manufacturer's most recent printed application instructions. Use only thinner provided by coating manufacturer. If thinning is used, sufficient additional coats shall be applied to assure the required dry film thickness is achieved. The manufacturer's recommended thinner or clean-up solvent shall be used for all clean-up. Application by brush, spray, airless spray or roller shall be as recommended by the manufacturer for optimum performance and appearance.

## 3.04 APPLICATION

A. Paint all exposed surfaces in rooms scheduled for painting whether or not colors are designated in schedules, except where the natural finish of material is obviously intended and specifically noted as a surface that will not be painted. Where items or surfaces are not specifically mentioned, paint these the same as adjacent similar materials or areas. If color of finish is not designated, the Engineer will select these from standard colors available for the materials systems as specified. All paints and similar materials shall be mixed in galvanized iron pans or pails or other approved containers of adequate capacity. All paint shall be stirred thoroughly before being taken from the containers, shall be kept stirred while using, and all ready-mixed paint shall be applied exactly as received from the manufacturer without addition of any kind of drier or thinner, except as specified or as permitted or directed by the Engineer. Successive coats of paint shall be tinted to make various coats easily distinguishable. Undercoats of paint shall be tinted to the approximate shade of the final coat of paint. The paint shall be a minimum temperature of 60 degrees F before application.

B. Color Selection

1. Colors for Multi-Coat Systems: Each coat shall be applied in a different color or shade from the preceding coat to aid in determining

the uniformity and coverage of the coating. The finish coat color shall be selected by the Owner or Engineer. When a white finish coat is specified, the last two (2) coats shall be white.

2. Color Coding Piping: All exposed piping shall be identified as specified in Section 09905: Piping and Equipment Identification System. Pipe identification system shall include color coding or banding, legends, and arrows.

C. All painting shall be done by skilled and experienced craftsmen and shall be of highest quality workmanship. Only skilled painters shall be used on the work, and specialists shall be employed where required. Paint shall be applied by brush, roller, or sprayer in accordance with the manufacturer's recommendation. Finished surfaces shall not show brush marks or other irregularities. Top and bottom edges of doors shall be painted. Undercoats on hollow metal work shall be thoroughly and uniformly sanded with No. 00 sandpaper or equal abrasive to remove all surface defects and provide a smooth, even surface.

D. Painting shall be a continuous and orderly operation to facilitate adequate inspection. All paint application methods shall be in accordance with the instructions of the paint manufacturer and as approved by the Engineer. Access panels, pipes, pipe covering, ducts, and other building appurtenances built into or adjoining walls to be painted shall be painted the same color as adjacent walls, unless otherwise directed by the Engineer. Hardware and accessories, fixtures, and similar items placed prior to painting shall be removed or protected during painting and replaced on completion of painting. All wall surfaces to be concealed by equipment shall be painted before installation of the equipment.

E. Areas under and adjacent to painted work shall be fully protected at all times and dripped or splattered paint shall be promptly removed. Painting shall not be done when the temperature is below 60 degrees F, or in dust-laden air, or until moisture on the surface has completely disappeared. If necessary, sufficient heating and ventilation shall be provided to keep the atmosphere and all surfaces to be painted dry and warm until each coat of paint has hardened. Any painting found defective shall be removed and repainted or touched up as directed by the Engineer.

F. Apply paint in accordance with the manufacturer's directions. Use applicators and techniques best suited for the type of material being applied. All equipment shall be maintained in good working order and shall be comparable to that described in the coating manufacturer's most recent application instructions. It shall be thoroughly cleaned and inspected daily. Worn spray nozzles, tips, etc., shall be replaced regularly. Effective oil and water separators shall be used and serviced on all air lines.

G. All paints and coating materials shall be stored under cover and at a temperature within 10°F of the anticipated application temperature and at least 5°F above the dew point.

H. Coatings must be allowed to cure before being recoated or placed into service. Drying time requirements recommended by the manufacturer should be followed exactly. Coverage shall be complete. Apply additional coats when undercoats, stains, or other conditions show through the final coat of paint, until the paint film is of uniform finish, color, and appearance.

I. Paint shall be applied in a neat manner with finished surfaces free of runs, sags, ridges, laps, and brush marks. Each coat shall be applied in a manner that will produce an even film of uniform and proper thickness. Allow each coat to dry thoroughly before applying the next coat following manufacturer's recommendations taking into account temperature and relative humidity.

J. All interior surfaces of structures shall be finish coated prior to installation of equipment, conduit, and other exposed items. Paint back sides of access panels and removable or hinged covers to match the exposed surfaces.

K. Finish exterior doors on tops, bottoms, and side edges the same as the exterior faces, unless otherwise indicated.

L. Sand lightly between each succeeding enamel or varnish coat.

M. Omit the field primer on metal surfaces which have been shop-primed and touch-up painted, unless otherwise specified.

N. The prime and intermediate coats as specified for the various coating systems may be applied in the shop by the manufacturer. The shop coats shall be of the type specified and shall be compatible with the field coating. Items such as pumps, motors, equipment, electrical panels, etc. shall be given at least one touch-up coat with the intermediate coating material and one (1) complete finish coat in the field.

O. All application tools and equipment shall be in good working order and suitable for proper applications. It shall be the Contractor's responsibility to ensure that no paint mist or spatter falls or blows to other objects, vehicles, equipment, buildings, etc.

## 3.05 APPLICATION RESTRICTIONS

A. Environmental Requirements

1. Comply with manufacturer's recommendations as to environmental

conditions under which coatings and coating systems can be applied.

a. The conditions below shall be adhered to even if manufacturer's recommendations are less stringent. If manufacturer's recommendations are more stringent, they shall apply.

b. No coatings shall be applied when the air, surface, and material temperature is below 55°F or above 95°F for 24 hours prior to and 24 hours after coating application. Surface temperature shall be at least 5°F above the dew point for 24 hours prior to and 24 hours after coating application. The dewpoint shall be determined by use of a sling psychrometer in conjunction with U.S. Weather Bureau psychometric tables. Do not apply coatings when the relative humidity exceeds 85 percent or to damp or wet surfaces, unless otherwise permitted by the coating manufacturer's printed instructions. No painting shall be done when the surfaces may become damaged by rain, fog or condensation or when it is anticipated that these conditions will prevail during the drying period, unless suitable enclosures to protect the surface are used. Where heat is necessary, it shall be supplied by the painting applicator and shall be of such type that it will maintain an air and coated surface temperature of 55°F minimum prior to and after the coating application as described above, and 90°F minimum during the cure stage if hot air forced curing is recommended by the coating manufacturer for special coatings. Further, this heater shall be of such type as not to contaminate the surface area to be or being coated with combustion products. The Contractor shall supply utilities to run electric or gas heaters. Any surface coating damaged by moisture or rain shall be removed and redone as directed by the Owner or Engineer.

2. Do not apply finish in areas where dust is being or will be generated during application through full cure.

3. All exterior painting shall be done only in dry weather.

4. Spray application shall occur only when wind velocities, including gusts, are less than 10 miles per hour. All materials, equipment, etc. in the vicinity of spray application shall be protected from overspray.

B. Application of materials shall be done only on properly prepared surfaces as herein specified. Between any two coats of material, unless specifically

covered in the coating manufacturer's most recent printed application instructions, if more than one (1) week passes between subsequent coats, the coating manufacturer shall be contacted for his recommended preparation of the surface prior to application of the next coat. This preparation might include brush-off blasting, steam cleaning, or solvent wiping (with an indicated solvent) and shall be specified in writing by the material supplier and followed by the applicator. Any surface coating damaged by moisture or rain shall be removed and redone as directed by the Owner or Engineer.

C. In no case shall paint be applied to surfaces which show a moisture content greater that 14 percent. The presence of moisture shall be determined prior to coating by testing with a moisture detection device such as a Delmhorst Model DLM2E.

3.06 MINIMUM COATING THICKNESS

A. Coating thickness shall meet or exceed the specified minimum dry film thickness (DFT) in all areas. The average coating thickness as determined by multiple representative DFT measurements shall meet or exceed the mid-point of the specified DFT range. If the measured DFT is below this value, the surface shall be recoated with at least the minimum DFT until the total DFT meets or exceeds the mid-point DFT.

B. Coverage rates are theoretical as calculated by the coating manufacturer and are, therefore, the maximum allowable.

C. Apply a prime coat to material which is required to be painted or finished, and which has not been prime coated by others.

D. On masonry, application rates will vary according to surface texture; however, in no case shall the manufacturer's stated coverage rate be exceeded. On porous surfaces, is shall be the painter's responsibility to achieve a protective and decorative finish either by decreasing the coverage rate or by applying additional coats of paint.

E. Recoat primed and sealed walls and ceilings where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.

3.07 FINISHES

A. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

B. Complete Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not in compliance with specific requirements.

3.08 FIELD QUALITY CONTROL

A. The Contractor shall request acceptance of each coat by the Owner's representative before applying the next coat; and the Contractor shall provide the

necessary properly calibrated gauges. All nonferrous surfaces shall be checked for number of coats and thickness by use of a Tooke gauge. All ferrous surfaces shall be checked for film thickness by use of an Elcometer or Micro-Test magnetic dry film gauge properly calibrated. In addition, submerged tank linings and metals shall be tested for freedom from holidays and pinholes by use of a Tinker-Rasor or K-D Bird Dog Holiday Detector. All defects shall be corrected to the satisfaction of the Owner.

3.09 PROTECTION

A. All other surfaces shall be protected while painting.

B. Protection of furniture and other movable objects, equipment, fittings, and accessories shall be provided throughout the painting operation. Remove all electric plates, surface hardware, etc., before painting; protect and replace when completed. Mask all machinery nameplates and all machined parts not to receive paint. Lay drop cloths in all areas where painting is being done to adequately protect flooring and other work from all damage.

3.10 CLEANING

A. The Contractor shall perform the work under this Section while keeping the premises free from accumulation of dust, debris, and rubbish and shall remove all scaffolding, paint cloths, paint, empty paint containers, and brushes from buildings and the project site when completed.

B. The Contractor shall touch up and restore any damaged finish. Care shall be taken not to mar any surface finish or item being cleaned. All paint brushed, splattered, spilled, or splashed on any surface not specified to be painted shall be removed.

C. The Contractor shall insure that all glass throughout the facility is cleaned of dirt and paint before he leaves the job site. Further, the Contractor shall insure that all glass is thoroughly washed and polished.

D. Upon completion of the project, the job site shall be left neat and clean.

3.11 EXTRA STOCK

A. Paint To Be Supplied To Owner: Upon completion of painting work, the Owner shall be furnished at no additional cost, unopened containers providing a minimum of one (1) gallon of each type and color of finish paint for

touching up. Multi- component coatings shall have each component supplied in separate containers boxed together. Paint container labels shall be complete with manufacturer's name, generic type, number, color, and location where used.

## 3.12 SAFETY

A. The Contractor shall be responsible for exercising all necessary precautions to ensure that no accidents or damage to personnel, equipment, or buildings shall occur. The Contractor shall further determine any special operations which could influence the safe workmanship of his personnel with respect to electrical, mechanical, or chemical fumes or fire hazard situations.

B. When painting in confined areas or otherwise in areas where explosive fumes or gases need to be ventilated, the Contractor shall use suction type fans designated specifically for the safe removal of explosive fumes or gases, and all equipment involved shall meet all OSHA (Occupational Safety Hazard Act) requirements and MSHA (Mine Safety and Health Administration) approved. The Contractor shall be responsible in all respects for the safe conduct of his personnel when using any of the rigging or equipment involved in the accomplishment of the work specified herein.

END OF SECTION

# SECTION 09905

# PIPING, VALVE, AND EQUIPMENT IDENTIFICATION SYSTEM

## PART 1 - GENERAL

### 1.01 DESCRIPTION

A. Scope of Work: The work included under this Section consists of providing an identification system for piping systems and related equipment.

B. Related Work Described Elsewhere:

1. Project Coordination: Section 01040.

2. Painting: Section 09900.

3. Equipment: Division 11.

4. Special Construction: Division 13.

5. Mechanical: Division 15.

6. Electrical: Division 16.

### 1.02 QUALITY ASSURANCE

A. Standards: ANSI Standard A13.1, Scheme for the Identification of Piping Systems.

### 1.03 SUBMITTALS

A. Submit manufacturer's descriptive literature, illustrations, specifications, and other pertinent data in accordance with Section 01040: Project Coordination.

B. Schedules:

1. Provide a typewritten list of all tagged valves giving tag color, shape, letter code and number, the valve size, type, use, and general location.

2. Provide a complete list of materials to be furnished and surfaces on which they will be used.

C. Samples:

1. Provide a sample of each type valve tag supplied.

2. Provide a sample of each type of identification tape supplied.

3. Provide manufacturer's color charts for color selection by Engineer.

1.04 PRODUCTS DELIVERY, STORAGE, AND HANDLING

A. Delivery Of Materials: Except for locally mixed custom colors, deliver sealed containers with labels legible and intact.

B. Storage Of Materials:

1. Store only acceptable project materials on project site.

2. Store in suitable location.

3. Restrict storage to paint materials and related equipment.

4. Comply with health and fire regulations.

1.05 JOB CONDITIONS

A. Environmental Requirements:

1. Comply with manufacturer's recommendations as to environmental conditions under which coatings and coating systems can be applied.

2. Do not apply finish in areas where dust is being generated.

B. Protection: Cover or otherwise protect finished work of other trades and surfaces not to be painted.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Materials for painting shall conform to requirements of Section 09900: Painting.

B. Materials selected for coating systems for each type surface shall be the product of a single manufacturer.

C. Aboveground piping shall be identified by self-adhesive pipe markers equal to those manufactured by W. H. Brady Company.

1. Markers shall be of wording and color as shown in Table 09905.

2. Lettering shall be:

a) 2 1/4-inches high for pipes 3 inches diameter and larger.

b) 1 1/8-inches high for pipes less than 3 inches diameter.

3. Flow arrows shall be:

a) 2 1/4-inches by 6 inches for pipes 3 inches diameter and larger.

b) 1 1/8-inches by 3 inches for pipes less than 3 inches diameter.

D. Buried piping shall be identified by identification tape installed over the centerline of the pipelines.

1. Identification Tape for Steel or Iron Pipe: Identification tape shall be manufactured of inert polyethylene film so as to be highly resistant to alkalies, acids, or other destructive agents found in soil, and shall have a minimum thickness of 4 mils. Tape width shall be 6 inches and shall have background color specified below, imprinted with black letters. Imprint shall be as specified below and shall repeat itself a minimum of once every 2 feet for entire length of tape. Tape shall be Terra Tape Standard 250, or approved equal.

2. Identification Tape for Plastic or Non-Magnetic Pipe: Identification tape shall be manufactured of reinforced polyethylene film with a minimum overall thickness of 4 mils and shall have a 0.35 mil thick magnetic metallic foil core. The tape shall be highly resistant to alkalies, acids, and other destructive agents found in soil. Tape width shall be 3 inches and shall have background color specified below, imprinted with black letters. Imprint shall be as specified below and shall repeat itself a minimum of once every 2 feet for entire length of tape. Tape shall be TerraTape Sentry Line 1350, or approved equal.

3. Tape background colors and imprints shall be as follows:

| Imprint | Background Color |
|---|---|
| "Caution Electrical Line Buried Below:" | Red |

4. Identification tape shall be "Terra Tape" as manufactured by Reef Industries, Inc., Houston, TX; Allen Systems, Inc., Wheaton, IL; or approved equal.

5. In addition to the metallic identification tape specified, buried metallic pipe used for reclaimed water, effluent, and non-potable water service shall be painted with three (3) continuous stripes in order to identify service. Each stripe shall be 2-inches wide and the paint color shall match the color of the corresponding identification tape. Paint shall be an acrylic or epoxy paint that is suitable for the intended service. One (1) stripe shall be located on the top of the pipe and the remaining stripes shall be on each side of the pipe.

E. Aboveground Valve Identifications: A coded and numbered tag attached with brass chain and/or brass "S" hooks shall be provided on all valves.

1. Tag Types: Tags for valves on pipe shall be brass or anodized aluminum. Colors for aluminum tags shall, where possible, match the color code of the pipe line on which it is installed. Square tags shall be used to indicate normally closed valves and round tags shall indicate normally open valves.

2. Coding: In addition to the color coding, each tag shall be stamped or engraved with wording or abbreviations to indicate the valve service and number. All color and letter coding shall be approved by the Engineer. Valve service shall either be as listed in Table 09905, or by equipment abbreviation if associated with a particular piece of equipment. Valve numbering, if required, shall be as approved by the Engineer and/or Owner.

## PART 3 - EXECUTION

### 3.01 COLOR CODING FOR PIPES AND EQUIPMENT

A. Piping color codes and code labels for pipe identification shall be selected by the Owner.

B. General Notes and Guidelines:

1. Pipelines, equipment, or other items which are not listed here shall be assigned a color by the Owner and shall be treated as an integral part of the Contract.

2. Color coding shall consist of color code painting and identification of all exposed conduits, through lines and pipelines for the transport of gases, liquids, or semi-liquids including all accessories such as valves, fittings, junction boxes, bus bars, connectors and any operating accessories which are integral to a whole functional mechanical pipe and electrical conduit system.

3. All moving parts, drive assemblies, and covers for moving parts which are potential hazards shall be Safety Orange.

4. All safety equipment shall be painted in accordance with OSHA Standards.

5. All inline equipment and appurtenances not assigned another color shall be painted the same base color as the piping. The pipe system shall be painted with the pipe color up to, but not including, the flanges attached to pumps and mechanical equipment assigned another color.

6. All pipe hangers and pipe supports shall be painted, unless specified otherwise due to material of construction.

C. All pipe hangers, pipe supports, and accessories shall be painted to match their piping. The system shall be painted up to, but not including, the face of flanges or the flexible conduit connected to electrical equipment. Structural members used solely for pipe hangers or supports shall be painted to match their piping. Where the contact of dissimilar metals may cause electrolysis and where aluminum will contact concrete, mortar or plaster, the contact surface of the metals shall be coated in accordance with Section 09900.

D. All systems which are an integral part of the equipment, that is originating from the equipment and returning to the same piece of equipment, shall be painted between and up to, but not including, the face of flanges or connections on the equipment.

E. System code lettering and arrows shall conform to the requirements of ANSI A 13.1 marked on piping as follows:

1. Legends shall be of the following color for the respective pipe color:

| Key to Classification of Predominant Colors For Piping | | Color of Letters, if not Otherwise Specified |
|---|---|---|
| (F) Fire Protection: | Red | White |
| (D) Dangerous: | Yellow | Black |
| | Orange | Black |
| (S) Safe: | Green | Black |
| | White | Black |
| | Black | White |
| | Light Grey | Black |
| | Dark Grey | White |
| | Aluminum | Black |
| (P) Protective: | Blue | White |

2. An arrow indicating direction of flow shall be placed adjacent to each marker.

3.02 FABRICATED EQUIPMENT

A. Unless otherwise indicated or specifically approved, all fabricated equipment shall be shop primed and finished. See Section 09900 - Painting.

B. The Contractor shall be responsible for and take whatever steps are necessary to properly protect the shop prime and finish coats against damage.

C. Where specified in other Sections of these Specifications for mechanical equipment, the Contractor shall apply field coats of paint in accordance with Section 09900. If the shop finish coating is unsatisfactory due to poor adhesion or other problems with primer or finish coats, coatings shall be removed and replaced by sandblasting, priming and finishing in accordance with Section 09900 and this Section.

D. Wherever fabricated equipment is required to be sandblasted, the Contractor shall protect all motors, drives, bearings, gears, etc., from the entry of grit. Any equipment found to contain grit shall be promptly and thoroughly cleaned. Equipment contaminated by grit in critical areas, such as bearings, gears, seals, etc., shall be replaced at no cost to the Owner.

## 3.03 INSTALLATION OF IDENTIFICATION TAPE

A. Identification tape shall be installed for all buried pipelines and conduits in accordance with the manufacturer's installation instructions and as specified herein.

B. Identification tape for piping shall be installed at two (2) locations:

1. One (1) foot below finished grade along centerline of pipe, and;

2. Directly on top of the pipe.

END OF SECTION

# SECTION 11209

# SUBMERSIBLE HORIZONTAL PROPELLER PUMPS

## PART 1 – GENERAL

### 1.01 SCOPE OF WORK

A. The Contractor shall furnish and install one (1) submersible horizontal propeller pump complete with all supports, drive unit, electric motor, pump shaft and propellers, and any other appurtenances required by the pump manufacturer and as shown on the Drawings. The installation shall be in complete conformity with the Drawings and Specifications and the instructions and recommendations of the equipment manufacturer, as approved by the Engineer. The pump shall be installed in Zone 6 of Train1 of the Diffused Aeration Reactor as shown on the Drawings.

### 1.02 RELATED WORK

A. Project Coordination: Section 01040.

B. Operations and Maintenance Data: Section 01730.

C. Concrete: Division 3.

D. Painting: Section 09900.

E. Piping, Valve, and Equipment Identification System: Section 09905.

F. Instrumentation: Division 13.

G. Mechanical – General Requirements: Section 15000.

H. Electrical: Division 16.

### 1.03 QUALIFICATIONS

A. The submersible horizontal propeller pumps shall be the standard product of manufacturers who regularly engage in the production of this type of equipment and who are fully experienced, reputable, and qualified in the manufacture of the equipment to be furnished. The equipment shall be designed, constructed, delivered, and installed in accordance with the best practices and methods. Each component and ancillary equipment item furnished under this specification shall be the product of a manufacturer having successful record of operation,

manufacturing and servicing the equipment for a minimum of five (5) years. Manufacturer shall supply Engineer with previous installation details.

B. The submersible horizontal propeller pumps shall be as manufactured by Xylem Flygt Model 4660, or an approved equal.

1.04 SUBMITTALS

A. Submit manufacturer's descriptive literature, illustrations, specifications, and other pertinent data in accordance with Section 01040: Project Coordination.

1.05 OPERATING INSTRUCTIONS

A. A factory representative who has a complete knowledge of the proper operation and maintenance shall be provided for a minimum of one (1) 8-hour working day to instruct a representative of the Owner and the Engineer on proper operation and maintenance of the equipment. This work may be conducted in conjunction with the inspection of installation and test run as provided under Part 3 – Execution. If there are difficulties in the operation of the equipment due to the manufacturer's design or fabrication, additional service shall be provided at no cost to the Owner.

1.06 PUMP TESTING

A. The pump manufacturer shall perform the following inspections and tests on each pump before shipment from the factory:

1. Propeller, motor rating, and electrical connections shall first be checked for compliance with the specifications.

2. The pumps shall be vacuum tested to establish sealing integrity. A motor and cable insulation test for moisture content or insulation defects shall be made.

3. All pumps shall be momentarily energized to determine correct rotation and current draw (prior to immersion).

4. The pump shall be run dry and/or immersed to establish correct shaft rotation, thrust direction and power consumption.

5. After immersion test(s), all pumps shall be inspected for lubricant seepage and/or water infiltration, insulation defects, and resistance (Ohms).

A written report stating the foregoing steps have been done shall be supplied with each pump at the time of shipment for approval by the Engineer.

## PART 2 – PRODUCTS

### 2.01 GENERAL

A. Furnish and install one (1) submersible horizontal propeller pump complete with all supports, complete drive unit, electric motor, pump shaft, propeller, vortex protection shield, and any other appurtenances required of the pump manufacturer, specified herein and shown on the Drawings. Each pump shall be equipped with a minimum 11 HP, submersible inverter duty, electric motor connected for operation on 460 volt, 3 phase, 60 Hertz power service. All cables shall be suitable for underwater service and oil resistant chlorinated polyethylene rubber jacketed.

B. The pump shall be capable of pumping 5,400 gpm at a discharge head of 3.2 ft. The maximum pump speed at the design flow shall be 585 rpm.

C. The discharge connection shall be a 24-in flanged connection per ANSI B16.1 Class 125.

### 2.02 PUMP DESIGN

A. The pump shall be capable of handling mixed liquor with a maximum suspended solids concentration of 6000 mg/L. The pump shall be able to be raised and lowered and shall be easily removed for inspection or service without the need for personnel to enter the reactor. A sliding guide bracket shall be an integral part of the pump unit. The entire weight of the pump unit shall be guided by a single bracket which must be able to handle all thrust created by the pump. The standard pump, with its appurtenances and cable, shall be capable of continuous submergence under water to a depth of 60 ft. without loss of watertight integrity.

B. The pump assembly shall incorporate a bell shaped inlet shroud, 360 degrees around the propeller.

C. A vortex protection shield shall be provided for the pump.

### 2.03 PUMP CONSTRUCTION

A. Each pump shall be of the integral design, close coupled, submersible type. All components of the pump, including motor shall be capable of continuous underwater operation. Major wetted pump components shall be of Type 316 stainless steel construction unless otherwise noted. The stator housing shall be grey iron. The oil housing cover plate shall be of corrosion resistant composite (vinylester) or 316 stainless steel. All exposed nuts and bolts shall be of 316 stainless steel. In order to insure that the low velocity area around the motor remains impervious to low pH solids and or liquid attack, the motor housing exterior shall be made of Type 316 stainless steel. All metal surfaces coming into contact with the pumped fluid, other than stainless steel, shall be protected by a

factory applied spray coating of acrylic dispersion zinc phosphate primer with an epoxy finish coat on the exterior of the pump.

2.04 MOTOR

A. The 12-pole motor shall be directly connected to the propeller (gearbox designs are not acceptable) to produce a propeller speed of 585 RPM.

B. The pump motor shall be squirrel cage, induction, shell type design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180°C (356°F). The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31. The stator shall be heat-shrink fitted into the cast iron stator housing. The motor shall be designed for continuous duty, capable of sustaining a minimum of at least ten (10) evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of aluminum.

2.05 ELASTOMERS

A. All mating surfaces where watertight sealing is required shall be machined and fitted with a double set of nitrile rubber or viton O-rings. Fitting shall be such that sealing is accomplished by metal-to-metal contact between machined surfaces. This will result in controlled compression of the O-rings without requiring a specific torque limit. No secondary sealing compounds, rectangular gaskets, elliptical O-rings, grease or other devices shall be used.

2.06 PROPELLER

A. The propeller shall be of Type 316 stainless steel, factory balanced, and of a non-clogging backward curved design. Each blade shall be laser cut and welded to the hub to ensure that the propeller is properly balanced.

B. The propeller shall be capable of handling solids, fibrous materials, heavy sludge and other matter found in normal sewage applications.

2.07 CABLE ENTRY

A. The cable entry housing shall be an integral part of the back plate. The cable entry shall have a double set of elastomer grommets in order to ensure a redundant system in the event of a cable entry failure. The cable entry shall be comprised of two (2) cylindrical elastomer grommets, each flanked by washers and a ferrule designed with close tolerance fit against the cable outside diameter and the entry inside diameter. This will provide a leak-proof seal at the cable entrance without the need for specific torque requirements. The assembly shall bear against a

shoulder in the stator casing opening and be compressed by a gland nut threaded into it. Interaction between the gland nut and the ferrule should move the grommet along the cable axially instead of with a rotary motion. The junction chamber and motor compartment shall be separated by a terminal board which shall protect the motor interior from foreign material gaining access into the pump top. Connection shall be made with the threaded compressed type binder post thus securely affixing the cable wires to the terminal board. The use of the terminal compressed type post and a terminal board O-ring shall render the motor compartment leak proof from any liquid which may enter the terminal compartment. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.

2.08 BEARINGS

A. All bearings shall have a minimum B-10 or L-10 rated life of 100,000 hours and shall have inner and outer races of metal construction. Bearings with races made of nonmetallic construction will not be deemed acceptable or meeting the load handling and environmental requirements of this application. Bearing cages of nonmetallic construction will not be acceptable. The outboard propeller bearing shall be an angular contact bearing. The motor shaft end shall be supported by two (2) bearings. A roller and an angular contact ball bearing shall take up the radial loads while an angular contact ball bearing shall take up the axial loads. The bearings shall be pre-loaded by a bearing loading nut located on the motor end of the shaft in order to reduce shaft deflection and increase bearing life and seal life. Pumps without pre-loaded bearings will not be considered acceptable or equal.

2.09 THERMAL MOISTURE SENSORS

A. Thermal sensors shall be provided to monitor stator temperatures. The stator shall be equipped with three (3) thermal switches embedded in the end coils of the stator winding and set for 285°F (140°C). Moisture sensors shall also be provided to detect leakage and protect the motor. Sensors specified in this paragraph shall be used in conjunction with, and supplemental to, external motor overload protection, and wired to the control panel.

2.10 OIL HOUSING

A. The oil housing shall contain two (2) compartments consisting of an inner and an outer section with four (4) ports to connect and facilitate oil flow. In the event that the mixed media bypasses the other seal, this design shall allow the outer compartment to collect the heavier (denser) fluids by means of a simple gravity process.

## 2.11 MECHANICAL SEALS

A. Each pump shall be provided with two (2) sets of lapped end face type mechanical seals running in oil reservoirs for cooling and lubrication. The mechanical seals shall contain positively driven rotary, corrosion resistant, tungsten carbide/tungsten carbide seal face rings for both the inner and outer seal assembly. In order to avoid seal failure due to sticking, clogging, and misalignment from elements contained in the mixed media, only the seal faces of the outer seal assembly and its retaining clips shall be exposed to the mixed media. All other components shall be contained in the oil housing.

B. The seals shall require neither maintenance nor adjustment, but shall be easy to check and replace. Shaft seals without positively driven rotating members shall not be considered acceptable or equal.

## 2.12 SEAL SHIELD

A. The pump shall be equipped with a seal shield that prevents fibrous material from winding up around the shaft and outer seal. The shield shall be welded to the propeller hub and extended toward the motor. The shield shall rotate with the propeller and there shall be a radial micro-gap between the shield and oil housing.

## 2.13 PUMP GUIDE BARS

A. The pump manufacturer shall provide with Type 316 stainless steel upper and lower guide brackets, which the two guide bars will be mounted between as shown on the drawings. All anchor and mounting hardware shall be of Type 316 stainless steel.

B. The CONTRACTOR shall provide guide bars for pump mounting and removal. The guide bars system shall be of Type 316 stainless steel suitably sized for the pump furnished. Guide bars shall have a diameter of 2.37 inches with a wall thickness of 0.13 inches.

# PART 3 – EXECUTION

## 3.01 GENERAL

A. The equipment manufacturer shall furnish the services of a competent and experienced representative who has complete knowledge of proper operation and maintenance of the equipment for a period of one (1) day to inspect the installed equipment, supervise the initial test run, and to provide instructions to the plant personnel. The final copies of operation and maintenance manuals specified in Division 1 must have been delivered to the Engineer prior to scheduling the instruction period with the Owner.

## 3.02 INSTALLATION

A. Each unit shall be installed in accordance with the manufacturer's instructions and accurately aligned in relation to related equipment.

B. The Contractor shall supply all necessary anchor bolts, temporary lifting equipment, power, water, labor, lubricants, and all other requirements for satisfactory installation.

## 3.03 INSPECTION AND TESTING

A. Upon completion of installation, the Contractor, in the presence of the Engineer and a qualified manufacturer's representative, shall perform a preliminary test on the system to ensure the functioning of all component parts to the satisfaction of the Engineer. The Contractor shall furnish all labor, equipment, water, and power required to perform each test.

B. Approval of the test by the Engineer shall not constitute final acceptance of the equipment furnished.

END OF SECTION

# SECTION 11225

# PIER MOUNTED VERTICAL TURBINE MIXERS

## PART 1 – GENERAL

### 1.01 SCOPE OF WORK

A. The Contractor shall furnish and install three (3) pier mounted vertical turbine mixers complete with vertical motor, flexible coupling with approved steel guard, parallel shaft gear reducer, the specified shaft and turbine assembly, and any other appurtenances required by the mixer manufacturer and as shown on the Drawings. The installation shall be in complete conformity with the Drawings and Specifications and the instructions and recommendations of the equipment manufacturer, as approved by the Engineer. One mixer shall be installed in each of the first three (3) zones of Train 1 of the Diffused Aeration Reactor as shown on the Drawings.

### 1.02 RELATED WORK

A. Project Coordination: Section 01040.

B. Operations and Maintenance Data: Section 01730.

C. Concrete: Division 3.

D. Painting: Section 09900.

E. Piping, Valve, and Equipment Identification System: Section 09905.

F. Instrumentation: Division 13.

G. Mechanical – General Requirements: Section 15000.

H. Electrical: Division 16.

### 1.03 QUALIFICATIONS

A. The pier mounted vertical turbine mixers shall be the standard product of manufacturers who regularly engage in the production of this type of equipment and who are fully experienced, reputable, and qualified in the manufacture of the equipment to be furnished. The equipment shall be designed, constructed, delivered, and installed in accordance with the best practices and methods. Each component and ancillary equipment item furnished under this specification shall be the product of a manufacturer having successful record of operation,

manufacturing and servicing the equipment for a minimum of five (5) years. Manufacturer shall supply Engineer with previous installation details.

B. Only agitator manufacturers that are a member of American Gear Manufacturers Association (AGMA) will be allowed to supply the agitator assembly.

1. All components of each gear drive shall be designed, manufactured and assembled in full compliance with all applicable AGMA requirements. The mixer gear drive must be built and rated in accordance with the current AGMA Standard 6010-E88. The AGMA calculated drive HP rating shall be stamped on the drive nameplate. Drive housings shall be of high quality close-grained cast iron, stress relieved and reinforced, and shall be provided with lifting lugs or holes. Housings not composed entirely of metal will not be allowed. Plastic or fiberglass housing components will not be allowed. Fabricated housings will not be allowed.

2. Gearing shall be of AGMA Quality 10 (ten) or better per AGMA Standard 390.03a and ANSI/AGMA 2000-A88.

C. To ensure design integration and unit responsibility, the agitator gear drive coupled to the impeller shaft shall be designed, manufactured, inventoried, and tested by the mixer supplier.

D. Manufacturer shall have Quality Assurance System in place which complies with NQA-1, ISO 9001:2000, ANSI and MIL-Q-9858A. Upon request from the Engineer, the manufacturer shall submit to an audit to verify compliance with the referenced standards.

E. The pier mounted vertical turbine mixers shall be as manufactured by Chemineer Model 20 GT, or an approved equal.

1. Any equal must be approved by the Engineer prior to bid submittal and shall be added to the list of acceptable manufacturers by addendum.

2. In order to qualify for approval, any mixer manufacturer must submit the following:

a. Sizing criteria.

b. Proposed Model Number (specific to the size to be provided).

c. Mixer literature.

d. Project Specific Computational Fluid Dynamics (CFD) Model of all mixing chambers with the proposed alternative mixers.

e. Particle Imaging Velocimetry (PIV) data for the impeller design to be proposed.

f. Installation lists with a minimum of 10 installations of similar size and type in satisfactory operation (no warranty claims against the supplier).

3. Any supplier approved as an equal will be responsible for any additional costs resulting from changes to the project structural or electrical requirements. The Contractor shall include any additional costs incurred by using an alternate supplier in the bid amount.

1.04 SUBMITTALS

A. Shop Drawings: Submit shop drawings in accordance with Section 01040: Project Coordination. At a minimum, shop drawings shall include the following:

1. Certified test reports verifying quality of gears in Gear Reduction Units.

2. Shop drawing data for accessory items.

3. Templates or certified setting plans, with tolerances for anchor bolts.

4. Motor data.

5. Motor shop test results.

6. Field inspection/testing reports.

7. Recommended spare parts other than those specified.

8. Mixer shop test results.

9. Recommendations for short and long term storage.

10. Shop and field testing procedures and equipment to be used.

11. Results of vibration tests including a vibration signature for each mixer drive assembly. Provide vibration testing procedure for review.

12. Mixer supplier shall submit bearing life calculations. Submit bearing calculations based on hydraulic loadings as seen in each specific mixing application.

B. Submit dimensional drawings of equipment including design loads (including design load torque, upward thrust, starting thrust, side loads, moment loads and vibrating impacts.

C. Submit manufacturer's catalog data and descriptive literature. Show materials of construction by ASTM reference and grade. Show coatings.

D. Submit an analysis of the agitator design that shows reducer service factor, shaft stresses, output shaft bearing life, and shaft critical speed.

E. Submit electrical/control diagrams detailing the requirements and features of the system, including interlocks, terminals, wiring, controls, disconnects, and panel layouts.

F. Submit anchorage calculations for equipment.

G. Operating and Maintenance Manuals: Provide operating and maintenance manuals in accordance with the applicable provisions of Section 01040.

1.05 OPERATING INSTRUCTIONS

A. A factory representative who has a complete knowledge of the proper operation and maintenance shall be provided for a minimum of one (1) 8-hour working day to instruct a representative of the Owner and the Engineer on proper operation and maintenance of the equipment. This work may be conducted in conjunction with the inspection of installation and test run as provided under Part 3 – Execution. If there are difficulties in the operation of the equipment due to the manufacturer's design or fabrication, additional service shall be provided at no cost to the Owner.

1.06 PERFORMANCE

A. The pier mounted vertical turbine mixers, as installed, shall be capable of:

1. Operating within the liquid levels of the tank as specified.

2. Keeping the contents of the anoxic basins in suspension including the recycled mixed liquor, the raw wastewater, and the return activated sludge.

3. Minimizing any mixing that will add oxygen to the basin or hinder biological denitrification.

4. Mixers normally operated automatically shall be provided with manual control devices.

## PART 2 – PRODUCTS

### 2.01 GENERAL

A. Furnish and install three (3) pier mounted vertical turbine mixers complete with vertical motor, flexible coupling with approved steel guard, parallel shaft gear reducer, the specified shaft and turbine assembly, and any other appurtenances required of the mixer manufacturer, specified herein and shown on the Drawings. Each mixer shall be equipped with a minimum 7.5 HP, vertical electric motor connected for operation on 460 volt, 3 phase, 60 Hertz power service.

### 2.02 MIXER DESIGN

A. The mixers shall be capable of handling mixed liquor suspended solids. Mixing shall result in a homogeneous mixture of raw wastewater and return activated sludge. The suspended solids concentration in the basins will range from 3,000 mg/L to 4,000 mg/L. Sufficient mixing energy shall be provided to prevent sedimentation of biological solids and grit on the floor of the process basins.

B. Basin dimensions may vary based on Fine Bubble Diffused Aeration System (Section 11376) provided and manufacturer's recommendations. Refer to Section 11376 for approximate aeration zone dimensions. Contractor shall provide mixer designed for tank and aeration zone dimensions based on aeration equipment provided.

### 2.03 MATERIALS

A. Design for long, continuous, and uninterrupted service, easy adjustment or replacement of parts, minimum 1/4-inch thickness, steel members, minimum 1/2-inch diameter, and structural bolts.

B. Structural steel shall be in accordance with ASTM A36.

C. Iron castings shall be in accordance with ASTM A48.

D. Wetted parts shall be defined as the bottom half of the uppermost coupling, the agitator shaft, any additional shafts (excluding the gearbox output shaft), impeller hubs, impeller blades and hardware below the mounting surface with exception of the gearbox output shaft coupling hardware. Wetted parts shall be 316 stainless steel.

E. Non-wetted parts shall be any component other than the wetted parts. Any non-wetted parts shall be of the material specified. If no material is specified, provide a material appropriate to the location and design conditions.

## 2.04 MIXER DRIVES

A. The mixer drive shall include a vertical motor, flexible coupling with OSHA-approved guard, parallel shaft gear reducer with shaft, and impeller assembly. The mixer gear drive shall be designed with a shaft and bearing system suitable for the hydraulic loadings experienced in each specific mixing application. Standard commercial gear drives will not be acceptable.

B. Provide drive units specifically designed for mixer service and suitable for continuous 24-hour-per-day operation. Each drive and impeller shaft shall be manufactured, inspected, and tested only by the mixer vendor. The mixer manufacturer shall design and test the mixer drive attached to the impeller shaft. Drives manufactured by vendors not specifically involved in the manufacture of complete mixer systems will not be acceptable. Each drive unit shall consist of an electric motor and a gear reducer with a flexible coupling provided between the motor and the gear reducer. Drive units having a pinion mounted directly on the motor shaft will not be acceptable.

C. Each mixer drive shall consist of a fabricated steel or fine grain cast-iron reducer housing which shall be fully stress relieved prior to machining. Housing shall be pressure tested to preclude casting porosity or weld imperfections that could result in drive oil leakage. Lifting lugs shall be provided on the motors and gear reducers. These lugs shall have the strength and be located in the appropriate place in order to lift the complete mixer assembly. Motors shall be readily separable from the gear reducer and shall be foot mounted. Motors shall be removable without exposing reducer internals to outside contamination.

D. The agitator gear drive shall be a heavy duty, parallel shaft design utilizing only case-carburized and ground helical gearing. Lubricated for life gear reducers are specifically excluded. All reducers must be designed for standard rust & oxidation (R&O) style lubricants. Mandatory requirements for costly synthetic lubricants are prohibited. Double and triple reductions must be in a single housing. The gear drive efficiency shall be a minimum of 95%.

E. The gears shall be protected from the normal and shock loads that are transmitted to the drive from the agitator shaft/impeller assembly. To accommodate large overhung loads typical in agitator service, the output bearings must have wall section supports, which are at least 1.5 inches thick. Dry well mounted output bearings are specifically excluded. The agitator drive shall incorporate oversized, solid, single piece output shaft. The cross-sectional area of the single piece output shaft at the lower output bearing must be at least 2.4 times the cross-sectional area of the largest diameter section of the impeller shaft.

F. The drive shall incorporate a dry well around the low speed shaft to eliminate oil leakage down the output shaft and include a v-ring seal on the low speed shaft to the top of the dry well housing. The base of the drywall feature shall be integral to the reducer housing casting. Drywell configuration in which the base is threaded

into the gearbox housing will not be acceptable. Lubrication shall be of the "fail safe" oil splash type or immersed in oil. Oil pumps will not be acceptable. Drive oil levels shall be checked either by a "dipstick" or "bulls-eye" sight glass. Drive bearings shall be either oil or grease lubricated. All grease-lubricated bearings shall be regreasable and not "sealed-for-life".

G. All drive bearings shall be of antifriction type, tapered roller bearings. All bearings within the drive, except for the output shaft bearings, shall have minimum AFBA L-10 lives of 100,000 hours when operating at full motor nameplate horsepower at design speed. All output shaft bearings shall have a minimum L-10 life of 500,000 hours. The design of the output shaft bearings shall be adequate to support the weight of the shaft and turbine assembly and to withstand the random hydraulic forces of agitation.

H. The full load operating noise levels of the mixer drives shall meet current OSHA Occupational noise standards, and/or AGMA standard 299.1, and shall not exceed 85 dBA at 3 feet from any part of the drive assembly.

I. The agitator drive shall have an AGMA service factor of at least 1.5 based upon motor nameplate (The reducer Class I mechanical rating must be at least 1.5 times the motor nameplate horsepower.). The thermal rating of the gear drive shall exceed the mechanical rating. No external cooling devices shall be allowed. Manufacturer shall show reducer service factor, agitator critical speed, weight, bending moment, reaction torque, and minimum L-10 output bearing life in the submittal.

J. The gearbox output shaft shall be composed of carbon steel. Any portion of the output shaft external to the gearbox housing will be painted with epoxy paint of the same color as is used for the remainder of the gear reducer.

K. All oil fill and drain lines shall be located so as to be easily accessible, with the oil drain located at least 12 inches above the mounting elevation (pedestal mounted). All gearing must be contained within a single housing and lubricated by a common oil bath.

L. The pedestal mount shall be of the "milk stool" type. I-beam type pedestals will not be accepted.

## 2.05 SHAFT AND IMPELLER SYSTEM

A. The impeller shall be designed to keep the contents of the anoxic basin in suspension and mix the incoming wastewater with the recycled mixed liquor.

B. Extension shaft shall be designed such that the material tensile yield stress is at least 3.0 times the calculated shaft tensile stress and the material shear yield stress is at least 3.5 times the calculated shaft shear stress. Calculations shall consider the combined torsional and bending loads, and shall be submitted in accordance

with paragraph 1.04. Shafts shall be 55 inches long as measured from the agitator mounting surface.

C. Shaft rotational speed of 20 rpm shall not exceed 80% of the first critical speed when Hydrofoil impellers are used. The use of stabilizers is not permitted.

D. Shafts shall be manufactured of turned, ground and polished or annealed and centerless ground bar which is straightened to within 0.005" TIR (Total Indicated Runout) per foot of length. Material of construction shall be steel conforming to the requirements of ASTM A36. Fiberglass or composite shaft and impeller systems shall not be allowed.

E. The impeller shaft shall be provided with a rigid coupling located immediately below the gear reducer to allow easy removal of the shaft system without disturbing the gear drive. The coupling should be recessed into the housing to avoid damage during shipment. Exposure of the gear reducer internals to remove the shaft system will not be acceptable.

F. Impeller shall be axial flow 3-bladed design with either welded blades to central hub or bolted blades to central hub. Hub shall be key driven and set screw attached to the shaft. Set screw shall be countersunk into the hub. Key shall be contained within the height of the hub and top and bottom caps shall be affixed to the hub to prevent sharp edges and exposed shaft keyway. Bolting on hub for caps shall be countersunk. No exposed bolt heads or set screws are permitted and all bolts shall be countersunk. A single impeller shall be used to control the basin and an additional upper impeller is not permitted.

G. Impeller blades shall be of the "non-ragging" design with sweeping leading edges designed to prevent fibrous build-up of material on the blades. The blades shall pump axially up-pumping for anoxic mixing applications. Radial flow impellers are not permitted. No support or guide rings are allowed under the impeller for shaft support or containment due to increased maintenance requirements for such design. To reduce shaft loads and improve mix basin control, the bottom of the impeller shall be as recommended by the manufacturer but no closer than 3 feet off the basin floor.

2.06 MOTOR

A. Motor shall be provided in accordance with Specification Section 16150 and the following:

1. Motors shall be vertical, C-Face mount and suitable for operation on 460 volts, 3 phase, 60 Hertz, alternating current. The motor shall have a TEFC enclosure and shall be built to current NEMA standards for NEMA design B operation. Motor shall have as a minimum Class F insulation, and a 1.15 service factor. Motor shall be grease-lubricated ball bearing, solid shaft

design with Premium Efficiency design suitable for severe duty service, and shall be of manufacturer's standard design and features.

2. The connection between the motor and the gear drive shall be made with a flexible coupling, Woods Sureflex type, or approved equal. The drive shall have "built-in" motor to reducer alignment. The coupling shall be designed to withstand continuous full load motor horsepower including torque. Minimum service factor shall be 1.5. Drive couplings shall be provided with approved steel guards conforming to OSHA requirements. Plastic coupling guards are not allowed.

2.07 FINISH

A. Exposed carbon steel components of the agitator system shall be painted with a two-coat finish system; the first coat to be a 3 to 4 mil DFT (dry film thickness) coat of Sherwin Williams 2.8 VOC catalyzed primer, the second coat to be a 2 to 3 mil DFT coat of Sherwin Williams Polane HS Plus polyurethane enamel paint.

B. Apply a 2 to 3 mil DFT coat of "barrier" primer Tnemec #37-77 to all external previously painted surfaces, followed by a 3 to 4 mil DFT coat of Tnemec Primer #66-1211, followed by a 4 to 6 mil DFT top coat of Tnemec Hi-Build Epoxoline #66-J8150.

C. Steel weldments (gear boxes) shall be sandblasted to remove mill scale and rust. No sandblasting to machined surfaces will be allowed. Prior to painting all surfaces must be thoroughly solvent washed.

2.08 ANCHOR BOLTS, NUTS, AND WASHERS

A. Anchor bolts shall be stainless steel per ASTM A193, Grade B8 or SATM F593, Type 304. Nuts shall be ASTM A194, Grade 8 or ASTM F594, Type 304. Use ASTM A194 nuts with ASTM A193 bolts; use ASTM F594 nuts with ASTM F593 bolts. Provide washer (minimum 1/8-inch thick) for each nut and bolt head. Washers shall be of the same material as the nuts.

PART 3 – EXECUTION

3.01 GENERAL

A. The equipment manufacturer shall furnish the services of a competent and experienced representative who has complete knowledge of proper operation and maintenance of the equipment for a period of one (1) day to inspect the installed equipment, supervise the initial test run, and to provide instructions to the plant personnel. The final copies of operation and maintenance manuals specified in

Division 1 must have been delivered to the Engineer prior to scheduling the instruction period with the Owner.

3.02 INSTALLATION

A. Each unit shall be installed in accordance with the manufacturer's instructions and accurately aligned in relation to related equipment.

B. The Contractor shall supply all necessary anchor bolts, temporary lifting equipment, power, water, labor, lubricants, and all other requirements for satisfactory installation.

3.03 INSPECTION AND TESTING

A. Upon completion of installation, the Contractor, in the presence of the Engineer and a qualified manufacturer's representative, shall perform a preliminary test on the system to ensure the functioning of all component parts to the satisfaction of the Engineer. The Contractor shall furnish all labor, equipment, water, and power required to perform each test. The equipment manufacturer’s representative will check the installation, supervise start-up, and supervise the field testing.

B. Approval of the test by the Engineer shall not constitute final acceptance of the equipment furnished.

C. Operate the mixers and drives continuously for five consecutive days with the basins filled with water and check for binding, sticking, or overloading of the motors and gear boxes. Measure the amperage drawn by each motor. The amperage shall not exceed the rated motor amperage stated on the motor data plate. Repair, replace, or realign motors and drives and retest if the mixers bind, stick, or overload. Mixers and drives shall operate smoothly for five consecutive days.

END OF SECTION

# SECTION 11376

# FINE BUBBLE DIFFUSED AERATION SYSTEM

## PART 1 - GENERAL

### 1.01 DESCRIPTION

A. Scope of Work: Furnish all labor, materials, equipment, and incidentals required to install, place in operation, and field test fine bubble diffused aeration systems for all six (6) zones of Train 1 of the Diffused Aeration Reactor as shown in the drawings. These Specifications are intended to give a general description of what is required, but do not cover all details, which will vary in accordance with the requirements of the equipment as offered. It is, however, intended to cover the furnishing, shop testing, delivery, complete installation, and field testing of all materials, equipment, and appurtenances for complete fine bubble diffused aeration systems as herein specified.

1. Equipment components included:

   a. Stainless steel droplegs.

   b. PVC manifolds.

   c. Panel Diffuser assembly with membrane, gaskets, end seals, integral fixed joint couplings.

   d. Stainless steel supports, hold downs and anchors.

   e. Bolts, nuts and gaskets for aeration system flange connections.

   f. Purge systems.

2. The aeration system shall be designed based on the following Actual Oxygen Requirements (AOR) and the following Standard Oxygen Correction Factors Perimeters unless otherwise approved by the Engineer.

3. Where shown in the drawings, diffuser grids installed in aeration zones with pier mounted vertical turbine mixers (Specification 11225), aeration equipment shall be compatible with mixers and designed to withstand any forces resulting from mixer. Coordinate with mixer manufacturer as required.

| Parameter | Units | Max. (All Zones Aerated) | Max. (Zones 1 & 2 Anoxic) | Average | Min. |
|---|---|---|---|---|---|
| AOR | Lbs $O_2$/day | 36,263 | 31,604 | 19,883 | 12,041 |
| Alpha | - | 0.55 | 0.55 | 0.55 | 0.55 |
| Beta | - | 0.95 | 0.95 | 0.95 | 0.95 |
| Theta | - | 1.024 | 1.024 | 1.024 | 1.024 |
| Dissolved Oxygen | mg/L | 2.0 | 2.0 | 2.0 | 2.0 |
| Site Elevation | ft. above sea level | 23 | 23 | 23 | 23 |
| Ambient Pressure | psia | 14.69 | 14.69 | 14.69 | 14.69 |
| Temperature | °C | 30 | 30 | 30 | 30 |

B. Related Work Described Elsewhere:

1. Project Coordination: Section 01040.
2. Operating and Maintenance Data: Section 01730.
3. Painting: Section 09900.
4. Piping, Valve, and Equipment Identification: Section 09905.
5. Pier Mounted Vertical Turbine Mixers: Section 11225.
6. Instrumentation: Division 13.
7. Mechanical: Division 15.

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 diffused aeration equipment shall be the integrated product of a single manufacturer who designs and manufactures the entire assembly. The system components shall be designed, constructed, delivered and installed in accordance with the best practices and methods.

2. Each component and ancillary equipment items furnished under this specification shall be new and unused, and the product of a manufacturer

having a successful record of operation, manufacturing and servicing similar duty equipment for a minimum of five (5) years.

3. The diffused aeration equipment shall be furnished by a single supplier who shall be responsible for the coordination of the system design and who shall assume complete responsibility for the proper function of the system.

B. Equipment Manufacturers: The diffused aeration equipment shall be the Gold as manufactured by Sanitaire (Xylem, Inc). or Aerostrip Q Type as manufactured by Ovivo USA, LLC.

1.03 SUBMITTALS

A. Material and Shop Drawings: Copies of all materials required to establish compliance with these Specifications shall be submitted in accordance with Section 01040: Project Coordination. Submittals shall include at least the following:

1. Certified shop and erection drawings showing all important details of construction, physical characteristics, dimensions, connections, and anchor bolt locations. Show plan, elevation and cross sections of the equipment. Show details of droplegs, manifolds, quantity and location of diffuser assemblies, supports, hold downs, anchor bolt locations, threaded union and/or flanged joints, field connections, and purge systems.

2. Descriptive literature, bulletins, and/or catalog cut sheets of each item of equipment. Provide the recommended minimum, design and maximum air flow for the system.

3. The total weight of the equipment including the weight of the single largest item.

4. A complete total bill of materials for all equipment.

5. A list of manufacturer's recommended spare parts to be supplied including those specified in Paragraph 1.06, with the manufacturer's current price for each item.

6. A detail of the intended support members with certification demonstrating their adequacy for the application and anticipated loads.

7. Calculations showing the thermal expansion/contraction of the manifolds and air distribution headers and the resulting thrust forces, full buoyant

uplift load on the air distributers, as well as forces from the movement of the water. Provide calculations for the total loads the pipe supports and anchors must resist. Include forces from the pier mounted vertical turbine mixer and Mixed Liquor Return pumps, where applicable.

8. Performance data including oxygen transfer calculations, headloss calculations and pressure equipment and operating experience for the diffused aeration equipment indicating the equipment proposed for this Project will comply with the specified mixing and oxygen requirements.

9. The equipment suppliers' recommended installation procedures.

10. Submit a reference list of at least 5 different applications in domestic wastewater treatment plants of similar size, with at least 5 years of successful operation, where the manufacturer has supplied equipment substantially the same regarding design, materials of construction, structural elements and other characteristics to that proposed for this project.

B. Factory Oxygen Transfer Efficiency Test:

1. Provide factory clean water performance testing data for three (3) different conditions and densities to demonstrate the capacity of equipment to meet the specified oxygen transfer efficiency and mixing requirements. The three (3) test conditions shall be selected by the Engineer. Testing shall have been conducted at an approved facility by an independent testing firm.

2. Tests shall have been performed in accordance with the latest ASCE Clean Water Test Procedure.

3. Testing shall have been conducted in a tank having a surface area greater than 300 square feet to eliminate the potential of wall effects. Testing shall have been conducted at the specified submergence and for a diffuser density equivalent to the actual project tank configuration. Diffuser density is defined as the ratio of the total tank surface area to the total combined diffuser surface area.

4. Submit test data as part of the shop drawings for the diffused aeration equipment. Include a plot of pounds oxygen per day per 1000 cubic feet of tank volume versus air per 1000 cubic feet of tank volume in tap water at 14.7 psia, 20°C and zero dissolved oxygen at the specified submergence. Certify and stamp all tests by a Professional Engineer.

## 1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. The aeration system shall be delivered to the site for installation assembled in as large of sections as is practical. The diffused aeration equipment shall be capable of being set in place and field erected by the Contractor with only minimal field assembly.

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 Contractor shall store and temporarily support equipment prior to installation in strict accordance with the manufacturer's recommendations and instructions. Protect all exposed surfaces. The Contractor shall keep records of the storage parameters and the dates that storage procedures were performed. The Contractor shall be responsible for work, equipment, and materials until inspected, tested and finally accepted.

D. Protect the equipment from being contaminated by dust, dirt, vibration and moisture. The equipment storage area shall be well ventilated to prevent excessive heat buildup.

E. Exposed openings for connection to piping shall be properly plugged or protected by wooden planks, strongly built and securely bolted to flanged surfaces.

F. The Contractor shall handle all components during delivery, storage and installation in a manner to prevent damage of any nature in accordance with the manufacturer's approved written instructions and in accordance with instructions given on-site by the manufacturer's representative.

G. Each box, crate or package shall be properly marked to show its net and tare weight in addition to its contents.

## 1.05 SPARE PARTS

A. The following spare parts shall be furnished and shall be suitably marked and boxed (protected from UV light) for shipment and storage:

1. Diffuser and Membrane Assemblies (ready for installation on air header)
   Quantity: 5 percent of total diffusers supplied

2. It is understood that the diffusers offered by various manufacturers have slightly different configurations. The intent of this Specification is to ensure

that the plant operational staff can replace membranes in a timely manner, therefore, depending upon the design of the diffuser, spares may include only membranes if the design facilitates simple membrane replacement. Alternatively, the entire diffuser assembly may be necessary if the membrane is not replaceable using standard tools and techniques normally available at a municipal wastewater treatment plant.

1.06 DEFINITIONS

A. SCFM: Standard cubic feet per minute is understood to be air at 68 degrees F, 14.7 psia, and 36 percent relative humidity flowing at a rate of 1 cubic foot per minute.

B. SOTE: Standard oxygen transfer efficiency is understood to be the fraction of oxygen transferred to tap water under standard conditions of 20 degrees C, 0.0 mg/l residual dissolved oxygen concentration, and a barometric pressure of 760 mm Hg (dry air).

C. Sidewater Depth: Sidewater depth is understood to be the interior dimensions from the structure base to the water surface.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. The test data submitted as part of the shop drawing shall indicate an SOTE of at least that required per Paragraph 2.01.D. at a sidewater depth of 17.00 feet over the range of air flows set forth in this Specification. The manufacturer of the aeration system shall design the aeration grids and place the diffusers to ensure that this transfer efficiency can be attained under the operating air flow ranges specified herein. Further, the system shall ensure adequate mixing within the basins to keep solids in suspension over the range of air flows specified.

B. The diffused aeration system will be installed in a concrete basin with six (6) aeration zones. Dimensions of zones are given in the table below:

| | Zone 1[(1)] | Zone 2[(1)] | Zone 3 | Zone 4 | Zone 5 | Zone 6[(1)] |
|---|---|---|---|---|---|---|
| Zone Length (ft.) | 52’-7” | 52’-2” | 52’-2” | 52’-2” | 52’-2” | 52’-7” |
| Zone Width (ft.) | 53’-0” | 53’-0” | 53’-0” | 53’-0” | 53’-0” | 53’-0” |
| Zone Depth (ft.) | 17’-0” | 17’-0” | 17’-0” | 17’-0” | 17’-0” | 17’-0” |
| Drop Leg Diameter (inches) | 12 | 10 | 10 | 10 | 8 | 8 |

(1) A portion of the zone is unavailable for diffuser installation. Refer to Drawings for actual floor space available.

C. Design aeration system to transfer the following minimum amount of oxygen per day at standard conditions at the specified submergence, air rate and pressure.

| Parameter | Units | Zone 1 | Zone 2 | Zone 3 | Zone 4 | Zone 5 | Zone 6 |
|---|---|---|---|---|---|---|---|
| Max Pressure at Top of Drop Leg | PSIG | 8.30 | 8.24 | 8.05 | 8.00 | 8.00 | 8.30 |
| Minimum Diffuser Submergence | ft | 15.86 | 15.86 | 15.86 | 15.86 | 15.86 | 15.86 |

| Oxygen Transfer and Performance Requirements – Maximum (All Zones Aerated) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Parameter | Units | Zone 1 | Zone 2 | Zone 3 | Zone 4 | Zone 5 | Zone 6 | Total/ Overall |
| Oxygen Distribution | % | 33.3 | 29.2 | 20.3 | 9.5 | 4.5 | 3.2 | 100 |
| Actual Oxygen Transfer Rate (AOR) | Lbs $0_2$/day | 12,091 | 10,602 | 7,344 | 3,458 | 1,621 | 1,147 | 36,263 |
| Standard Oxygen Transfer Rate (SOR) | Lbs $0_2$/day | 28,702 | 25,168 | 17,434 | 8,209 | 3,848 | 2,723 | 86,083 |
| Min Delivered SOTE | % | 29.4 | 32.2 | 34.5 | 39.1 | 43.6 | 40.7 | 32.8 |
| Design Air Rate | SCFM | 3,895 | 3,118 | 2,017 | 838 | 352 | 337(1) | 10,556 |

(1) Design air flow rate based on minimum air rate required for mixing (0.12 scfm/$ft^2$) which exceeds that required for process.

| Oxygen Transfer and Performance Requirements – Maximum (Zones 1&2 Anoxic) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Parameter | Units | Zone 1 | Zone 2 | Zone 3 | Zone 4 | Zone 5 | Zone 6 | Total/ Overall |
| Oxygen Distribution | % | | | 31.3 | 27.6 | 24.0 | 17.1 | 100 |
| Actual Oxygen Transfer Rate (AOR) | Lbs $0_2$/day | | | 9,877 | 8,721 | 7,596 | 5,410 | 31,604 |
| Standard Oxygen Transfer Rate (SOR) | Lbs $0_2$/day | | | 23,447 | 20,703 | 18,032 | 12,843 | 75,024 |
| Min Delivered SOTE | % | | | 32.7 | 33.4 | 34.3 | 32.7 | 33.3 |
| Design Air Rate | SCFM | | | 2,865 | 2,472 | 2,099 | 1,569 | 9,005 |

| Oxygen Transfer and Performance Requirements – Average | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Parameter | Units | Zone 1 | Zone 2 | Zone 3 | Zone 4 | Zone 5 | Zone 6 | Total/ Overall |
| Oxygen Distribution | % | | | 44.0 | 29.5 | 16.9 | 9.6 | 100 |
| Actual Oxygen Transfer Rate (AOR) | Lbs $0_2$/day | | | 8,749 | 5,873 | 3,352 | 1,910 | 19,883 |
| Standard Oxygen Transfer Rate (SOR) | Lbs $0_2$/day | | | 20,768 | 13,941 | 7,957 | 4,534 | 47,200 |
| Min Delivered SOTE | % | | | 33.4 | 35.9 | 39.3 | 39.1 | 35.5 |
| Design Air Rate | SCFM | | | 2,481 | 1,551 | 808 | 463 | 5,302 |

| Oxygen Transfer and Performance Requirements – Minimum | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Parameter | Units | Zone 1 | Zone 2 | Zone 3 | Zone 4 | Zone 5 | Zone 6 | Total/ Overall |
| Oxygen Distribution | % | | | 55.7 | 23.0 | 11.5 | 9.8 | 100 |
| Actual Oxygen Transfer Rate (AOR) | Lbs $0_2$/day | | | 6,702 | 2,773 | 1,381 | 1,185 | 12,041 |
| Standard Oxygen Transfer Rate (SOR) | Lbs $0_2$/day | | | 15,909 | 6,584 | 3,279 | 2,813 | 29,638 |
| Min Delivered SOTE | % | | | 35.1 | 40.5 | 43.9 | 40.7 | 37.7 |
| Design Air Rate | SCFM | | | 1,811 | 650 | 337(1) | 337(1) | 3,135 |

(1) Design air flow rate based on minimum air rate required for mixing (0.12 scfm/$ft^2$) which exceeds that required for process.

## 2.02 EQUIPMENT DESCRIPTION

A. General:

1. The diffuser equipment system shall be of the fixed header, fine bubble, membrane strip type. The system shall be suitable for installation in the structures shown on the Drawings.

2. The process train will include multiple aeration zones and each zone will receive air via a single drop pipe. The number of aeration grids per zone are listed in paragraph 2.01. The locations and sizes of the drop pipes to each diffuser zone is provided in paragraph 2.01. The equipment for each grid shall include, but not be limited to, a vertical section of drop pipe, a flexible connection to the drop pipe, an air manifold, air headers, diffusers, supports, expansion joints, air manifold and header joints, gaskets, bolts, nuts, and washers.

3. The design, fabrication, and installation of the diffuser equipment shall be such that, upon completion of installation, all diffusers are leveled to within $\pm$ 1/4 inch of a common horizontal plane.

4. The fine bubble membrane strip diffuser equipment shall be designed for easy installation and shall include provisions for level adjustment, rotational adjustment, and thermal expansion.

5. The entire system shall be designed to allow for expansion and contraction over a temperature range of 60 to 104 degrees F when installed.

6. The system shall be designed to withstand the design air pressures plus a minimum 1.5 psig surge factor.

7. All pipe supports and assemblies shall be shop fabricated from Type 304L stainless steel with a 2D finish conforming to AISI 304L and ASTM A240-78a.

B. Drop Pipe, Air Manifold, and Headers:

1. Drop pipes shall be a minimum of Schedule 10 or 12 gauge Type 304L stainless steel pipe meeting the requirement of Section 15066. The pipes shall extend from approximately 8 feet below the top of the process tank to approximately 3 feet above the air grid manifold. A Van Stone style flanged connection with a 150 pound bolt pattern shall be provided at the top of the pipe and a Type 304L stainless steel band clamp coupling with gasket shall be provided for connection to the manifold.

2. Stainless Steel – Pipe, Fittings and Supports

   a. Fabricate all welded parts and assemblies from sheets and plates of 304L stainless steel with a 2D finish conforming to ASTM A240, 554, 784, 778.

b. Fabricate non-welded parts and flanges from sheets, plates or bars of 304 stainless steel conforming to ASTM A240 or ASTM A276.

c. Welds & Welding Procedure

(1) Weld in the factory with ER 304L filler wire using MIG, TIG or plasma-arc inert gas welding processes. Provide a cross section equal to or greater than the parent metal.

(2) Provide full penetration butt welds to the interior surface with gas shielding of interior and exterior of joint.

(3) Continuously weld both sides of face rings and flanges to eliminate potential for crevice corrosion.

d. Corrosion Protection and Finish

Clean all welded stainless steel surfaces and welds after fabrication by using the following procedure:

(1) Pre-clean all outside weld areas to remove weld splatter with stainless steel brushes and/or de-burring and finish grinding wheels.

(2) Finish clean all interior and exterior welds and piping by full immersion pickling and rinse with water to remove all carbon deposits and contaminants to regenerate a uniform corrosion resistant chromium oxide film per ASTM A380 Section 6.2.11, Table A2.1 Annex A2 and Section 8.3.

(3) Corrosion protection techniques not utilizing full immersion methods are unacceptable and will be cause for rejection of the equipment.

3. Manifolds: Provide a PVC manifold for connection to the air distribution headers.

a. Fabricate manifolds with a maximum length of 30 feet.

b. Provide threaded union or flanged joints to connect manifold sections and to connect to the air distribution headers to prevent rotation and separation.

(1) Design threaded union joints with spigot section connected to one end of the distribution header, a threaded socket section

connected to the mating distribution header, an o-ring gasket and a threaded screw on retainer ring. Solvent welding shall be done in the factory.

(2) Fixed joints shall be designed to resist 80 ft-lb torque without joint movement or failure.

(3) All fixed joints shall have interlocking splines and grooves to prevent rotation of the air distributors. All rotational forces shall be transferred through the interlocking splines. Joints that require the o-ring to transfer rotational forces between the splines are not acceptable. If positive locking fixed joints are not used, all distributor connections shall be 125 lb flanges.

(4) Design flanged joints with a 125 lb drilling angle face ring, follower flange and stainless steel hardware.

c. Fabricate 6-inch diameter manifolds and larger of Schedule 40 PVC conforming to ASTM D1784, D1785 and D2466.

d. Design piping, pipe joints and supports to resist expansion/contraction thrust forces of the air distribution headers over a temperature range of 125ºF.

e. PVC components shall be produced from a PVC compound with a minimum tensile strength of 7,000 psi.

f. Design manifolds to withstand 125° F mean wall temperature.

g. PVC components shall have a titanium dioxide resin content of at least 1.5 percent to minimize ultraviolet light degradation.

h. Factory solvent weld all PVC joints and diffuser holders. Field solvent welding shall not be permitted.

4. Distribution Pipe (and Diffuser Holders): Alternative 1

a. Produce all pipe and fittings from PVC compound with a minimum tensile strength of 7000 psi.

b. Fabricate air distribution headers with a maximum length of 24 feet. Provide diffuser holders factory solvent welded to the crown of the pipe for positive air seal and strength.

c. Fabricate minimum 4-inch diameter air distribution headers of SDR 35 conforming to ASTM D3915, D3034, or Schedule 80 conforming to ASTM D1784, 1785 and 2466.

d. Connect air distribution header sections with threaded union or flanged joints to prevent rotation and separation.

e. Fabricate joints with mating halves which are factory solvent welded to the ends of the air distribution header. Field solvent welding shall not be acceptable.

f. Provide threaded union joints with spigot and socket ends joined with a threaded ring and sealed with an O-ring gasket.

g. Flanged joints shall include an angle face ring, follower flange with 150 lb. drilling and stainless steel hardware.

h. Air distribution headers and diffuser holders shall resist a dead load of 200 lbs. applied vertically to the outer edge of the diffuser holder.

i. Provide threaded removable end caps complete with gasket, threaded coupling and end plate at the end of each air distributer.

j. All fixed and expansion joint o-ring gaskets shall be of natural rubber/SBR with a Shore A durometer of 45±5.

5. Distribution Pipe (and Fittings): Alternative 2

a. PVC air header piping and fittings 6 inches and larger shall be Schedule 80, conforming to ASTM D 1784, 1785, and 2466.

b. Pipe and Fittings Extruded from Type 1, Grade 1, Class 12454-B material in accordance with ASTM D 1784.

c. Solvent Cement: In accordance with ASTM D 2564.

d. Polyethylene (PE) piping shall be 1-inch in diameter and meet the requirements of ASTM D 1248, Type III, Class C, Category 5 Grade P34, or ISO S8, 3/SDR 17.6.

e. All polyethylene shall be provided in continuous lengths. No field welding shall be required.

f. Provide compression fittings to connect PE piping to diffuser and air header piping.

g. All feed assemblies shall be fabricated for field installation using standard components and couplings.

h. Feed lines shall be easily connected and disconnected to allow purging of debris after installation but before operation. Each distribution pipe shall be supplied with a removable end cap or plug to allow purging of the air lines.

i. Couplings between segments of the PVC distribution pipe shall be from 304 stainless steel.

6. Pipe Supports: Provide each section of manifold and air distribution header (where applicable) with a minimum of two (2) supports. Additional requirements are set forth below:

a. General:

(1) Support spacing to be limited to a maximum of 8 feet.

(2) Design all supports to allow for thermal expansion and contraction forces over a temperature range of 125°F and to minimize stress build up in the piping system.

(3) Design supports to be adjustable without removing the air distribution header from the support.

(4) Design supports to allow for complete removal from the tank, less the anchor bolt, to facilitate installation of additional headers and in-tank maintenance. Support structures which consist of rods epoxied directly into the tank floor are not acceptable.

(5) All hardware for supports shall be Type 316 stainless steel.

b. Manifold Supports 6-inch Diameter and Larger:

(1) Supports shall include hold down guide straps, support structure and anchor bolts.

(2) Guide straps shall have a 2-inch minimum width to eliminate point load on manifold and minimize binding.

(3) Design supports for a total of ±2-inch vertical adjustment for leveling of manifold within 1/4 inch of a common plane.

(4) Attach supports to tank floor with two (2) Type 316 stainless steel anchor bolts.

c. Diffuser and Manifold Supports 4-inch Diameter:

(1) Provide guide and fixed type supports to allow expansion/contraction.

(2) Supports shall include hold down straps, support structure, and single anchor bolt.

(3) Design supports for a total of 1-1/2-inch vertical adjustment for leveling air distribution headers within ¼ inch of a common plane.

(4) Guide straps shall have 1-1/2-inch wide top and bottom contoured bearing surfaces with chamfered edges to minimize binding and resistance to movement of air distributor under full buoyant uplift load.

(5) Design strap to be self-limiting and so that it cannot be over-tightened.

(6) Fixed straps to have 1-1/2 inch wide top and bottom contoured bearing surface with punched burrs to positively grip the air distributor when tightened.

d. When diffused aeration equipment is installed in swing zones with mixers, additional supports shall be provided in the areas near the mixers to address the turbulence caused by the mixers. The number of supports shall be determined by the manufacturer of the diffused aeration system. Coordinate with mixer supplier to determine forces from the mixers.

e. When diffused aeration equipment is installed in areas near the Internal Recycle pumps, additional supports shall be provided to account for the forces created by the pumps. The number of supports shall be determined by the manufacturer of the diffused aeration system.

7. Membrane Diffuser

a. Incorporate an integral check valve or check valve perforation techniques into the membrane diffuser such that when air is shut off the pores close.

b. Design and test diffusers for a dynamic wet pressure (DWP) of 12 inches ± 20% water column @ 1.0 SCFM/diffuser and 2 inches submergence.

c. Visual Uniformity: Observe diffusers for uniform air distribution across the active surface of the diffuser at 0.5 SCFM/diffuser and 2 inches submergence. Active surface is defined as the perforated horizontal projected area of the diffuser.

d. Quality Control: Test diffuser using primary sampling criteria outlined in Military Standard 105E.

e. Manufacture diffuser membrane from sheets of polyurethane or homogenous thermoplastic material from the polyurethane family.

f. The membrane material shall have an additive for resistance to ultraviolet light.

g. Produce seemless diffusers free of tears, voids, bubbles, creases, or other structural defects.

h. The surface of the membrane shall be smooth to prevent biological growth from attaching.

i. Diffuser material shall provide minimum 5 year life in the wastewater environment. All diffusers shall be tested in the factory for uniformity, bubble distribution and leaks. All individual membranes shall be tested for pressure drop and given a unique serial number. All test results associated with the membrane serial number shall be maintained at the manufacturer's facility for a period of 5 years.

j. Furnish diffuser material to meet the following:

| Test | ASTM Test Method | Value |
|---|---|---|
| Specific Gravity | D-792 | 1.13 +/- 0.5 |
| Durometer (Shore A) | D-2240 | 90 +/- 5 |
| Ultimate Tensile Strength | D-882 | 9700 PSI Min |
| Ultimate Elongation | D-882 | 550% Min |
| 100% Modulus | D-882 | 1200 PSI Min |
| 300% Modulus | D-882 | 3200 PSI Min |

| | | |
|---|---|---|
| Min. Softening Point (TMA Onset) | ES2347-04 | 151 C/304 F |
| Max. Softening Point (TMA Endpoint) | ES2347-04 | 171 C/341 F |
| Tear Resistance (MD/CD Ave.) | D-1004 | 500 pli |
| Thickness | | 0.023" +/- 5% |

k. Diffuser Body: Alternative 1

(1) Provide a 4-inch diameter diffuser body with wing assembly to support the polyurethane membrane.

(2) Extrude PVC diffuser body with integral diffuser support wing on the crown of the pipe to support and restrain the membrane.

(3) Diffuser body shall have a minimum 0.125" wall thickness.

(4) Longitudinal wing edges shall have a groove designed to seat a silicone o-ring cord to restrain membrane down the length of the diffuser.

(5) Diffuser support wings shall have end seal assemblies consisting of an EPDM gasket, PVC support holder, and stainless steel strap with locking unit.

(6) Perforations shall be needle-punched. A 3/8-inch wide strip down the longitudinal center of each membrane shall remain unperforated in order to seal over the air flow control orifices in the diffuser support wing.

(7) Design diffuser as one piece extruded part with a minimum thickness of 0.023-inch.

l. Diffuser Body: Alternative 2

(1) The frame shall provide structural support for the diffuser membrane and be structurally self-sufficient. In addition to securing the entire perimeter of the membrane with an airtight sealing mechanism, the frame shall provide the necessary mechanism for even distribution of air. No fasteners shall be allowed to penetrate the membrane.

(2) The base profile shall be made from PVC. The membrane shall be fastened to the base profile using polyamide tubing.

(3) Air shall be supplied to the strip diffuser through a fitting in the end of the diffuser. The air feed fitting shall be made from PVC and shall be bonded to the base profile.

(4) The diffuser shall be anchored by preformed elements (304 SS or PP) and secured by stainless steel bolts, nuts and anchors.

(5) The outside dimensions of the strip diffuser shall be approximately 7 inches wide and 98 or 157 inches long.

8. Anchor Bolts

a. Design a mechanical or adhesive anchor bolt system for embedment in 4,000 psi concrete with a pullout safety factor of 4.0.

b. Provide a mechanical stainless steel expansion type anchor bolt system.

c. Provide a chemical bond adhesive stainless steel anchor bolt system with stainless steel threaded stud bolt.

d. All anchor bolts shall be Type 316 stainless steel.

9. Liquid Purge System: Provide a liquid purge system for each aeration grid to substantially drain the submerged aeration piping system including air lift purge eductor line and control valve.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

A. All materials and equipment shall be stored, handled and installed in such a manner as not to degrade quality, serviceability or appearance. The equipment shall be stored in a clean, dry location free from construction dust, precipitation and excess moisture as well as extreme temperatures. Diffusers shall be stored to avoid exposure to direct sunlight and heat (not to exceed 104°F).

B. Continuously weld both sides of face rings and flanges. All metal welding on the aeration equipment shall be completed by welders certified by AWS. All stainless steel welding shall be by the shielded arc, inert gas, MIG, or TIG method. Filler wire shall be added to all welds to provide a cross section of weld metal equal to, or greater than, the parent metal. Butt welds shall have full penetration to the interior surface, and gas shielding shall be provided to the interior and exterior of the joint.

C. Interior weld beads shall be smooth, evenly distributed, with an interior projection not exceeding 1/16 inch beyond the inner diameter of the air header or fitting.

D. All outside weld areas shall be wire-brushed to remove weld splatter. Brushes shall be of stainless steel and used only on stainless steel.

E. Solvent welding of PVC joints shall be in strict accordance with the pipe manufacturer's written requirements.

F. Follow equipment manufacturer’s recommendations for sequencing of equipment installation. The diffuser system shall be stored, handled and installed in strict accordance with the manufacturer’s recommendations to ensure that warranty of diffusers is not voided. The individual diffusers shall not be installed until all other work in the basin has been finished. Care shall be taken to protect the diffusers from physical damages and prolonged exposure to weather without protection. All air piping shall be purged of debris before the aerators are connected and the basins are filled with water. After the system has been installed and the air piping purged, all connections shall be tested for leaks. The basin shall be filled with clean water to a level a few inches above all connections and run at the design air flow rate without any visible leaks. Care should be taken to ensure that the air is properly cooled before entering the PVC piping and diffusers. The diffuser manufacturer shall be responsible for calculating and providing cooling loops.

G. Layout and install support anchors in accordance with equipment manufacturer’s recommendations and anchor setting plan.

H. Level aeration system such that all diffusers connected to a header are within plus or minus 1/4-inch of a common horizontal plane. At the end of the break-in period, the air distribution shall be uniform over the entire basin.

I. The tanks shall not be filled with wastewater until the Engineer receives certification from the supplier that the complete system has been installed and tested in accordance with the written instructions of the supplier and that the system is ready for operation.

## 3.02 FACTORY SERVICE REPRESENTATIVE

A. The Contractor shall provide the services of a trained, competent, qualified and experienced factory field representative during inspection, testing and start-up of the equipment. The factory representative shall have a complete knowledge of proper operation and maintenance of the fine bubble diffused aeration system. The Contractor shall provide factory representative services for a minimum of four (4) 8-hour days in four (4) separate visits. The first two (2) visits shall be during installation to check and inspect the equipment. A third visit shall be for

start-up of the equipment. The fourth visit shall be allocated solely to the instruction of the Owner's personnel in the proper operation and maintenance of the equipment. Provide additional visits as required to ensure correct installation and operation of equipment at no additional cost to the Owner. Contractor shall be responsible for any additional cost.

B. The purpose of the services provided by the factory representative will be for the performance of the following work:

1. Verify that the Contractor is proceeding properly during the installation of equipment.

2. Following installation, but before the equipment is operated by others, the representative shall inspect the completed installation for soundness, completeness, correctness, alignment, arrangement, equipment setting, and operation of the equipment. The field engineer shall make, or cause to be made, any and all adjustments, corrections or repairs necessary.

3. Start-up of the equipment in the presence of the Contractor and Owner's operating personnel.

4. Train Owner's operating personnel in proper operation and maintenance procedures, startup/shutdown procedures, response to emergency conditions, and troubleshooting. The responsibility of the Contractor and the factory service representative with regard to start-up shall be fulfilled when the start-up is complete, the equipment is functioning properly and has been accepted by the Owner.

a. The training period for the Owner's operating personnel shall be scheduled at least ten (10) days in advance with the Engineer and shall take place after plant start-up and acceptance by the Engineer. The preliminary copies of operation and maintenance manuals specified in Special Conditions must have been delivered to the Engineer prior to scheduling start-up.

C. Upon completion of his work, the manufacturer's field engineer shall submit to the Engineer, six (6) copies of a written report for each diffused air system, as a result of his inspection, adjustments, corrections, repairs, start-up and testing. The report shall include descriptions of the inspection, adjustments, corrections and repairs made, testing and start-up, and training of the Owner's personnel. The report shall also include a notarized certification signed by the manufacturer's field engineer that the installed equipment:

1. Has been installed per manufacturer's requirements.

2. Has been accurately aligned, set and leveled and that proper running clearances have been established.

3. Is free from undue stress imposed by mounting bolts or equipment setting.

4. The equipment has been tested as required below in Paragraph 3.03 and is in conformance with normal operating parameters. Test procedures and results shall be included in the report.

5. Is ready for permanent operation on a continuous basis, is free from any known defects and that nothing in the installation will render the manufacturer's warranty null and void.

D. The Contractor's attention is directed to the fact that the services specified for the manufacturer's field engineer 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, including additional or extended visits to the jobsite by manufacturer's representatives, to comply with said requirements.

3.03 INSPECTION AND TESTING

A. Upon completion of installation, the Contractor, in the presence of the Engineer and a qualified manufacturer's representative, shall perform tests necessary to demonstrate functioning of all component parts and compliance with these Specifications. The Contractor shall furnish all labor, equipment, water and power required to perform each test.

B. If the diffused aeration equipment performance does not meet these Specifications, corrective measures shall be taken or the equipment shall be removed and replaced with equipment which satisfies the conditions specified. A 24-hour operating period of the equipment shall be required before acceptance.

C. Equipment Field Testing:

1. Upon completion of all the mechanical work, the Contractor shall conduct testing as specified herein to demonstrate that the equipment performs in accordance with all Specifications.

2. The Contractor shall perform initial testing of the equipment to insure himself that the equipment will perform adequately during subsequent testing.

3. After installation of the fine bubble membrane strip diffuser equipment is complete, functional testing shall be conducted by the Contractor to check for leaks, uniformity of air release, and verification of level installation. Functional testing shall be performed with clean water at a depth over the diffusers as recommended by the aeration system manufacturer for the range of operating airflows. The Contractor shall repair any leaks in the headers, diffusers, pipes, or any part of the system. The test shall be repeated until the installation is void of air leaks.

4. After the functional and leakage tests, fill the tank to the normal operating level with reuse water and operate the diffused aeration equipment for 72 hours. Check for uniform air distribution over the range of operating airflows.

END OF SECTION

# SECTION 13600

# INSTRUMENTATION GENERAL PROVISIONS

## PART 1 - GENERAL

### 1.01 DESCRIPTION

A. General

1. This part of the Contract Documents covers the general requirements for the furnishing and installation of a Primary Instrumentation, Control, and Monitoring System complete in every detail for the purposes specified and shall form a part of any other technical specifications supplied unless otherwise specified.

2. The intent of this specification is to require that the Primary Instrumentation, Control and Monitoring System including all Sections of this Specification, i.e., primary elements, panel mounted and miscellaneous field instruments, etc., shall be furnished by a single Supplier to assure system uniformity, subsystem compatibility and coordination of all secondary system interfaces. Where specific manufacturers are designated, substitutions will not be accepted. Deviations may be considered in special circumstances but must be approved by the Owner.

3. The Primary Instrumentation and Control System Supplier shall be as listed below or approved equal by owner:

   (a) Rocha Controls
   (b) Curry Controls Inc.
   (c) C2i
   (d) Revere Controls

B. Scope of Work:

1. Furnish and install all instrumentation and control systems hereinafter specified to perform the intended function. Work shall include all labor, materials and equipment, performance of all work necessary to complete the manufacture, to make factory tests, to prepare and load for shipment, to deliver to the site, to provide programming, calibration, installation supervision, system start-up, services and incidentals required to completely furnish and install a programmable controller based control and data acquisition system with instruments and control devices for the

automation of the aeration basin and including all work necessary during the Warranty Period. The installation of the system hardware shall be by the Contractor with the supervision by the instrumentation and control Instrumentation System Supplier.

2. Furnish all tools, equipment, materials, and supplies and perform all labor required to complete the furnishing, installation, validation, start-up and operational testing of a complete Instrumentation, Control and Monitoring System as specified herein.

3. Auxiliary and accessory devices necessary for system operation or performance, such as transducers or relays to interface with existing equipment or equipment provided under other Sections of this Specification, shall be included whether specified or not.

4. Equipment shall be fabricated, assembled, installed, and placed in proper operating condition in full conformity with detail drawings, specifications, engineering data, instructions and recommendations of the equipment Manufacturer as approved by the Engineer.

## 1.02 QUALITY ASSURANCE

1. The Primary Instrumentation, Control and Monitoring System as specified in this Specification is an integrated system and therefore shall be provided by a competent, qualified instrumentation and control system supplier who shall have total responsibility for the work of this Specification. Entire system installation including process parameter verification, calibration, validation, start-up, testing, and training shall be performed by qualified personnel, possessing all the necessary equipment and who have had a minimum of 5 years experience in engineering, programming and installing of similar instrumentation, control and monitoring systems. The system shall be integrated using the latest, most modern and proven design and shall, as far as practical, be of one supplier.

2. The Primary Instrumentation, Control, and Monitoring System Supplier shall be responsible for the correct selection of all instrumentation and installation of all hardware and secondary systems specified in this Specification.

3. Prior to the selection of any device, coming in contact with the process, actual on-site process conditions and the suitability of the device and materials of construction for the stated application shall be verified with the original equipment manufacturer by the Instrumentation and Controls Systems Supplier. Unless notified in writing all devices and component part numbers, when provided, shall be assumed to have been verified as

having been selected based on actual process parameters and application. Ultimately, the Contractor shall be responsible for all cost associated with replacements and delays due to improper equipment selection.

4. The Primary Instrumentation, Control, and Monitoring System Supplier shall be responsible to see that all components of the primary as well as secondary Control Systems, including measuring, indicating, transmitting, receiving, totaling, controlling, alarming devices and all appurtenances are completely compatible, correctly sized for actual process conditions, and properly interface to each other and shall function as outlined. The Primary Instrumentation, Control, and Monitoring System Supplier shall furnish and install such additional equipment, accessories, etc. as are necessary to meet these objectives at no additional cost to the Owner.

5. The Primary Instrumentation, Control, and Monitoring System Supplier shall, in fact, be an Owner recognized supplier of instrumentation, control panels, and systems, etc., of the general type and complexity of the system specified herein and shall have been regularly engaged in providing and engineering instrumentation, control, and monitoring systems on a single system responsibility basis for a minimum of 5 consecutive years. The personnel employed for system engineering, supervision, start-up, operational testing and training shall have been regularly employed and factory trained by the Instrumentation, Control, and Monitoring System Supplier for a minimum of 2 years.

6. A detailed description of the experience of each engineer that will be assigned for the duration of the project shall be submitted for review and approval by the Owner. The Suppliers lead instrumentation engineer shall be an electrical engineer specializing in the selection and implementation of instrumentation, control, and monitoring systems of the type specified herein for the past 5 consecutive years. References shall be provided for all projects successfully completed by each engineer or software programmer assigned to this project.

7. Actual installation may or may not be performed by the Suppliers employees but the Instrumentation, Control, and Monitoring System Supplier shall be responsible for the technical supervision of the installation to insure that it is proper in all respects.

8. Secondary control systems include all instrumentation, switchgear, and controls (including but not limited to actuators, transmitters, panels, process and manual switches, indicators, controllers, etc.) existing or furnished under sections other than section, INSTRUMENTATION, CONTROL AND MONITORING SYSTEMS and are generally

considered as a "packaged" system supplied specifically for the equipment being specified under that section.

9. Major constituents of each secondary system shall include, but not limited to, all materials, equipment, and work required to implement a complete and operating system of instrumentation and controls for its associated equipment. The systems shall include primary elements for process variable measurements, analog display and control elements, and discrete display and control elements as noted hereinafter and in the referenced Specification sections.

10. Qualifications of the secondary system supplier's engineers shall be as specified herein above unless otherwise noted. The Owner reserves the right to reject the use of any supplier not meeting the qualifications specified herein and under the specific equipment specification.

1.03 RESPONSIBILITY

1. The Contractor shall be ultimately responsible and shall provide for the verification of process conditions, supply, installation, certification, adjustment, and start-up, of complete, coordinated systems which shall reliably perform the specified functions.

2. All interconnecting conduit and wiring, between elements of a single secondary control system shall be furnished, installed and connected under the same section as is the secondary control system unless the electrical drawings specifically indicate otherwise.

3. All other electrical conduit and wiring are provided, installed and connected under Division 16, ELECTRICAL.

1.04 ENGINEERING SUBMITTALS

1. Before proceeding with any manufacturing, submit the following for approval in complete bound sets indexed by specification number. Describe and verify all component part numbers for the items being submitted. Submit only complete systems, not pieces of equipment from various systems. Show dimensions, physical configurations, methods of connecting instruments together, mounting details, and wiring schematics. Schematics shall be complete with all components identified by a unique tag reference in accordance with ISA-S5.1 Instrumentation Symbols and Identification. Terminal number identification associated with relays, lights, electrical devices, etc., shall be clearly identified on all drawings. Submit fabrication drawings, nameplate legends, and control panel internal wiring and piping schematic drawings clearly showing all equipment and

tag numbers for all components. Submit panel graphic drawings when applicable. Include material specifications listed where applicable.

2. Include a draft of the theory of operation for all relay circuits including software logic implemented via programmable controllers that will eventually be included in the operation and maintenance instruction manuals required below.

3. Each submittal shall be bound in a white, standard three ring, clear view type, hard cover binder which indicates the system name, submittal content, project reference, revision date and purpose of the submittal on the spine as well as the cover which shall also include the owners name, location, and supplier's name. Binders shall not exceed three inches in thickness.

A. Hardware Submittal

(1) Index and Comments

a. Provide a detailed index identifying each tabbed section and its content.

b. If there are any deviations or clarifications to the specifications, they shall be documented in writing in this section. If there are no comments or concerns identified in the submittal, it will be presumed that there are no deviations from the Contract Documents for the system being furnished.

(2) Component Data Sheets

a. Component Data Sheets shall be specifically prepared for all components being furnished under these Specifications. The purpose of this material is to supplement the generalized catalog information by providing the specifics of each component (e.g., individual component tag ID reference, service, quantity supplied, part number, breakdown and descriptions for all options, scales, ranges, materials of construction, component location reference, and reference to associated drawings).

b. Include such other necessary data as would provide a complete and adequate specification for re-ordering an exact duplicate of the original item from the manufacturer

at some future date. More than one tag numbered item with the same part number may be included on a sheet.

(3) Catalog Cuts

a. Manufacturer's standard specification or data sheets shall be clearly marked to delineate the options or styles to be furnished. Standard manufacturer catalog information, descriptive literature, wiring diagrams, and shop drawings shall be provided for all devices, whether electrical or mechanical, furnished under these Specifications. This includes, but is not limited to, pressure switches, gauges, solenoid valves, controllers, indicators, power supplies, switches, lights, relays, timers, circuit breakers, fuses, etc.

(4) Sizing Calculations

a. Complete certified sizing calculations shall be provided for all control valves and flow elements. The calculations shall include the process data used, minimum and maximum values, permanent head loss and all assumptions made. Equations shall be submitted for all computing modules and function generating modules and shall include the actual scaling factors and units used.

(5) System Hardware Submittal Format

a. Tab 1. Component Index and Comments

b. Tab "N" through "NN" (as required)

c. Component "X" Data Sheet(s) - one tab shall be provided per each component type and shall include the standard manufacturer catalog information and sizing calculations (when required).

B. System Control Panel(s) Drawing Submittal

1) All drawings shall be provided on "B" size paper and shall be laser generated with a minimum 300 DPI resolution, tabbed, and bound as directed above. Drawing submittal may be combined with the Hardware submittal providing the binder capacity is not exceeded.

a. Index and Comments

1. Provide a detailed index identifying each tabbed section and its content.

2. If there are any deviations or clarifications to the specifications, they shall be documented in writing in this section. If there are no comments or concerns identified in the submittal, it will be presumed that there are no deviations from the contract documents for the system being furnished.

b. Panel Layout Drawings

1. Provide detailed shop drawings for all panels and enclosures. Drawings shall show the location of all exterior and internal panel mounted devices to scale and shall include a panel legend and bill of materials. Layout drawings shall show all major dimensions, front, back, side, and mounting details, as well as all elevations, in inches from the base up, of all rows of components.

2. The panel legend shall list and identify all front of panel devices by the components unique tag identifier, all nameplate inscriptions, service legends, and annunciator inscriptions when applicable. Service legends, and nameplate inscriptions shall show size, engraving per line, character height and color. Information may be included on the layout drawing if spacing permits.

3. The bill of materials shall include all components mounted within or on the panel that are not listed in the panel legend, and shall include the component identification tag, description, manufacturer, and complete part number for re-ordering. Information may be included on the layout drawing if spacing permits.

4. Fabrication drawings shall be submitted for review and shall show all cut-out dimensions, support details, brackets, materials of construction, finish, etc. to be used for fabrication of each panel. Fabrication drawings may be submitted separately

after the layout drawings have been approved. Construction of panels shall not be started until the approval of the fabrication drawings is received.

c. Detailed Panel Wiring Diagrams

1. Wiring diagrams shall be provided in the form of ladder type schematics with line numbers for all devices. All components shall be identified by a unique identification tag, terminal block numbers, wire sizes and color codes clearly identified, and external interconnections noted. Drawings shall be drawn in “landscape” mode.

2. Provide complete terminal identification of all internal and external elements, panels, and junction boxes.

3. Polarity of all analog signals shall be shown at each terminal as well as all shielded cable connections and grounding requirements.

4. All external panel wiring that must be provided and installed shall be clearly identified as a dashed line. Use unique terminal symbols to denote MCC locations.

5. All special cables that are provided with purchased equipment external to panels shall be identified as being supplied by the Supplier.

6. Wiring diagrams shall show all circuits individually; no common diagrams will be allowed.

7. Provide panel power wiring diagrams for all panels. The diagrams shall include all grounding requirements.

d. Control Panel Submittal Format

1. Tab 1. Index and Comments

2. Tab “N” through “NN” as required:

a. Heat Dissipation and Power Calculations Summary.

b. Panel “A” Layout Drawing (one tab per panel).

c. Panel “A” with Fabrication Drawing Legend/Engravings/Bill of Materials.

d. Panel “A” Power Wiring.

e. Panel “A” Wiring Diagrams.

3. Tab “X”. Loop Drawings (When Applicable)

4. Tab “Y”. Installation Details (When Applicable)

C. Analog Loop Drawing Submittal

1) Provide an individual loop wiring diagram for each analog loop showing all terminal numbers, the location of the DC power source, the location of any dropping resistors, polarity, etc. The loop diagrams shall meet the minimum requirements of ISA standard S5.4 approved October 9, 1981, plus the following requirements:

a. Loop diagrams shall be on 11-inch by 17-inch paper. Only one loop shall be shown on each drawing.

b. Reference to supplementary records and drawings, such as installation details, P&IDs, location drawings, wiring diagrams or drawings, and instrument specifications shall be included. Drawings may be included in the Control Panel Drawing Submittal when only a few drawings are required.

D. Instrument Installation Details Submittal

1) The Supplier shall develop and submit for review, complete installation details for each field mounted device and panel furnished prior to shipment and installation. Common details may be referenced by an index showing the

complete instrument tag number, service, location, and device description. Installation details shall be provided as required to adequately define the installation of the components. Drawings may be included in the Control Panel Submittal when only a few are required.

E. Power Requirement and Heat Dissipation Summary

1) Provide a summary of the power requirements and heat dissipation for all control panels furnished. Power requirements shall state required voltages, currents, and phase(s). Heat dissipations shall be maximums and shall be given in BTU/Hr. Summary shall be supplemented with calculations and show expected temperatures to be maintained for proper control equipment operation.

F. PLC Subsystem Submittal

1) In addition to the detailed hardware submittal requirements noted herein, the following shall also be provided:

a. Theory of Operation and Logic Descriptions.
b. System block diagram and cabling requirements.
c. Annotated software program listing and I/O address mapping.
d. I/O arrangement and wiring drawings.

G. Operation and Maintenance Manuals Submittal

1) All manuals shall be original manufacturers literature provided as noted herein above.

2) Include in the manuals not less than the following applicable information for each instrument, component, subsystem and/or control loop.

a. Index and Comments

1. Provide a detailed index identifying each tabbed section and its content.

2. If there are any deviations or clarifications to the specifications, they shall be documented in writing in this section. If there are not comments or concerns identified in the

submittal, it will be presumed that there are no deviations from the contract documents for the system being furnished.

b. Bill of Materials

1. A listing of all the panels, racks, instruments, components, and devices furnished. All components shall be grouped by component type, i.e., pressure switches, pressure gauges, indicators, etc. The list shall contain, as a minimum:

a. Instrument, panel, rack or device tag number
b. Description
c. Quantity supplied
d. Reference to component data sheet and/or catalog cut
e. Component type

c. Component Data Sheets

d. Catalog Cuts

e. Operation and Maintenance Manuals

(1) Operation and Maintenance manuals shall be submitted for all instruments and devices supplied. The O&M manuals shall contain, as a minimum:

a. Operation procedures
b. Installation procedures
c. Maintenance procedures
d. Troubleshooting procedures
e. Calibration procedures
f. Internal device schematics and wiring diagrams
g. Shut-down procedures
h. Component parts list
i. Detailed circuit operational description including programmable controller ladder diagrams
j. Listing of Manufacturers with local telephone numbers and contacts for all instrumentation hardware furnished.

f. Spare Parts and Expendables List

(1) A spare parts and expendables list shall be submitted to include not only those items being supplied, but also any additional items recommended for successful long term operation.

g. Operation and Maintenance Manual Format

(1) Volume I (or as required) - Hardware

a. Tab 1. Component Index and Comments

b. Tab 2. Theory of Operation

c. Tab "N" through "NN" as required:

1. Component "X" Data Sheet(s) (one tab per component type as required).

2. Standard Manufacturer Catalog Information, and Manufacturers O&M Manual.

d. Tab "X" Recommended Spare Parts and Expendables Listing.

e. Tab "Y" Current Manufacturers/Local Representatives Telephone/address listing for all major components.

(2) Volume II (if necessary)

a. Tab 1. Index and Comments

b. Tab "N" through "NN" as required:

1. Panel "X" Layout Drawing
2. Panel "X" Fabrication Drawing
3. Panel "X" Legend/Engravings/Bill of Materials
4. Panel "X" Power Wiring
5. Panel "X" Wiring Diagrams

c. Tab “X” Loop Drawings (When Applicable)

d. Tab “Y” Installation Details (When Applicable)

H. System Calibration and Test Documentation Submittal

(1) The Supplier shall submit an example of each type of Instrument Calibration Report and Loop Functional Test Report that will be used to verify that all preliminary calibration and testing has been performed and the system is considered, by the supplier, to be ready for the Owner’s acceptance testing.

(2) After approval of the examples, the Supplier shall prepare Loop Functional Test Report(s) for each loop and an Instrument Calibration Sheet for each active element (except simple hand switches, lights, etc.). These sheets shall be completed and submitted to the Owner after completion of the operational availability field tests.

a. Instrument Calibration Reports

1. An Instrument Calibration report shall be used to certify that each instrument requiring calibration has been calibrated to its published specified accuracy shall be submitted to the Owner. This report shall include all applicable data as listed below plus an area to identify any defects noted, corrective action required, and corrections made.

a. Facility identification (Name, location, etc.)

b. Loop identification (Name or function)

c. Equipment tag and serial numbers

d. Scale ranges and units

e. Test mode or type of test

f. Input values or settings

g. Expected outputs and tolerances

h. Actual readings at 0, 10, 25, 50, 75, 90 and 100 percent of span

i. Percent of error for each reading

j. Explanations or special notes as applicable

k. Date, time, and weather conditions

l. Tester's certification with name and signature

b. Loop and Functional Test Reports

1. Submit a sample of each type of Loop and Functional Test Report form that will be used in verifying all control system functions as follows:

(a) Loop Status Report - For each function that can be demonstrated on a loop-by-loop basis:

(1) Each form shall include:

a. Project name

b. Loop number

c. Loop description

d. Test procedure description, with a space after each specific test to facilitate sign off on completion of each test.

e. For each component: tag number, description, manufacturer, and data sheet number.

f. Space for sign off and date by the Supplier

(b) Functional Acceptance Test Report - For those functions that cannot be demonstrated on a loop-by-loop basis:

1. Each form shall include a listing of the specific tests to be conducted. With each test description the following information shall be included:

a. Specification page and paragraph of function to be demonstrated

b. Description of function

c. Test procedure description

d. Space after each specific test to facilitate sign off on completion of each test

c. Supplier's Installation Certification Reports

(1) Upon completion of all preliminary calibration and functional testing, the Supplier, shall submit a certified report for each control panel and its associated field instruments certifying that the equipment (1) had been properly installed under his or her supervision, (2) is in accurate calibration, (3) was placed in operation, (4) has been checked, inspected, calibrated, and adjusted as necessary, (5) has been operated under maximum power variation conditions and operated satisfactorily, and (6) is fully covered under the terms of the guarantee.

I. Functional Acceptance Test Procedures Submittal

(1) Submit for approval not later than 30 days prior to the functional acceptance test demonstration, a written plan for demonstrating that each device and function of the equipment provided under these specifications meets the specified operational requirements.

(2) The plan shall detail procedures to be used in the functional acceptance testing of all systems. The plan shall include a description of test methods and materials that will be utilized for testing each system.

(3) Immediately correct defects and malfunctions with approved methods and materials in each case and repeat the testing.

1.05 SYSTEM TESTING AND ACCEPTANCE

A. Factory Tests

(1) Factory Testing

a. Prior to the arrival of the Owner, each panel shall have been completely tested by the manufacturer's personnel. Provide a report certifying the control panel(s) are fully operable and meet the Specifications. If upon arrival of the Owner, the panel tests have not been performed, the Supplier may be liable for back charges for all costs associated with the visit by the Owner. The necessary panel tests shall be repeated in the presence of the Owner. The Owner shall have the right to check all test observations. The Supplier shall demonstrate that the results of the Factory Tests are accurate. As a minimum, tests shall verify the following:

1. Accuracy of panel instruments for 4-20 mA inputs and outputs

2. Location of interface wires on terminal blocks

3. Function of discrete panel components

4. Control logic

(2) Factory Testing

a. Inspection and test of materials and equipment shall be made by the Owner (or his representative) at the place of manufacturer prior to shipment, to verify that the completed control panel(s) meet the requirements of the specifications. Shipment shall not be made until receipt of written approval from the Owner after satisfactory completion of shop tests.

b. The manufacturer furnishing materials, equipment and labor for the fabrication of the panel(s) shall afford the necessary facilities for such shop inspection and tests. The Supplier shall give the Owner written notice ten (10) working days prior to the estimated date when the equipment will be ready for the inspection and witnessed shop test.

c. Sufficient time, ample space, and necessary assistance shall be provided by the manufacturer to assure inspection and testing to the satisfaction of the Owner.

d. The Supplier shall furnish all power, labor, materials, and properly calibrated instruments required for the shop tests.

e. The Owner reserves the right to reject defective materials, poor workmanship and items that are not in accordance with the requirements of the specifications.

B. Installation Supervision

(1) Furnish the services of authorized factory personnel specially trained and experienced in the installation of the equipment to: (1) supervise the installation in accordance with the approved Instruction Manuals; (2) be present when the instruments and equipment are first delivered, installed, and put into operation; (3) inspect, check, adjust as necessary, and approve the installation; (4) calibrate the instruments, in accordance with the Specifications herein, until all trouble or defects are corrected and the installation and operation are acceptable.

C. Preliminary Calibration and Functional Testing

(1) After approval of the Loop Status Report and Calibration Worksheets described herein, the Supplier shall prepare Loop Status Report(s) for each loop and an Instrument Calibration Worksheet for each active element (except simple hand switches, lights, etc.). These sheets shall be completed, signed, and submitted to the Owner after the Preliminary Calibration and Functional Testing is completed.

(2) Although the Preliminary Calibration and Functional Testing does not require witnessing, the equipment Supplier shall maintain the reports and calibration worksheets at the job-site and make them available for the Owner’s review at any time.

a. Preliminary Calibration

1. Provide the services of factory trained instrumentation technician, tools and equipment to field calibrate each instrument to its specified accuracy in accordance with the manufacturer's specifications and instructions for calibration.

b. Functional Testing

1. Provide Loop Status Report(s) for verifying all control system functions as follows:

(a) Provide the services of factory trained and field experienced instrumentation engineer(s) to validate each system to verify that each system is operational and performing its intended function within system tolerance. System tolerance is defined as the root-mean-square sum of the system components specified accuracies from input to output.

(b) Validate calibration of each system by simulating inputs at the first element in the loop (i.e., sensor) of zero, 10, 25, 50, 75, 90 and 100 percent of span, or on/off and verify loop output devices (i.e., recorder, indicator, alarm, etc. except controllers). During system validation, make provisional settings on levels, alarms, etc. Verify that all logic sequences operate in accordance with the specifications.

(c) Cause malfunctions to sound alarms or switch to standby to check system operation. Check all systems thoroughly for correct operation.

(d) Immediately correct all defects and malfunctions disclosed by tests. Use new parts and materials as required and approved and retest.

c. Supplier's Certified Reports

1. Upon completion of the Preliminary Calibration and Functional Testing, the Supplier shall submit a certified report for each control panel and associated field instruments certifying that the equipment (1) had been properly installed under his supervision, (2) is in accurate calibration, (3) was placed in operation, (4) has been checked, inspected, calibrated, and adjusted as necessary, (5) has been operated under maximum power variation conditions and operated satisfactory.

D. Functional Demonstration Testing

1. Upon completion of the Preliminary Calibration and Functional Testing, re-test all systems in the presence of the Owner (or representative). The intent of this test is to demonstrate and verify the operational interrelationship of all instrumentation systems. This testing shall include, but not be limited to, all specified operational modes, taking process variables to their limits (simulated or actual) to verify all alarms, failure interlocks, and operational interlocks between systems and/or mechanical equipment. Notify the Owner in writing a minimum of 48 hours prior to the proposed date for commencing the test. Upon successful completion of this test the Supplier shall begin the Operational Acceptance Test Demonstration.

E. Operational Acceptance Test Demonstration

1. Upon completion of the Functional Demonstration Testing, re-test all systems under actual process conditions in the presence of the Owner and the Owner's Operators. The intent of this test is to demonstrate and verify the operational interrelationship of all instrumentation systems to the Owner's Operators. This testing shall include, but not be limited to, all specified operational modes, taking process variables to their limits (simulated or actual) to verify all alarms, failure interlocks, operational interlocks between systems and/or mechanical equipment, and making final adjustments. Notify the Owner in writing a minimum of 48 hours prior to the proposed date for commencing the test. Upon successful completion of this test the Supplier shall begin the 30 Day Availability Test.

F. 30 Day Availability Test

1. After completion of the Operational Acceptance Test Demonstration, the System Supplier shall be responsible for the operation of the supplied system for a period of 30 consecutive days, under conditions of full process operation, without a single non-field repairable malfunction.

2. During this test, plant operating and supplier personnel shall be present as required. While the test is proceeding, the Owner shall have full use of the system.

3. If any failures should occur that cannot be corrected within 24 hours, or more than two similar failures of any duration, the failure will be considered as a non-field-repairable malfunction. The system shall be repaired and the 30 day test period shall be re-started. Owner reserves the right to set the schedule.

4. Total availability of the system shall be greater than 99.5 percent during this test period. Availability shall be defined as "Availability = 1-(Total Down Time) ÷ (Total Time)".

5. Down times due to power outages or other factors outside the normal protection devices or back-up power supplies provided, shall not contribute to the availability test times above.

6. Upon successful completion of the system availability testing, submit a certified report, with substantiating data sheets, indicating that the equipment furnished meets all the functional requirements specified herein. The Owners will countersign this report and it shall constitute acceptance of the control system hardware.

1.06 FINAL DOCUMENTATION

A. Reproducible Drawings

1. The Supplier shall submit one (1) set of full size reproducible of complete schematics, wiring diagrams and installation drawings to include all installed field and panel instruments, mounting details, point-to-point diagrams with cable, wire, and termination numbers. Drawings shall be a record of work as actually constructed and shall be labeled "As-Installed". One copy of applicable schematics and diagrams shall be placed in each control panel in a protective envelope or binder.

a. Loop Diagrams

b. Panel Construction Drawings and Wiring Diagrams

c. Interconnecting Wiring Diagrams

d. Instrument Installation Details

B. Software

(1) In addition to the reproducible hard copy of drawings and literature specifically generated for the project, one (1) set optical diskettes shall be submitted to the Owner which shall include a copy of all files specifically generated to create the drawings, data sheets, bill of materials, operating and test procedures, control logic, etc. Drawing format shall be compatible with "AutoCAD" Release 13. Diskettes shall be clearly labeled with the following:

a. Project Name
b. Volume Number
c. Software Program Name and Version used to generate the files
d. Label "As-Installed"

(2) Provide one copy of all programming software, application programs, and source code utilized to generate, annotate, and debug all software provided. Programming software, detailed programming instructions, software keys, cables, and licenses shall be provided for all programmable devices, i.e., PLC, DCS, SCADA, controllers, and smart transmitters. Special devices used in programming supplied hardware shall be provided. It is the intent that the Owner shall have the full capability to re-program and modify any application on-site without the need to purchase additional software or hardware.

C. Operation and Maintenance Manuals

(1) Furnish the balance of six (6) sets of Operation and Maintenance Manuals for equipment provided under these Specifications. Content shall be as described above for the submittals.

## 1.07 TRAINING REQUIREMENTS

A. General

(1) Provide the services of a factory trained and field experienced control systems engineer to conduct group training of Owner's designated personnel in the operation of all Instrumentation, Control and Monitoring equipment furnished. Include instruction covering basic system theory, operating principles and adjustments, routine maintenance and repair, and "hands-on" operation. The text for this training shall be the P&IDs, panel wiring diagrams, layouts, ladder listings, and the operation and maintenance manuals furnished under these Specifications.

B. Duration

(1) Training specific to the system hardware shall be provided for a minimum of three operating shifts with a time period necessary to cover complete Operator and Maintenance Training.

C. Operator Training

(1) Operator training shall include instruction in the use of all control system hardware and software furnished. A detailed written description of the system furnished and all equipment start-up, shut-down, troubleshooting, and maintenance procedures shall be provided to each Operator attending the training sessions. Training material shall be organized and bound in appropriate binders. One copy of the training manual shall be submitted to the Owner prior to scheduling any training sessions. As a minimum, the format for the training material shall be as follows:

a. General system description and overview
b. Process and Instrumentation Diagrams
c. Sequence of Operation
    1. Panel Layout Drawing
    2. Legend
    3. Alarm Handling
    4. System Start-Up
    5. System Shut-Down
    6. Operator Adjustment & Setpoints
d. General Troubleshooting Techniques
e. Recommended Maintenance Procedures
f. Recommended Spare Parts

D. Maintenance Training

(1) Maintenance training shall include instruction in the calibration, maintenance, programming, and repair for all systems furnished.

(2) Maintenance training shall include instruction in the maintenance of all control system hardware and software furnished. A detailed written description of the system furnished and all equipment start-up, shut-down, troubleshooting, and maintenance procedures shall be provided to each person attending the training sessions. Training material shall be organized and bound in appropriate binders. One copy of the training manual shall be submitted to the Owner prior to scheduling any training sessions. As a minimum, the format for the training material shall be as follows:

a. General system description and overview
b. Process and Instrumentation Diagrams
c. Sequence of Operation
    1. Panel Layout Drawing
    2. Legend
    3. Alarm Handling
    4. System Start-Up
    5. System Shut-Down
    6. Operator Adjustment & Setpoints
d. Detailed review of all schematic diagrams
e. Detailed review of all software functions using actual software listings
f. Detailed programming instruction of hardware furnished unless otherwise noted
g. Detailed calibration procedures for all furnished
h. Recommended Maintenance Procedures
i. Recommended Spare Parts

E. Final Acceptance

(1) Final Owner acceptance is defined as a point in time when (1) all training has been performed, (2) final “As Installed” documentation and software (when applicable) have been received and approved, (3) the system has successfully passed the availability test period, and (4) all punch list items have been resolved. Only at this time, will final payment be released.

F. Guarantee and Warrantees

(1) Guarantee all work of these Specifications for a period of one (1) year from the date of final acceptance by the Owner. With respect to

instruments and equipment, guarantee shall cover (a) faulty or inadequate design; (b) improper assembly or erection; (c) defective workmanship or materials; and (d) leakage, breakage, or other failure not caused by Owner misuse. For equipment bearing a manufacturer's warranty in excess of one year, furnish a copy of the warranty to Owner with Owner named as beneficiary.

## PART 2 - PRODUCTS

### 2.01 JOB CONDITIONS

A. Exercise care (1) to secure neat arrangement of all piping, valves, conduit, and like items, and (2) to overcome structural interferences. Verify dimensions and conditions at the place of work, and install materials and equipment in the available spaces.

### 2.02 MATERIALS AND STANDARD SPECIFICATIONS

A. Provide instruments, equipment and materials suitable for service conditions and meeting standard specifications such as Instrument Society of America (ISA). The intent of this Specification is to secure instruments and equipment of a uniform quality and manufacture throughout the facilities; i.e., all instruments furnished by the Supplier of the same type of function shall be by the same manufacturer. This allows the stocking of the minimum number of spare parts.

### 2.03 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Box, crate or otherwise enclose and protect instruments and equipment during shipment, handling and storage. Keep all equipment dry and covered from exposure to weather, moisture, corrosive liquids, and gases or any element which could degrade the equipment. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Repair any damage as directed and approved.

### 2.04 MOUNTING

A. Mount and install equipment as required. Mount field instruments according to the best standard practice on pipe mounts, pedestal mounts, or other similar means in accordance with manufacturer's recommendations.

B. Equipment specified for field mounting shall be suitable for direct pipe mounting, pedestal mounting, or surface mounting. Non in-line indicators and equipment with calibration adjustments or requiring periodic inspection shall be mounted not lower than three (3) feet nor higher than five (5) feet above walkways, platforms,

catwalks, etc. All such equipment shall be weather and splash proof, and electrical equipment shall be in NEMA 4X cases unless otherwise noted.

## 2.05 COMPONENT TAG NUMBERING SCHEME

A. All control equipment shall be identified by unique alphanumeric code or tag number based on the latest International Society of Automation standards S5.1.

Tag Numbering Scheme: a-b-c-d

Equipment tagging shall be based on the following scheme:

| | Description | TAG | Explanation |
|---|---|---|---|
| | | | |
| a. | ISA Functional Identification | HS | Hand Switch |
| | | | |
| b. | Loop Number | 23 | Loop 23 |
| | | | |
| c. | Component Number | 2 | Second HS in Loop |
| | | | |
| d. | Unit | 3 (When Required) | Third Identical Process Control System |

Example 1: HS-23-2-3

Tag number identifies a Hand Selector Switch. It is part of Loop 23 and the second hand selector switch in the loop. This is the third identical process unit (i.e., three identical control stations).

## 2.06 INSTRUMENT IDENTIFICATION

A. All components provided, both field and panel mounted, shall be provided with permanently mounted name tags bearing the entire tag number of the component. Panel mounted tags shall be white with black lettering lamicoid plastic; field mounted tags shall be stamped stainless steel.

B. Nameplates for panels and panel mounted equipment shall be as indicated on the Drawings.

C. Field mounted tags shall be 16-gauge, 304 stainless steel with 3/16 inch high characters.

D. Tags shall be attached to equipment with a commercial tag holder using a stainless steel band with a worm screw clamping device or by a holder fabricated

with standard stainless steel hose clamps and meeting the same description. In some cases where this would be impractical, use 20 gauge stainless steel wire.

E. For field panels or large equipment cases use stainless steel screws, however, such permanent attachment shall not be on an ordinarily replaceable part. In all cases, the tag shall be plainly visible to a standing observer and not obscure adjustment ports or impair the function of the instrument. Field mounted control stations, recorders or indicators shall have a nameplate indicating their function and the variable controlled or displayed. Nameplate shall be attached by one of the above methods.

2.07 STANDARD LIGHT COLORS AND INSCRIPTIONS

Unless otherwise noted, the following color code and inscriptions shall be followed:

| **Tag Function** | **Inscription(s)** | **Color** |
|---|---|---|
| ON | ON | RED |
| ON | ON | GREEN |
| OPEN | OPEN | RED |
| CLOSED | CLOSED | GREEN |
| LOW | LOW | GREEN |
| FAIl | FAIl | RED |
| HIGH | HIGH | AMBER |
| AUTO | AUTO | WHITE |
| MANUAL | MANUAL | YELLOW |
| LOCAL | LOCAL | WHITE |
| REMOTE | REMOTE | AMBER |

Lettering shall be black on white and amber lenses. Lettering shall be white on red and green lenses.

2.08 STANDARD PUSHBUTTON COLORS AND INSCRIPTIONS

| **Tag Function** | **Inscription(s)** | **Color** |
|---|---|---|

| | | |
|---|---|---|
| OO | ON | RED |
| OC | OFF | GREEN |
| OC | OPEN | RED |
| | CLOSED | GREEN |
| OCA | OPEN | RED |
| | CLOSED | GREEN |
| | AUTO | WHITE |
| OOA | ON | RED |
| OC | OFF | GREEN |
| | AUTO | WHITE |
| MA | MANUAL | YELLOW |
| | AUTO | WHITE |
| SS | START | RED |
| | STOP | GREEN |
| RESET | RESET | RED |

All unused or non inscribed buttons shall be black.

## 2.09 ELECTRONIC EQUIPMENT

A. If the equipment is electronic in nature, provide industrial duty, solid state equipment to the greatest extent practicable. Select components of construction for their suitability and reliability. Employ adequate component derating to preclude failures because of transients and momentary overloads reasonably expected in normal operation. Where conduit connection is provided for mounting a surge/lightning suppressor directly to the instrument, the arrestor shall be so mounted.

## 2.10 EQUIPMENT OPERATING CONDITIONS

A. All equipment shall be rated for normal operating performance with varying operating conditions over the following ranges:

(1) Power:

120 Vac ± 10%, 60 Hz ±1 Hz except where specifically stated otherwise on the drawings or in the specifications.

(2) Environmental Conditions:

a. Equipment rated NEMA 1 or NEMA 12 shall be suitable for the following environmental conditions:

1. Temperature: 40 to 105 degrees F.
2. Relative Humidity: 10 to 80 percent.
3. Classification: Non-hazardous.

B. Equipment rated NEMA 4X shall be suitable for the following environmental conditions:

(1) Temperature: 20 to 105 degrees F.
(2) Relative Humidity: 10 to 100 percent.
(3) Classification: Non-hazardous.
(4) Atmosphere: Corrosive.

## 2.11. SIGNAL ISOLATORS, CONVERTERS AND CONDITIONERS

A. Insure that input-output of all instruments and control devices (whether furnished by the Supplier or not) are compatible. Analog signals between field and panels shall be 4 to 20 mA dc unless specifically approved otherwise. Granting such approval does not relieve the Supplier from the compatibility requirement above. Provide signal isolators and converters as necessary to obtain the required system performance. Mount the devices behind control panels or in the field at point of application, as required for accurate signal acquisition.

## 2.12. AUXILIARY CONTACTS BY OTHERS

A. Provide instruments and equipment to connect to auxiliary contacts provided by others for alarms, status of equipment, interlocking, and other functions as indicated and as specified herein.

## 2.13. ELECTRICAL

A. The construction work shall include all power supply wiring, instrumentation wiring, interconnecting wiring and equipment grounding as indicated, specified, and required.

B. Wiring installations shall include cables, conductors, terminals, connectors, heat shrunk wire markers on all terminations, conduits, conduit fittings, supports, hardware, and all other required materials.

C. Provide the materials and complete all the required installations for equipment grounding.

D. Incidental items not specifically included in the Contract Documents that can legitimately and reasonably be inferred to belong in the instrumentation work shall be provided and installed by the Supplier at no additional cost to the Owner.

E. Ring out all signal wiring prior to termination. Provide wire number tags marked in indelible waterproof form of slip-on type and heat shrunk for each wire termination point in the panel and field. Wire tagging shall identify the destination point of the wire and when applicable, shall include the signal polarity for analog signals. Each destination point shall be coded as follows:

(1) Destination ID - Terminal Block ID - Terminal Number - (Polarity)

## 2.14. ELECTRICAL TRANSIENT PROTECTION

A. All instrument and control equipment mounted outside of protective structures (field mounted equipment) shall be equipped with suitable surge-arresting devices to protect the equipment from damage due to electrical transients induced in the interconnecting lines from lightning discharges or nearby electrical devices. Both power and signal circuits shall be protected with surge and transient protectors installed at the source and destination ends of the circuits. Protective devices used on 120V ac inputs to field mounted equipment shall be secondary valve surge protectors conforming to the requirements of IEEE Standard 28-1972 (ANSI C62.1-1971).

B. Surge and transient protectors shall be normally connected to the electrical system ground. When an electrical system ground is not available near the device, the protectors shall be connected to a Stainless Steel ground rod 10 ft. in length by 3/4 inch in diameter and located within 10 feet of the device.

C. Protectors for signal circuits at the field transmitter shall be Joslyn Model No. 1669-06, 1669-02, and 1800-20 in panels. Protectors for 120 volt power circuits shall be UL listed Joslyn Model No. 1250-32 secondary arrestor.

## 2.15. PROCESS CONNECTIONS

A. Provide instrument piping, tubing, and capillary tubing to meet the intended process service and ambient environmental condition for corrosion resistance, etc. All instrument pneumatic tubing shall be stainless steel with stainless steel fittings. Slope lines according to service to promote self draining or venting back to the process. Terminate connection to process lines or vessels in a service rated block valve that will permit closing off the sense line or removal of the element without requiring shut down of the process. Include drip legs and blow-down valves for terminations of sense lines at the instruments when mounted such that condensation can accumulate.

## 2.16. MISCELLANEOUS MECHANICAL

A. Three Valve Instrument Equalizing Manifold

1. Manifolds shall be of stainless steel construction for isolation and equalization of differential pressure transducers. Units shall be Anderson, Greenwood and Company Type M1 or equal.

B. Welding of S.S. enclosures and instrument supports shall be TIG welded and finished to provide corrosion free appearance.

## 2.17. PAINTING

A. Provide factory paint for all instruments and equipment. Provide paint as required for non-stainless steel structural supports, brackets, etc.

## 2.18. CORROSION PROTECTION

A. All control panels, enclosures, and other equipment containing electrical or instrumentation and control devices, including spare parts, shall be protected from corrosion through the use of corrosion-inhibiting vapor capsules. Prior to shipment, the capsules shall be provided within the shipping containers and equipment as recommended by the capsule manufacturer’s recommendations. All capsules shall be replaced by the Contractor just prior to Owner’s final acceptance of the equipment. The corrosion-inhibiting vapor capsules shall be Northern Instruments Model Zerust VC or Hoffman Model A-HCI. NEMA 4x panels shall be provided with breather/drains, Chrouse-Hinds Model ECD18; or approved equal.

## 2.19. SPARES AND MAINTENANCE MATERIALS

A. Deliver to Owner, as directed, the following items as specified herein. Include an itemized list in a letter of transmittal with each shipment.

B. Materials shall be delivered in the manufacturer's original containers labeled to completely describe contents and equipment for which it is furnished.

1. One fuse of each size and type for every five used but no less than five of each type.

2. One circuit breaker of each size and type for every five used but no less than one of each type.

3. One relay of each type for every five used but no less than one of each type.

4. One status light bulb for every five used but no less than five of each type.

5. One indicating lamp assembly for every five panel mounted lamp assemblies used but no less than one of each type.

6. One switch assembly for every five used but no less than one of each type.

7. One transient protector for every five used but no less than one of each type.

## 2.20 WORKMANSHIP

A. General

1. Install materials and equipment in a workmanlike manner utilizing craftsman skilled in the particular trade. Provide work which has a neat and finished appearance.

2. Coordinate work with the Owner, and work of other trades to avoid conflicts, errors, delays, and unnecessary interference with operation of the facilities during construction.

B. Protection During Construction

1. Throughout this Contract, the Contractor shall provide protection for materials and equipment against loss or damage and the effects of weather. Prior to installation, store items in indoors in a dry locations. Provide heating in storage areas for items subject to corrosion under damp

conditions. Specific storage requirements shall be in accordance with the Owner reviewed Contractor recommendations.

C. Material and Equipment Installation

1. Follow manufacturers' installation instructions explicitly, unless otherwise indicated. Wherever any conflict arises between manufacturers' instructions, and these Contract Documents, follow the Owners decision, at no additional cost to the Owner. Keep copy of manufacturers' installation instructions on the jobsite available for review at all times.

D. Removal or Relocation of Materials and Equipment

1. Where existing materials and equipment are removed or relocated, remove and deliver to the Owner all materials no longer used unless otherwise directed by the Owner. Repair affected surfaces to conform to the type, quality, and finish of the surrounding surface in a neat and workmanlike manner. Follow any specific instructions by the Owner.

E. Cleaning and Touchup Painting

1. Keep the premises free from accumulation of waste material or rubbish. Upon completion of work, remove materials, scraps, and debris from premises and from interior and exterior of all devices and equipment. Touch-up scratches, scrapes, or chips in interior and exterior surfaces of panels and equipment with finishes matching as nearly as possible the type, color, consistency, and type of surface of the original finish.

F. Panels and Panel-Mounted Equipment

1. Panels and panel-mounted equipment shall be assembled as far as possible at the factory. No work, other than correction of minor defects or minor transit damage, shall be done on the panels at the jobsite.

G. Electrical

1. 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.

2. Wiring shall not be spliced or taped except at the device terminals or terminal blocks.

3. Use manufacturer's recommended tool with the proper sized anvil, for all crimp terminations. No more than one wire may be terminated in a single

crimp lug and no more than two lugs may be installed on a single screw terminal.

H. Inspections

1. All materials, equipment, and workmanship shall be subject to inspection at any time by the Owner. Correct any work, materials, or equipment not in accordance with these Contract Documents or found to be deficient or defective in a manner satisfactory to the Owner at no additional cost to the Owner.

END OF SECTION

# SECTION 13610

# FUNCTIONAL CONTROL DESCRIPTIONS

## PART 1 - GENERAL

### 1.01 DESCRIPTION

A. Scope of Work:

1. The Primary Instrumentation and Control System Supplier (System Supplier) shall furnish all labor, materials, modifications to existing equipment, programming, services and incidentals required to install and place into operation a digital computer-based data acquisition and process control system (DACS) in a distributed network configuration as specified and shown on the Contract Drawings, Section 13600: Instrumentation General Provisions AND Section 13615: Process Instrumentation and Controls - Products.

2. The System Supplier shall supply all equipment, materials, programming, and services, hereinafter termed the system. The System Supplier shall provide all equipment, materials, programming, software, modifications to existing equipment, calibrations and services that are required to successfully interface and interconnect the Aeration Control System and any other control systems and associated equipment that are specified or designated in any drawings or specification provisions in Division 11: Equipment, Division 13: Instrumentation, Division 15: Mechanical and Division 16: Electrical of these Specifications for the purpose of providing a fully integrated and functional control system as specified herein. Successful integration and interconnection of the data acquisition and process control system to any of the areas of interface specified shall require that the System Supplier provide the necessary extension to the existing data highways and I/O capability.

3. The System Supplier shall be responsible for providing accessory devices, revising existing control systems including furnishing and installation of control switches and signal converters and changes to software necessary to perform the intent as shown P&IDs and as specified in the functional process descriptions, providing services to re-calibrate all existing analog transmitters which provide inputs to the system, and services necessary to achieve a fully integrated and operational system as shown on the Contract Drawings, Section 13615 and described hereinafter. Repair of existing transmitters and field devices found to be out of operation shall not be included under this Section.

4. The System Supplier shall furnish for installation by the Contractor all cabling and cable accessories, including tools necessary for connecting the control system peripherals.

5. The System Supplier shall furnish startup assistance and operator and maintenance training necessary to successful operation and maintenance of the integrated control system.

B. Related Work Described Elsewhere:

1. Instrumentation General Provisions: Section 13600.

2. Process Instrumentation and Controls - Products: Section 13615

C. General Description of the System:

1. A computer directed monitoring, automatic control and management system shall be furnished to provide control logic, monitoring of process variables and operational records of system operation. It shall also be used to provide other management functions, including government reports and operational reporting.

2. The data acquisition and process control system shall operate as a stand-alone system with local inputs/outputs and shall interface with wide area data network. The data acquisition and process control system software shall be completely standard and consist of groups of functional software modules that have been developed and thoroughly tested. Operator prompting with menu selection shall configure the data acquisition and process control system. It shall not require knowledge of any programming language.

1.02 QUALITY ASSURANCE: Qualification requirements are specified under Section 13600: Instrumentation General Provisions.

1.03 SUBMITTALS: Refer to Section 01040: Project Coordination and Section 13600: Instrumentation General Provisions.

1.04 DOCUMENTATION: Refer to Section 13600: Instrumentation General Provisions.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING: Refer to Section 13600: Instrumentation General Provisions.

1.06 WARRANTY AND GUARANTEES (SEE SECTION 01740: WARRANTIES AND BONDS)

A. All equipment supplied under this section shall be warranted for a period of one (1) year by the System Supplier.

B. The System Supplier's warranty period shall run concurrently with the Contractor's warranty period. No exception to this provision shall be allowed.

PART 2 - PRODUCTS

2.01 Fiber-Optic Cable: All fiber-optic connection shall be multi-mode 62.5/125µm gel-filled, armored cable (pre-manufactured by a fiberoptic cable manufacturer).

2.02 Modem (Fiber-Optic): The system shall include a high speed 100 Mb/s fiber optic modem compatible with the PLC data highway, Modbus Plus.

2.03 SYSTEM SOFTWARE

A. General Description:

1. The supervisory system shall be an operator interface control system that includes support for process control, data acquisition, alarming, trending, and management reports, operating under the latest version of Windows® with applicable updates in use by the owner at the time of construction.

2.04 REPORTS

A. Reports shall be implemented through the specified Report Generator. Provide the following reports:

1. Monthly Operations Report: The data for this report shall be daily totals and averages calculated by the DACS. Configure handling of report data and generation of the report so that loss of Random Access Memory (RAM) during the month shall not cause loss of report data. The report shall provide totals by week of all process flows. The report shall also provide a monthly total for each process flow. Format of the report shall be decided at the first coordination meeting.

2. Daily Operations Report: The data for this report shall be the hourly values of all process values monitored by the DACS.

3. Daily Equipment Maintenance Report: A table to indicate totalized elapse runtime of all pumps, blowers and process equipment shall be configured

daily at the same time of day and automatically downloaded to the maintenance program.

4. Status/Alarm Report: The data for this report shall be the last 200 change of status or alarm conditions monitored at the plant.

## 2.05 AERATION CONTROL PANEL

A. Aeration Control Panel - One Aeration Control Panel shall be supplied for Train 1 to integrate and control all new aeration process equipment for Train 1 associated with the six modulating flow control valves, six air mass flow meters, six dissolved oxygen probes, two ammonium probes, two nitrate probes, one TSS probe and two pH probes, and internal recycle pump. The control panel will consist of a Xylem sensor communications module, Xylem sensor HMI, programmable logic controller (PLC), and local HMI. All dissolved oxygen probes, ammonium probes, nitrate probes, air mass flow meters, and zone flow control modulating valves must communicate and be controlled at the panel mounted HMI. The control panel shall be located and housed in a rated enclosure as shown on the drawings and as specified in Section 13615, Process Instrumentation and Controls – Products. The main control panel shall have the following components and be able to perform the following functions.

1. PLC and HMI shall be able to function in the following methods:

   a. PLC shall have the ability to provide complete control of the aeration system in the event of communication loss with the plant Data Acquisition Control System (DACS) system.

   b. Controller shall also be able to interface with, and be controlled remotely, by the facility control system using one of the following communication methods: Ethernet (number of ports as required, TCP/IP), MODBUS, MODBUS Ethernet, CANbus, CANopen, UniCAN, and have GPRS/GSM/SMS support.

2. HMI – PLC shall be accompanied by a LCD Color HMI with touch screen controls. Viewing area shall be 15” or larger. There shall be enough I/O modules for the data below to be processed. Application shall contain a minimum of 2MB of logic.

3. The Train 1 aeration control panel must interface with, six dissolved oxygen probes, six air mass flow meters, one ammonium probe, one nitrate probe, one combined ammonium/nitrate probe, and six modulating flow control valves. The local HMI shall provide complete control of aeration system. This includes operator adjustable setpoints and manual control of air flow control valves.

4. Manual Control - Air flow control valves shall be able to be manually operated via the local HMI.

5. Automatic Control – Air flow control valves shall be automatically modulated by the PLC based on setpoints specified in Paragraph 2.06, Function Descriptions.

6. Aeration system local HMI shall also display the following information for the aeration system.

    a. Run status of mixers.

    b. Run status and speed of IR pump.

    c. Each zone's modulating flow control valve's position.

    d. D.O. level from each probe and average per train.

    e. Ammonium concentration from each probe.

    f. Nitrate concentration from each probe.

    g. Air flow rate for each drop leg and total per train as measured by the air mass flow meters.

    h. pH concentration from each probe.

    i. TSS concentration.

8. Controller shall have an internal clock for the date and time stamp as well as to assist with the maintenance schedule.

9. PLC and local HMI shall have the ability to be password protected.

10. The Data Acquisition System (DACS) must display any motor and drive faults that prevent operation of the unit. The display must include, but is not limited to, the following faults:

    a. Motor Phase over current

    b. Motor Stall

    c. Motor Over Temperature

11. Visual Alarms and Visual Alarm Set Points – The PLC controller must also display visual alarms on the HMI screen when their respective Alarm set points are exceeded.

| | | |
|---|---|---|
| a. | Low DO in each zone | 0.5 mg/L |
| b. | High DO in each zone | 4.0 mg/L |

c. High NH4-N in Zone 6 0.5 mgN/L

d. Flow Control Valve Fault for each zone

2.06 FUNCTION DESCRIPTIONS

A. General Requirements:

1. The Data Acquisition System (DACS) shall perform the following as a minimum:

a. Monitor the status of all selector switches in the field.

b. Display on each facility screens the run status and totalized run hours of all equipment.

c. Display, indicate and record alarm status as required by other divisions of the specification.

d. Provide interlocking signals between unit processes.

e. Display and configure graphics. Graphics shall include facility structure and major process piping and alarms. The graphics shall include facility name, specifics areas, time and date stamp, flow direction arrows, adjacent to and from process icons, valves and equipment tags, each process equipment shall be called-out (i.e. High Pressure Pump No.1 etc.) and equipment status shall be indicated. A color code system shall be submitted for approval.

f. Trend all flow, level and analytical signals including minimum, maximum, and average for each.

g. Configure tables of real-time data for access by other users on the network.

h. Configure tables of elapse time of all equipment and relational data as required by the Owner.

i. Alarm events shall be tagged to allow the user to mouse click to the alarmed facility.

B. In addition to the Functional Requirements shown on the P & ID drawings and the General Requirements under 2.06 the DACS shall meet the following requirements:

1. Plant Graphic Requirements

a. Plant Overview Screen shall be re-configured to indicate major structures and piping systems including names of facilities. The Owner shall be able to click-on the facility to initiate the specific facility graphic.

b. In addition to the re-configuration of overview screen facility graphics there shall be provided as a minimum the following graphics:

1. Aeration Basins
2. Actuator Templates
3. Alarm Page

2. Trending: Trending shall be configured for all analog process signals located at the water reclamation facility. The X and Y axis shall be configured using engineering units, percent of scale is not acceptable.

3. Tables: Tables shall be configured to indicate elapses time for all pumps, blowers and process equipment. In addition, tables for all totalized flow and a table for control set points shall be configured.

4. Bar Graphs: Bar graphs shall be configured to indicate all analog processes, flow, level and analytical signals. The horizontal axis shall be scaled in engineering units.

C. General Automation:

1. The System supplier shall furnish, install, and program a complete process aeration control package, including a main control panel, drop leg air flow meters, nitrate monitoring probes, dissolved oxygen monitoring probes, and ammonium monitoring probes. Programming shall include control of electrically actuated modulating drop leg flow control valves.

2. At the Aeration Control Panel (ACP) HMI, the operator shall select manual or automatic operation of the process aeration system. In manual mode, the operator shall set position of the motorized air flow control valves. In automatic mode, the operator shall select one of the following automatic control modes of operation:

a. Dissolved Oxygen (DO) Control

b. Ammonium ($NH_4$) Control

3. Dissolved Oxygen (DO) Control

a. For the zones being aerated, the operator shall also set a minimum air flow rate per drop leg for each zone to maintain minimum mixing conditions and/or air flow per diffuser in those zones.

b. The operator shall input a DO set point and DO alarms (high and low) and select if the control shall be based on the average or minimum of the selected DO probes. The average or minimum will be based on the calculated values during an operator adjustable time period between 5 and 30 minutes. The main control panel will then adjust the basin air flow as required to maintain the DO set point.

c. Proposed initial control and alarm set points for DO control, which will be adjusted and field verified based on actual operating conditions and experience:

| | | |
|---|---|---|
| a. | Average DO Control Set Point | 2.0 mg/L |
| b. | Minimum DO Control Set Point | 1.0 mg/L |
| c. | High DO Alarm | 4.0 mg/L |
| d. | Low DO Alarm | 0.5 mg/L |

4. Ammonium ($NH_4$) Control

a. The operator shall select which zone DO probe (zone 3 or 4) shall be used to trim the $NH_4$ control loop.

b. The operator shall then input a $NH_4$ set point and high $NH_4$ alarm and select if the control shall be based on the average or maximum of the selected $NH_4$ probes. The operator shall also select a minimum DO set point to be maintained in each zone. The average or maximum $NH_4$, or minimum DO will be based on the calculated values during an operator adjustable time period between 5 and 30 minutes. The aeration control panel will adjust the air valve position as required to maintain the $NH_4$ set point. If the measured $NH_4$ concentration exceeds the $NH_4$ set point, then aeration is insufficient and the air flow shall be increased. If the measured $NH_4$ concentration is less than the $NH_4$ set point, then the aeration air flow shall be decreased. If the measured DO concentration is less than the minimum set point, then the air flow shall be increased, regardless of the $NH_4$ control loop.

c. Proposed initial control and alarm set points for $NH_4$ control, which will be adjusted and field verified based on actual operating conditions and experience:

| | | |
|---|---|---|
| 1) | Average $NH_4$ Control Set Point | 0.5 mg/L $NH_4$-N |
| 2) | Maximum $NH_4$ Control Set Point | 1.0 mg/L $NH_4$-N |
| 3) | High $NH_4$ Alarm | 0.5 mg/L $NH_4$-N |
| 4) | Zone 1 Minimum DO Control Set Point | 1.0 mg/L |
| 5) | Zone 1 Low DO Alarm | 0.5 mg/L |

5. Drop Leg Flow Control Valves

   a. At the aeration control panel (ACP) HMI, the operator will select manual or automatic operation of the flow control valves. In manual mode, the operator will select the valves in service and set the percent open position (0 to 100%) for the flow control valves.

   b. In automatic, the operator will place the DO probe in service, input a DO set point and DO alarms (high and low) for each zone, and select if the control shall be based on the average or minimum of the selected DO probe. The average or minimum will be based on the calculated values during an operator adjustable time period between 5 and 30 minutes. The main control panel will then modulate the position of the flow control valve for each zone to maintain the target DO concentration.

   c. To minimize the potential for fouling of the fine bubble membrane diffusers, the automatic mode will also include a pulse cleaning cycle. The operators will select a frequency (number of times per day) and duration (minutes) for the pulse cleaning cycle, during which time the flow control valves each zone will be opened 100% and the DO set points and high DO alarms in the zone will be ignored.

7. Trending and Alarms

   a. The Aeration Control Panel (ACP) will also provide historical trending and alarms. The HMI screen for ACP shall also display the total air flow to each basin based on the sum of the individual air flow meters for that basin.

8. Manually Operated Equipment

   a. The following equipment will be manually operated:

      1) Mixer No. 1 – Aeration Train No. 1, Zone 1 (MIX-1)

2) Mixer No. 2 – Aeration Train No. 1, Zone 2 (MIX-2)

3) Mixer No. 3 – Aeration Train No.1, Zone 3 (MIX-3)

4) Drop Leg Isolation Valves.

9. Data Acquisition Control System (DACS)

a. Monitoring and trending of key parameters and alarms (run status, concentrations, high alarms, low alarms, and faults/failures) on the facility DACS. Set point adjustment via DACS (remote) in addition to local set point adjustment at the Aeration Control Panel (ACP).

D. Internal Recycle Pump

1. The internal recycle pump speed will be based on feedback from the nitrate probe at the end of the anoxic zone (Zone 2 or Zone 3, depending on operation). If there are significant levels of nitrate leaving the anoxic zone, then the pump speed will be decreased. If little to no nitrate is leaving the anoxic zone, then the pump speed will be increased. Changes in speed will be incremental and time will be provided for the system to respond to the change prior to additional adjustments.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION: The computer system, peripherals, and accessory equipment shall be installed in accordance with the requirements set forth under Section 13600: Instrumentation General Provisions.

3.02 TESTS AND ACCEPTANCE: Field and system tests, and acceptance requirements are specified under Section 13600: Instrumentation General Provisions.

3.03 INSTRUCTION: Personnel training requirements are specified under Section 13600: Instrumentation General Provisions.

END OF SECTION

# SECTION 13615

# PROCESS INSTRUMENTATION AND CONTROLS - PRODUCTS

## PART 1 - GENERAL

### 1.01 SCOPE OF WORK

A. Attention is drawn to the requirement that all instrumentation and control equipment specified herein shall be furnished by the same System Supplier who shall provide all other related equipment as specified in Section 13600.

B. System Supplier shall furnish all labor, materials, equipment, and services required to install and place into operation the field instrumentation and controls specified herein and as shown on the Contract Drawings.

C. Any auxiliary devices such as lightning/surge protectors, relays, timers, isolators, signal boosters, etc., which are necessary for complete operation of the system, or to perform the functions specified, shall be included whether or not they are specifically shown on the drawings.

D. System Supplier shall coordinate programming of the programmable logic controllers with the local control panel supplier specified in other sections of these specifications and motor control center supplier and all other related equipment supplied by other vendors.

### 1.02 RELATED WORK

A. System Supplier shall be responsible for supplying and installing all equipment as defined in this section and the following related sections:

1. Section 13600 - Instrumentation General Provisions

B. System Supplier shall be responsible for coordinating with the work to be performed as defined in section 13600.

### 1.03 QUALIFICATIONS

A. All System Suppliers shall comply fully with the qualification requirements stated in specification section 13600.

### 1.04 SUBMITTAL REQUIREMENTS

A. Refer to Section 13600 - Instrumentation General Provisions.

1.05 FINAL DOCUMENTATION

A. Final Documentation requirements are defined in specification Section 13600.

1.06 QUALITY CONTROL

A. Quality Control requirements are defined in specification Section 13600.

1.07 PRODUCT HANDLING

A. Product handling requirements are defined in specification Section 13600.

1.08 TOOLS AND TEST EQUIPMENT

A. In addition to the general tools and test equipment defined in specification section 13600, the System Supplier shall provide any items, such as calibration fixtures, patch cables, test leads, etc. necessary for properly checking field operation of equipment supplied under this section.

1.09 SPARE PARTS

A. Spare parts shall be provided for all field replaceable components so there is one spare for every five like items or part thereof.

B. All spares shall be packed in a manner suitable for long-term storage and shall be adequately protected against corrosion, humidity and temperature.

C. Storage and handling instructions shall be provided with each spare part.

D. One year's supply of paper, ink cartridges, calibration gases, etc., as required for the equipment being supplied, shall be provided. Items with less than one year's shelf life shall be provided at required intervals to ensure reliable systems operation throughout the first year following system acceptance.

1.10 Provide all Xylem instruments with a warranty upgrade package except as noted.

PART 2 - PRODUCTS

2.01 FIELD MOUNTED INSTRUMENTS

A. Thermal Mass Flow Sensor

Tags:

| ISA Designation | Service |
|---|---|
| FE/FIT-111 | Aeration Train #1 Zone #1 |
| FE/FIT-112 | Aeration Train #1 Zone #2 |
| FE/FIT-113 | Aeration Train #1 Zone #3 |
| FE/FIT-114 | Aeration Basin #1 Zone #4 |
| FE/FIT-115 | Aeration Basin #1 Zone #5 |
| FE/FIT-116 | Aeration Basin #1 Zone #6 |
| | Uninstalled Spare |

1. Type: Thermal dispersion type linear flow meter that measures the differential temperature between two RTD's and produces an output signal linear to the mass flow rate of air.

2. Required Features:

a. Performance Requirements:

1) Repeatability: ±1 percent of full scale.
2) Signal Output: 4-20 madc, 1200 ohms max. load.
3) Operating Pressure: Maximum of 1250 psig
4) Flow Element Range: 0.25 to 200+ FPS at standard conditions.
5) Power Input: 115 VAC, ±15 VAC, 16 watts max
6) Flow: ± 1% reading + 0.5% full scale. Temperature: ± 2º F [± 1º C]

b. Operating Temperature:

1) Flow Element: -50 F to 350 F.
2) Electrical Housing: 0 F to 150 F.

c. Calibration: Factory calibrated at flow range under given conditions.

d. Construction Features:

1) Process Connection: Threaded NPT, 1-inch minimum.
2) Insertion Length: Tip of probe to extend past centerline of pipe. Pipe size as shown.
3) Process Wetted Parts: All welded 316L stainless steel or Hastelloy C for all wetted surfaces.
4) Sensor Housing: Explosion proof Class 1, Group C and D, Division 1 and 2.
5) Remote Electronics Housing: NEMA-4 enclosure painted with corrosion resistant epoxy paint system (NEMA 4X).

e. Mounting:

1) Remote electronics housing shall be remotely mounted from the sensor housing at locations shown. Provide complete Type 316 stainless steel mounting hardware.
2) Provide hot-tap type flow element mounting with isolation valve and packing gland for removal/reinsertion of element without shutting down the line. Materials shall be compatible with process air piping material. Standard: 0.75 or 1 inch male NPT stainless steel compression fitting with adjustable Teflon ferrule rated up to 150 psig [10 bar (g)] and 200ºF [93ºC], or metal ferrule rated up to 250 psig [17 bar (g)] and 350ºF [177ºC]

2. Accessories:

a. Provide one portable calibrator unit for field checking and adjusting flowmeter calibration.
b. Local Indication:
1) Flow Rate Indicator: Liquid Crystal Display (LCD) with 3-1/2 digits scaled in SCFM.
2) Totalizer: 8 digit Liquid Crystal Display (LCD) counter with lithium battery backup.
c. Interconnecting Cable: Provide standard interconnecting cable between sensor head housing and remote electronic housing. Cable length as required per installation shown.
d. Provide special temperature compensation circuitry for 90 F process temperature range.
e. Flow conditioners (Vortab VMR Flow Conditioning Tube)
f. Provide transient surge protection, DIN rail mounted in a 316 stainless steel box.

3. Product and Manufacturer: Provide one of the following:

   a. ST-98 Series as manufactured by Fluid Components, Incorporated.

B. Multi Parameter Analyzer/Controller

Tags:

| ISA Designation | Service |
|---|---|
| Xylem IQSN | Aeration Train #1 |

1. General:

   a. Function: Serve as interface control for remote monitoring of multiple analytical elements.
   b. Type: Microprocessor
   c. Parts: Transmitter unit, mounting hardware, and connectors.

2. Performance:
   a. Signal Interface: The recommended maximum is 20 elements per controller. There are fourteen (14) probes in Train 1.
      (1) Connected Analyzer Elements: AE-111A, AE-111B, AE-112A, AE-112B, AE-113A, AE-114A, AE-115A, AE-115B, AE-116A, AE-116B, AE-116C, AE-116D, AE-116E
      (2) Output: Ethernet TCP/IP

3. Transmitter Features:
   a. Indicator: black and white back-light LCD
   b. Portable.
   c. Main Display: Operator configurable, displaying up to eight (8) parameters simultaneously.
   d. Auxiliary Display: Temperature, sensor diagnostics, etc.
   e. Scale Range: field selectable.

4. Enclosure:

   a. Provide a 316 stainless steel type NEMA 3R free-standing enclosure to mount the analyzer components. Enclosure to include panel heater, 120VAC circuit breaker, fiberoptic media converter, DIN rail mounted surge protection, circuit breaker and ground lug. Door shall include a 3-point latch and stainless steel handle.

5. Mounting: Rack mounted.

6. Power: 105-250VACc, 50/60-Hz.

7. Accessories:

   a. Air burst compressor typical for some probes as specified herein.

8. Manufacturer, Model: Xylem Sanitaire System

C. Dissolved Oxygen, Luminescent Element

Tags:

| ISA Designation | Service |
|---|---|
| AE-111A | Aeration Train #1 Zone #1 |
| AE-112A | Aeration Train #1 Zone #2 |
| AE-113A | Aeration Train #1 Zone #3 |
| AE-114A | Aeration Basin #1 Zone #4 |
| AE-115A | Aeration Train #1 Zone #5 |
| AE-116A | Aeration Train #1 Zone #6 |
| | Uninstalled Spare |

1. General:
   a. Function: Continuously measure, indicate and transmit a signal proportional to dissolved oxygen of a process fluid.
   b. Type: Luminescent.
   c. Parts: Element, interconnecting cable, and accessories.

2. Performance:
   a. Range: 0 to 20 mg/l
   b. Accuracy:
      (1) ± 0.05 mg O2/L in the range less than 1 mg O2/L
      (2) ± 0.10 mg O2/L in the range greater than 1 mg O2/L
   c. Response Time:
      (1) 90 percent of the final (true) reading (t90) in less than 150 seconds [60 seconds for FDO® 701] and 95 percent of the final (true) reading in less than 200 seconds.90-percent: 40 seconds.

3. Element:
   a. Type: Photocell sensed, nephelometic sensor used for continuous flow, continuous reading.
   b. Operating Temperature Range: 0 to 60 degrees C.
   c. Materials:
      (1) See specification 13630 – 2.3.
   d. Process Connections: submerged
   e. Mounting: Handrail.

4. Manufacturer: Xylem

D. Ammonium Monitoring Probe

Tags:

| | |
|---|---|
| AE-115B | Anoxic Basin #1 Zone #5 ($NH_4$-N) |
| AE-116D | Anoxic Basin #1 Zone #6 ($NH_4$-N) |
| | |
| | Uninstalled Spare |

1. General:
   a. Function: Continuously measure, indicate and transmit a signal proportional to ammonium level of a process fluid.
   b. Type: Potentiometric ion-selective measurement
   c. Parts: Element, interconnecting cable, and accessories.

2. Performance:
   a. Range: 0 to 1000 mg/L $NH_4$–N
   b. Lower Limit: 0.2 mg/L $NH_4$–N
   c. Accuracy:
      (1) 5 % of measured value +0.2 mg/lL (with standard solutions) $NH_4$–N Below 1 mg/l: plus or minus 0.1 mg/l.
   d. Response Time:
      (1) <3 min
   e. Measuring Interval: Continuous
   f. Flow: < 4 m/s max

3. Element:
   a. Type: Potentiometric ion-selective measurement
   b. pH Range: 5 to 9 pH
   c. Materials:
      (1) Sensor: Stainless steel
      (2) Probe: 316 Stainless Steel.
   d. Process Connections: submerged
   e. Mounting: Rail Mount.

4. Accessories:
   a. Automatic air cleaning unit for each probe with on/off switch and 115V power supply.

5. Manufacturer: Xylem.

6. Provide a 1 year service contract for probes as part of this bid.

E. Nitrate Monitoring Probes
Tags:

| ISA Designation | Service |
|---|---|
| AE-112B | Aeration Basin #1 Zone #2 |
| AE-113B | Aeration Basin #1 Zone #3 (Alternate Input Point from Zone #2 sensor) |
| AE-116C | Aeration Basin #1 Zone #6 |
| | Uninstalled Spare |

1. General:
   a. Function: Continuously measure, indicate and transmit a signal proportional to nitrite or nitrate level of a process fluid.
   b. Type: Ion Selective
   c. Parts: Element, interconnecting cable, and accessories.
   d. Path length: 2 mm

2. Performance:
   a. Range: 0.1 - 50 mg/L $NO_3$–N
   b. Accuracy:
      (1) ± 3 % of measured value +0.5 mg/l (with standard solutions)
   c. Response Time:
      (1) ≥ 1 min
   d. Measuring Interval: ≥ 1 to 30 min (fixed values selectable)

3. Element:
   a. Type: Ion selective measurement
   b. Process Connections: submerged
   c. Mounting: Vertical Fixed Point Mount.

4. Manufacturer: Xylem

2.02 OTHER FIELD EQUIPMENT

A. Intrinsic Safety Barriers

1. Intrinsic safety barriers shall be passive devices requiring no external voltage supply and supplied with series resistors, series fuse and shunt zener diodes to limit the transfer of energy to levels required by intrinsically safe protection between safe and hazardous locations.

2. Unit shall be Factory mutual approved and certified for use in accordance with National Fire Protection Association (NFPA 493 of 1978).

3. Unit shall be as manufactured by R. Stahl, Inc. or approved equal.

2.03 PANELS

| Designation | Incoming Power | Enclosure Rating | Remarks |
|---|---|---|---|
| ACP-1 | 120V, 1 phase, 3 wire | NEMA 4X 316 SS | Provide load center for power distribution to remote devices |

A. Components

1. Discrete Control Distribution within Panels:

a. All discrete I/O control points shall be 120VAC power.

b. All discrete field I/O control points entering panel shall be protected with a surge protection unit, as manufactured by Phoenix Contact Trabtech.

c. Programmable Logic Controller (PLC)

1) General:

a) The programmable logic controller (PLC), as specified herein, shall be provided under this section and located within the control panel. RAM capacity shall be determined by size of project.

b) The programmable logic controller (PLC) shall calculate and store at least four hours of two-minute data (instantaneous) for all analog values (except pump speed) in case of communication failure with Plant SCADA System. After communication is reestablished to SCADA Servers, update historical data with this information as required.

. 2) Programmable Controller:

a) The PLC CPU shall be as manufactured by GE Series Rx3i with Ethernet using ETM001 Communications Card.

b) 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 (2) 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 GE.

c) Each discrete output module shall provide eight (8), 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 (4) 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 GE.

d) 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 GE.

e) 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 GE.

f) Power supply modules shall be as manufactured by GE.

3) PLC Ladder Logic Software

a. The System Integrator shall program PLC to perform, and warrant proper system operation as described in this document.

b. The Owner shall be sole owner of all programming software described in this contract, the use of any proprietary software other than described in this contract will not be accepted.

c. All points used in Ladder logic shall be documented and labeled so Owners personnel can identify each point and its function.

d. Control (Command) points shall be programmed such that control can be performed from HAND field devices (such as a selector switch) or from REMOTE by operator interface or MMI SCADA system, as described in contract. In some applications this will require that OR logic be in the

program. The control description shall include how the MMI software should handle the commands.

e. PLC Command points shall be "SET" from MMI or Remote SCADA system. Command example: To start Pump #1, the MMI system shall set the bit to a 1 at address 02001.2 and to stop the pump the MMI shall set the same bit to a 0 (zero) at the same address 02001.2.

f. Programmer shall keep the amount of points needed to control equipment to a minimum; project is licensed to a limited amount of MMI points to be used.

g. Provide a Device Specific, Control Description in one (1) document. The document shall provide all information about controlling each specific device in the same area of the document. This prevents the user from looking in four (4) different places for information on one (1) device.

h. Provide the Product Authorization License for Proficy ME 7.0.

i. All PLC logic instructions (all coils, contacts and registers), shall be programmed and labeled using GE Proficy Machine Edition 7.0 programming software.

j. System Integrator shall furnish the Owner's Technician with Basic PLC Operation training.

d. Relays:

1) Relays shall be provided as necessary to perform switching functions required of control panels and other control circuits. All relays shall have screw type terminal interface. Terminals shall have a permanent, legible identification. Relays shall be mounted such that the terminal identifications are clearly visible and all terminals are readily accessible.

2) General-purpose relays shall be used for logic and switching power to external loads and shall be DIN rail

mounted, general purpose, medium power, and industrial type. Minimum mechanical life expectancy shall be 10,000,000 operations and electrical life expectancy of 100,000 operations at rated load. They shall be of the dust cover enclosed, plug-in type, with 8 or 11 pin, screw terminal, snap-on sockets. Relays shall have a maximum of three form C contacts rated for 10 amperes at 120V ac and be equipped with coil status indicator lamps and hold down springs. Relays shall be as manufactured by Potter-Brumfield series KRPA, KUP, or Omron Type G2R or approved equal.

e. Power Supplies:

1) Provide dc power supplies as required to power instruments requiring external dc power, including two-wire transmitters, dc relays.

2) Power supplies shall convert 120V ac, 60-Hz power to dc power of the appropriate voltage(s) with sufficient voltage regulation and ripple control to assure that the instruments being supplied can operate within their required tolerances.

3) Output over voltage and over current 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. Provide NEMA 1 enclosure for all power supplies. Power supplies shall be DIN rail mounted such that dissipated heat does not adversely affect other components.

4) Power supplies shall be manufactured by Omron or Equal.

f. Wiring: Wiring within panels, consoles, racks, and cabinets shall meet the following requirements:

1) AC power wiring shall be 600 VAC, 12 AWG tinned stranded unless otherwise noted.

2) All Discrete Output control wiring to be orange in color, 300 VAC no less than, 16 AWG, Tinned Stranded Copper type B/N 16/19 or Belden 8500 or XHHW, insulated wire or equal.

3) All Discrete Input control wiring to be red in color, 300 VAC no less than, 16 AWG, Tinned Stranded Copper type B/N 16/19 or Belden 8500 or XHHW, insulated wire or equal.

4) Control wiring routed to MCC and field shall be no less than 14 AWG multi-conductor Tray Cable, Stranded Copper type PVC, THWN or XHHW, insulated wire or equal.

5) All internal analog wiring, (PLC to field terminal), shall be properly labeled and color coded White for positive and Black for negative polarity, no less than 18 AWG, Shielded Tinned Stranded Copper type Belden or equal.

6) All analog field signal cable exiting enclosure, outer jacket shall be labeled with dot matrix printed shrink tube type wire labels. All shield drain wire shall be insulated and properly terminated per ISA and OEM standards. Labels shall identify terminal number, PLC logic reference number and affiliated process variable, properly color coded white for positive and black negative, no less than 16 AWG, Twisted Shielded Stranded Tinned Copper Signal type wire, Belden # 8719 or equal.

7) Wiring shall be numbered and tagged at each termination. Heat shrunk dot matrix wire markers shall be provided at each wire termination point internal and external to each panel(s). Wire tags shall be marked with legible machine printed markings and numbers. Adhesive or taped on tags will not be accepted. Each wire shall have a unique tag number assigned and be clearly identified on the approved shop drawings. Tagging scheme shall identify the designated component tag and terminal number destination.

8) Wiring for special signals such as communications, digital data, and multiplexed signals shall be labeled and use manufacturer's standard cables.

9) All wires to internal components shall be connected to the "inside" of the field interface terminal strip. All wires to external components shall be connected to the "outside" of the field interface terminal strip. No more than two wires shall be connected to any one terminal point.

10) All panel wiring not run in wire ducts shall be bundled and tied.

11) Wiring shall not be spliced or tapped except at device terminals or terminal blocks.

12) Control and signal wiring 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.

13) Where panel components are provided for future equipment, wiring from the components to the panel terminal blocks shall be provided.

g. Wire Color Coding

1) Power Wiring: Phase A shall be black with brown phasing tape, Phase B black with orange tape, and Phase C black with yellow tape.

2) Internally powered AC Control Wiring: Control panel wiring associated with control circuits that are de-energized when the main panel disconnect is opened shall be color coded "Red".

3) Externally powered AC Control Wiring: Control panel wiring associated with control circuits that remain "Hot" when the main panel disconnect is opened shall be color coded "Yellow".

4) All yellow wiring leaving panels shall be brought to an isolated set of terminal blocks.

5) Low voltage, DC Wiring: Blue (DC+); White with Blue or White with red and black -tracer (DC-).

6) DC Control Wiring: Dark Blue (+) and White with Blue tracer (-).

7) Neutral: White

Exception: Where prefabricated wire bundles are used, it is permissible to identify the neutral at every termination with a white shrink tube at least 12 inches long.

8) Ground: Green

9) Field interface wiring shall be black and white pairs unless otherwise noted or required by the National Electrical Code.

10) Intrinsically safe Light Blue

11) 24 VAC power wire shall be orange and brown.

h. Wire Duct

1) Panel wire duct shall be provided between each row of components and adjacent to each terminal strip. Wire ducts shall be a minimum of one inch wide and three inches deep with removable snap-on covers and perforated walls for easy wire entrance. Wire ducts shall be constructed of non-metallic materials with voltage insulation in excess of the maximum voltage carried therein.

2) Empty panel wire duct shall be provided for all field connections to the terminal blocks.

3) A minimum of two inches shall be provided between wire duct and terminal block assemblies

4) Wiring duct shall not be filled to more than 60% visible fill.

i. Wiring Interface: All wiring including spares entering or leaving each panel, console, rack or cabinet shall be terminated and identified as follows:

1) Analog and discrete signal wiring shall be terminated at numbered terminal blocks. All wire shall be labeled with terminal number and PLC logic reference number.

2) Wiring for special signals such as communications, digital data, and multiplexed signals may be terminated at manufacturer's standard connectors.

j. Terminal Blocks: Terminal blocks for panels, consoles, racks, and cabinets shall meet the following requirements:

1) All terminal blocks shall be 600-volt rated and shall be provided for termination of all circuits entering or leaving all panels. Terminal blocks shall have screw clamp compression, dead front barriers with current bar providing direct contact with wire between the compression screw and yoke. Yoke, current bar, and clamping screw shall be constructed of high strength and high conductivity metal. Yoke assembly shall guide all strands of wire into the terminal. Current bar shall provide dependable vibration-proof connections. Terminals shall be constructed to allow connection of wires without any special preparation other than stripping. Individual terminals shall be rail mounted to create a complete assembly such that jumpers can be installed with no loss of space on terminal or rail.

2) Terminal block components shall be sized to allow insertion of all necessary wire sizes and types. Legible, factory machine printed markings and numbers shall be provided for terminal block identifications on both the inside and outside tracks of the terminal block assembly. Terminal blocks shall be numbered in numerical order.

3) Sufficient terminal blocks shall be provided to terminate all wires routed to the panel, all spare points and spare conductors. In addition, the greatest of 20 percent or four unused spare terminals shall be provided

4) All connections for future functions shall be wired to numbered terminal blocks, grouped separate from the terminal blocks in use. Terminal blocks shall be grouped to keep 120V ac circuits separate from the 24V dc circuits.

5) Terminal blocks shall be CSA certified and UL approved.

6) Control type terminal blocks shall be as manufactured by WAGO, Entrlec, SQ-D or Owner approved equal. Analog signals (4-20 mA dc) shall be connected to knife type disconnect terminal. Shields required to be grounded shall be terminated. Signal shields shall be grounded at only point within a loop. Use blocks when passing the shields through.

k. Grounding: Panels, consoles, racks and cabinets shall be provided with an isolated tinned copper grounding bus and lugs for all signal and shield ground connections. This ground bus shall be grounded at a common signal ground point. The signal grounding system shall meet National Electrical Code requirements. (See section 16450 Grounding System)

1) Each analog loop shall be grounded at a single point for the loop. This single point shall be at location of the dc power supply for the loop. Keep all in separate conduit away from parallel runs or AC wiring.

2) Each analog loop shall have its wire shields connected to ground at a single point for the loop. Shields shall be grouped and connected to ground at the same point as the analog signal ground.

l. Analog Signal Isolators and Surge Protectors: Instruments on different panels, cabinets, or enclosures shall not be wired in series. Provide din rail mount analog signal isolators as manufactured by Moore Industries model SCX or M-Systems model M2VS, for analog signals that are sent from one panel or cabinet to another. All analog signals entering or leaving the control system shall be protected at both ends of loop by a surge arrester as manufactured by Phoenix Contact Trabtech.

m. Uninterruptable Power Supply

1) Capacity VA/Watts 850/510

2) Voltage (Single Phase) 120 V + 10%, -20% 230 V +/ -20%

3) Frequency 50 or 60 Hz, +/ -10% (auto-sensing)

4) OUTPUT Simulated sine wave 120 V +/-5% 230 V +/-5%

5) Frequency (on battery) 50 or 60 Hz, +/-0.5% auto-sensing

6) Transfer Time <4 milliseconds

7) Protection

a. Unit Input Circuit breaker for overload and short circuit protection

b. Overload Protection UPS automatic shutdown if overload exceeds 105% of nominal at 20 s, 120% at 10 s, 130% at 3 seconds

c. Short Circuit UPS output cut off immediately.

8) BATTERY

a. Type Sealed, maintenance-free, lead acid batteries

b. Typical Recharge Time to 90% of full capacity 8 hours

c. Backup Time at full load, 4 min. 2 min. 4 min. 2 min.

9) ALARM

a. ON Battery Slow beeping every 4 seconds

b. Battery Low Rapid beeping every second

c. Overload Continuous beeping sound

10) ENVIRONMENT

a. Ambient Operation 0–95% humidity, non-condensing. 50°C up to 10,000 ft. (3000 m).

b. Audible Noise <40 dBA (1 m from surface)

11) SAFETY/APPROVALS

a. UL 1778 C-UL Recognized for industrial applications in accordance with UL 508A without de-rating. Overvoltage Category 3, Pollution Degree 3. FCC Part 15, Subpart B, Class A. CE Marked; LVD: EN62040-1-1; EMC: EN50091-2, EN61000-3-2, EN61000-3-3, IEC801-2, IEC801-3, IEC801-4, IEC1000-2-2

12) Minimum Quantity Per Panel

a. Two (2)

13) Manufacturer

a. Sola

b. Schneider

## PART 3 - EXECUTION

### 3.01 GENERAL

A. Instrumentation and accessory equipment shall be installed in accordance with specification section 13600 and as specified herein.

B. Unless specifically shown otherwise in the Drawings, direct reading or electrical transmitting instrumentation shall not be mounted on process piping. Instrumentation shall be mounted on instrument racks or stands as detailed on the

installation detail drawings provided by the instrument manufacturer. All instrumentation connections shall be provided with shutoff and drain valves. For differential pressure transmitters, three-way valve manifolds shall also be provided. For slurries, chemical or corrosive fluids, diaphragm seals with flushing connections shall be provided.

C. All piping to and from field instrumentation shall be provided with necessary unions, test tees, couplings, adapters, and shut-off valves.

D. Field instruments requiring power supplies shall be provided with local electrical shut-offs and fuses as required.

E. The shield on each process instrumentation cable shall be continuous from source to destination and be grounded as directed by the manufacturer of the instrumentation equipment, but in no case shall more than one ground point be employed for each shield.

F. Lifting rings shall be removed from all panels and assemblies once in position. Plugs of the same color as the panel shall then be installed in the holes.

G. System Supplier shall coordinate the installation, placing and location of system components, their connections to the process equipment panels, cabinets and devices, subject to the Engineer's approval.

H. System Supplier shall ensure that all field wiring for power and signal circuits are in accordance with best industry practice, and provide for all necessary system grounding to insure a satisfactory functioning installation.

END OF SECTION

# SECTION 13620

# DIGITAL PROCESS CONTROL COMPUTERS

## PART 1 GENERAL

### 1.01 DESCRIPTION

A. Section Includes

1. Multi-parameter terminal/controllers and associated modules that control, indicate, record, and transmit signals from multiple online sensors in wastewater treatment processes.

B. Scope

1. Furnish, install, configure, and place into satisfactory operation multi-parameter terminal /controllers as shown on the Drawings and specified herein.

2. The Drawings and Specifications illustrate and specify functional and general construction requirements of terminal/controllers and associated networks but do not necessarily show or specify all components, wiring, piping, and accessories required to make a completely integrated system. Provide all components, piping, wiring, accessories, and labor required for a complete and integrated process monitoring and control network.

3. Alternate manufacturers submitting as an “or equal” shall be responsible for design and interfacing with the existing SCADA system. Manufacturer shall submit complete design drawings demonstrating that the proposed equipment meets or exceeds the intent of this specification.

C. Coordination: Coordinate with other suppliers for installation of all items specified herein and required to ensure the complete and proper interfacing of all process monitoring and control network components and systems.

### 1.02 SYSTEM DESCRIPTION

A. Design Requirements

1. Design terminal/controller system for continuous operation outdoors.

2. Terminal/controllers shall stack-mount to any input/output module in the network specified in this section and in Section 40 95 23 Process Control Input/Output Modules by means of a simultaneous mechanical/electrical connection.

3. Terminal/controller system components shall be designed to be part of a network that has the following capabilities and features:

   a. Protected from overvoltage due to lightning and power supply fluctuations and covered by manufacturer's warranty when installed using manufacturer's recommended components per manufacturer's instructions.

   b. Powered from a centralized power supply.

   c. 24VDC loop powered communication.

   d. Modular: Additional sensors, up to a total of 20 sensors per controller, and process control input/output modules shall have full functionality from any location in the network.

   e. Line, tree, star, and multiple star topology.

B. Performance Requirements

1. Operating range

   a. Temperature: -4°F to 131°F (-20°C to 55°C).

   b. Relative humidity: less than or equal to 90% (yearly average).

   c. Altitude: less than or equal to 6,562 ft. (2,000 m) above mean sea level.

2. Automatic air pressure compensation.

1.03 QUALITY ASSURANCE

C. Acceptable Manufacturers:

1. Furnish terminal/controllers by the named manufacturers.

2. The named manufacturers have been specified to establish the standard of quality and performance of the equipment to be supplied.

3. Manufacturer shall be ISO 9001 certified.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Terminal/controllers shall not be delivered to the site until all product information and system shop drawings have been approved.

B. Delivery and Acceptance Requirements: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

C. Storage and Handling Requirements:

1. Store and handle materials in accordance with manufacturer's instructions.

2. Keep materials in manufacturer's original, unopened containers and packaging until installation.

3. Store materials in clean, dry area indoors.

4. Protect materials during storage, handling, and installation to prevent damage.

5. Temperature range for storage: -13°F to 149°F (-25°C to 65°C).

1.05 SUBMITTALS

A. Product data

1. Operating manual for terminal/controller and associated modules.

2. Mounting bracket installation instructions.

B. Manufacturer's Certifications: Submit manufacturer's certification that materials comply with specified requirements and are suitable for intended application.

C. Warranty documentation.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Provide products from the following manufacturer:

1. YSI Incorporated, 1700/1725 Brannum Lane, Yellow Springs, OH 45387. 1-800-765-4974, or approved equal

2.

2.02 MANUFACTURED UNIT

A. The multi-parameter controller consists of the following:

1. Model MIQ/TC 2020 XT 20-channel terminal/controller.

a. Display

1) Black/white, backlit

2) Resolution: 320 x 420 pixels

3) Viewable area: 4.49 in. x 3.39 in.

4) Display of measured values: lists or daily, weekly or monthly xy chart

b. Function/operation

1) 3 function keys

2) 2 confirmation/switching keys

3) 4-directional navigation key

c. Datalogger

1) Total storage: Up to 525,600 measurements in csv format.

2) User programmable logging interval: 1 minute to 60 minutes.

d. Multi-function USB-A port

1) Electronic key

2) Firmware upgrade

3) Data transfer

e. Status light: blue LED

f. Terminal controller shall use a menu-driven operating system.

g. Each terminal/controller shall control 1 to 20 sensors.

h. Terminal/controllers shall be portable within the network by connecting to any input/output module in the network by means of a simultaneous mechanical/electrical connection.

2. Model MIQ/PS power supply module

a. Inputs

1) 3 x sensor connections

2) 1 x 100 to 240 VAC power

b. Cable glands: M 16 x 1.5, 4 total, with screw plug

c. Status lights: yellow LED, red LED

3. SNCIQ network cable.

a. 3-conductor shielded cable: communications, power, shield

b. Conductors: Minimum 18 AWG

c. Power supply: low voltage (24 V)

2.03 MATERIALS

A. Terminal/controller.

1. Housing material: ASA

2. Function keys: silicon

3. EMI/RFI conformance

a. EN 61326 Class B

b. FCC Class A

4. Safety

a. Certification: CE, cETLus

5. Protection rating: IP66

6. Interface

a. Silicon operating keys

b. LED status light

B. Input/output modules

1. Housing material: polycarbonate, 20% glass filled

2. EMI/RFI conformance

a. EN 61326 Class B

b. FCC Class A

3. Safety

a. Certification: CE, cETLus

4. Protection rating: IP66

C. SNCIQ network cable.

1. Conductors: copper

2. Cable sheath: PUR [with PVC coating for /UG]

3. Protection rating: IP68 (waterproof)

2.04 ACCESSORIES

A. Sun shield:

1. YSI model 109 295Y sun shield

PART 3 EXECUTION

3.01 INSTALLATION

A. Install terminal/controllers and input/output modules in strict accordance with the manufacturer's instructions and recommendations.

B. Network cable

1. Bend radius

a. Permanent bend: not less than 3.2 in. (80 mm).

b. One-time bend: not less than 2 in. (50 mm).

3.02 DEMONSTRATION AND TRAINING

A. Manufacturer's representative will include a half-day of training, if requested, for the process monitoring system inclusive of the equipment supplied in this section and Section 40 95 23 Process Control Input/Output Modules and sections specifying primary process measurement devices.

1. Contractor will schedule a date and time for start-up.

2. Contractor will require representatives of the following be present during the start-up:

a. General contractor

b. Electrical contractor

c. YSI factory-trained representative

d. Owner’s personnel

e. Engineer

END OF SECTION

# SECTION 13625

# PROCESS CONTROL INPUT/OUTPUT MODULES

## PART 1 GENERAL

### 1.1 DESCRIPTION

A. Section Includes

1. Input/output modules for process monitoring and control networks installed in wastewater treatment facilities.

B. Scope

1. Furnish, install, configure, and place into satisfactory operation process control input/output modules as shown on the Drawings and specified herein.

2. The Drawings and Specifications illustrate and specify functional and general construction requirements of input/output modules and associated networks but do not necessarily show or specify all components, wiring, piping, and accessories required to make a completely integrated system. Provide all components, piping, wiring, accessories, and labor required for a complete and integrated process monitoring and control system.

C. Coordination: Coordinate with other suppliers for installation of all items specified herein and required to ensure the complete and proper interfacing of all process monitoring and control network components and systems.

### 1.2 SYSTEM DESCRIPTION

A. Design Requirements

1. Design process control input/output modules for continuous operation outdoors.

2. Design process control input/output modules to stack-mount directly to process control input/output modules specified in this section and terminal/controllers and process control input/output modules specified in Section 40 94 13 Digital Process Control Computers.

3. Process control input/output modules shall be designed to be part of a network that has the following capabilities and features:

a. Protected from overvoltage due to lightning and power supply fluctuations and covered by manufacturer's warranty when installed using manufacturer's recommended components per manufacturer's instructions.

b. Powered from a centralized power supply.

c. Modular: Process control input/output modules shall have full functionality from any location in the network.

d. Line, tree, star, and multiple star topology.

e. 24VDC loop powered communication.

B. Performance Requirements

1. Operating range

a. Temperature: -4°F to 131°F (-20°C to 55°C).

b. Relative humidity: less than or equal to 90% (yearly average).

c. Altitude: less than or equal to 6,562 ft. (2,000 m) above mean sea level.

## 1.3 QUALITY ASSURANCE

A. Acceptable Manufacturers:

1. Furnish process control input/output modules by the named manufacturers.

2. The named manufacturers have been specified to establish the standard of quality and performance of the equipment to be supplied.

3. Manufacturer shall be ISO 9001 certified.

## 1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Process control input/output modules shall not be delivered to the site until all product information and system shop drawings have been approved.

B. Delivery and Acceptance Requirements: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

C. Storage and Handling Requirements:

1. Store and handle materials in accordance with manufacturer's instructions.

2. Keep materials in manufacturer's original, unopened containers and packaging until installation.

3. Store materials in clean, dry area indoors.

4. Protect materials during storage, handling, and installation to prevent damage.

5. Temperature range for storage: -13°F to 149°F (-25°C to 65°C).

1.5 SUBMITTALS

A. Product data

1. Operating manual for process control input/output module and associated modules.

2. Mounting bracket installation instructions.

B. Manufacturer's Certifications: Submit manufacturer's certification that materials comply with specified requirements and are suitable for intended application.

C. Warranty documentation.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Provide products from the following manufacturer:

1. YSI Incorporated, 1700/1725 Brannum Lane, Yellow Springs, OH 45387. 1-800-765-4974.

2.2 MANUFACTURED UNIT

A. Process control input/output modules consist of the following:

1. Inputs

a. SensorNet connections

1) Model MIQ/JB, Model MIQ/JBR: 4 SensorNet connections.

2) Model MIQ/PS, Model MIQ/24V, Model MIQ/IF232, Model MIQ/Blue PS Set: 3 SensorNet connections.

3) All other models MIQ: 2 SensorNet connections.

b. Power Supply

1) Model MIQ/PS, MIQ/Blue PS SET: 100..240VAC.

2) Model MIQ/24V: 24V AC/DC.

c. Current inputs

1) Model MIQ/IC2: 2 current inputs.

2. Outputs

a. Relay outputs

1) Model MIQ/CR3: 3 relay outputs.

2) Model MIQ/R6: 6 relay outputs.

b. Current outputs

1) Model MIQ/CR3: 3 current outputs.

2) Model MIQ/C6: 6 current outputs.

c. Transmitter Power

1) Model MIQ/IC2: 1 24V power supply output.

d. Network communications

1) Model MIQ/2-MOD, Model MIQ/MC2-MOD: Modbus interface.

2) Model MIQ/2-PR, Model MIQ/MC2-PR: Profibus interface.

3) Model MIQ/MC2: Ethernet RJ45 interface.

4) Model MIQ/MC2-MOD, Model MIQ/MC2-PR, Model MIQ/MC2: USB interface.

3. S/N terminator switch.

4. Status lights: yellow LED, red LED.

5. Cable glands: M 16 x 1.5, 4 total, with screw plug.

2.3 MATERIALS

A. Housing material: polycarbonate, 20% glass filled.

B. EMI/RFI conformance

1. EN 61326 Class B.

2. FCC Class A.

C. Safety

1. Certification: CE, cETLus.

D. Protection rating

1. Modules: IP66.

2. USB, Ethernet interfaces: IP67.

2.4 ACCESSORIES

A. Rail mounting kit

1. YSI Model 109 286Y.

B. Sun shield

1. YSI Model 109 284Y sun shield for modules.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install process control input/output modules in strict accordance with the manufacturer's instructions and recommendations.

3.2 DEMONSTRATION AND TRAINING

A. Manufacturer's representative will include a half-day of training, if requested, for the process monitoring system inclusive of the equipment supplied in this section and Section 40 94 13 Digital Process Control Computers and sections specifying primary process measurement devices.

1. Contractor will schedule a date and time for start-up.

2. Contractor will require representatives of the following be present during the start-up:

a. General contractor

b. Electrical contractor.

c. YSI factory-trained representative.

d. Owner’s personnel.

e. Engineer.

END OF SECTION

# SECTION 13630

# DISSOLVED OXYGEN PROCESS MEASUREMENT DEVICES

## PART 1 GENERAL

### 1.1 DESCRIPTION

A. Section Includes:

1. Instruments and associated equipment for measuring dissolved oxygen in water and wastewater treatment systems.

B. Scope

1. Furnish, install, calibrate, test, adjust, and place into satisfactory operation dissolved oxygen sensors as shown on the Drawings and specified herein.

2. The Drawings and Specifications illustrate and specify functional and general construction requirements of dissolved oxygen sensors and do not necessarily show or specify all components, wiring, piping, and accessories required to make a completely integrated system. Provide all components, piping, wiring, accessories, and labor required for a complete and integrated system.

C. Coordination: Coordinate with other suppliers for installation of all items specified herein and required to ensure the complete and proper interfacing of all the components and systems.

### 1.2 SYSTEM DESCRIPTION

A. Design Requirements

1. Design dissolved oxygen measurement system for continuous monitoring in situ using optical sensors that measure lifetime of luminescence caused by the presence of oxygen.

2. Connect dissolved oxygen sensor to field-mounted junction box or Input/Output modules specified in Section 40 95 00 with sensor connecting cable specified in Section 2.3.A.2.

3. Dissolved oxygen measuring system components shall be designed to be part of a process control system that is protected from overvoltage due to lightning and power supply fluctuations and covered by manufacturer’s warranty when installed using manufacturer’s recommended components per manufacturer’s instructions.

B. Performance Requirements

1. Operating range

a. Temperature: 32°F to 140°F (0°C to 60°C)

b. Pressure: less than or equal to 10 bar

c. pH: 4 S.U. to 12 S.U.

2. Measuring range: 0.00 to 20.00 mg O2/l; 0 to 200% of DO saturation

3. Accuracy

a. ± 0.05 mg O2/L in the range less than 1 mg O2/L

b. ± 0.10 mg O2/L in the range greater than 1 mg O2/L

4. Repeatability: ± 0.05 mg O2/L

5. Resolution: 0.01 mg O2 / L (0.1%)

6. Response time: 90 percent of the final (true) reading (t90) in less than 150 seconds [60 seconds for FDO® 701] and 95 percent of the final (true) reading in less than 200 seconds.

7. Signal averaging: User selectable, to provide a t90 from 150 seconds to 300 seconds [from 60 seconds to 300 seconds for FDO® 701].

8. Temperature measurement (compensation) range: 23°F to 140°F (-5°C to 60°C)

1.3 QUALITY ASSURANCE

A. Acceptable Manufacturers:

1. Furnish dissolved oxygen sensors by the named manufacturers.

2. The named manufacturers have been specified to establish the standard of quality and performance of the equipment to be supplied.

3. Manufacturer shall be ISO 9001 certified.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Dissolved oxygen sensors shall not be delivered to the site until all product information and system shop drawings for the sensors have been approved.

B. Delivery and Acceptance Requirements: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

C. Storage and Handling Requirements:

1. Store and handle materials in accordance with manufacturer's instructions.

2. Keep materials in manufacturer's original, unopened containers and packaging until installation.

3. Store materials in clean, dry area indoors.

4. Protect materials during storage, handling, and installation to prevent damage.

5. Temperature range for storage: 32°F to 149°F (0°C to 65°C)

1.5 SUBMITTALS

A. Product Data

1. Sensor operating manual.

2. Mounting bracket / sensor holder installation instructions.

B. Manufacturer's Certifications: Submit manufacturer's certification that materials comply with specified requirements and are suitable for intended application.

C. Warranty documentation.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Provide products from the following manufacturer:

1. YSI Incorporated, 1700/1725 Brannum Lane, Yellow Springs, OH 45387. 1-800-765-4974.

2.2 MANUFACTURED UNIT

A. The Dissolved Oxygen measurement system consists of the following:

1. Model FDO® 700/701 IQ Optical Dissolved Oxygen Sensor consisting of a probe and a replaceable sensor cap.

a. The sensor shall have integrated NTC thermistor.

b. The sensor shall use green LED light with fluorescing optics and equal path reference system.

c. The sensor shall not require calibration. Replacement sensor caps shall contain a built in microchip, not requiring field calibration upon installation.

d. The sensor shall include self-diagnostics for monitoring of membrane sensing element function.

e. The sensor output signal shall be digital.

f. The sensor shall detach from sensor cable allowing for easy replacement or repair.

2. SACIQ-15 (15 meter) sensor connection cable.

a. 3-conductor shielded cable: communications, power, shield

b. Conductors: Minimum 18 AWG

c. Power supply: low voltage (24 V)

d. Connections

1) Controller-side: Quick fastener (threaded)

2) Sensor-side: tinned conductors

## 2.3 MATERIALS

A. Sensor

1. Shaft: V4A Stainless Steel 1.4571 (equivalent to 316Ti)

2. Plug head connector housing: POM

3. Sensor head: POM and PVC

4. Plug: ETFE

5. Fixing Ring: POM

6. Protective hood: POM

7. EMI/RFI conformance

a. EN 61326 Class B

b. FCC Class A

8. Safety

a. Certification: CE, cETLus

9. Protection rating: IP68

B. Sensor Cap

1. Sensor cap: PMMA, PVC , silicone

C. Sensor connection cable

1. Conductors: Tinned copper

2. Coupling ring: Stainless Steel 1.4571 (equivalent to 316Ti)

3. Ring: POM

4. Screw: Stainless Steel V4A

5. O-ring: NBR

6. Enclosure: POM

7. Nut: Stainless Steel 1.4571 (equivalent to 316Ti)

8. Protection ring: POM

9. Cable sheath: PUR

10. Protective cap: PVC

11. Protection rating: IP68 (waterproof)

2.4 ACCESSORIES

A. Handrail Sensor mounting assemblies:

1. YSI model BE/ST 170 [-R, -M] Vario floor handrail mounting Stand.

2. YSI model EH/F 170-1.5 Sensoclean swing mounting assembly including 1.5 m boom and chain.

3. YSI model EH1 170 double, or triple sensor holder, depending on number of sensors required.

## PART 3 EXECUTION

### 3.1 INSTALLATION

A. Install dissolved oxygen sensors in strict accordance with the manufacturer's instructions and recommendations.

B. Immersion sensors:

1. Immerse sensor a minimum of 18in. (46 cm) below the surface.

2. Protect the probe against the oncoming flow of large objects.

3. Install where the optical window does not face into direct light.

4. Install instrument to prevent air bubbles from gathering on the membrane sensing element.

C. Sensor connection cable

1. Bend radius

a. Permanent bend: not less than 3.2 in. (80 mm).

b. One-time bend: not less than 2 in. (50 mm).

### 3.2 ADJUSTING

A. Adjust settings of the dissolved oxygen measuring system for the application requirements in accordance with the manufacturer's instructions

### 3.3 DEMONSTRATION AND TRAINING

A. Demonstrate performance of all instruments to the engineer before commissioning.

B. Manufacturer's representative will include a four hours of training, if requested.

1. Contractor will schedule a date and time for training.

2. Contractor will require representatives of the following be present during the training:

a. General contractor

b. Electrical contractor

c. YSI factory-trained representative

d. Owner’s personnel

e. Engineer

END OF SECTION

# SECTION 13635

# PH LEVEL PROCESS MEASUREMENT DEVICES

## PART 1 GENERAL

### 1.1 DESCRIPTION

A. Section Includes:

1. Instruments and associated equipment for measuring pH in water and wastewater treatment systems.

B. Scope

1. Furnish, install, calibrate, test, adjust, and place into satisfactory operation pH sensors as shown on the Drawings and specified herein.

2. The Drawings and Specifications illustrate and specify functional and general construction requirements of pH sensors and do not necessarily show or specify all components, wiring, piping, and accessories required to make a completely integrated system. Provide all components, piping, wiring, accessories, and labor required for a complete and integrated system.

C. Coordination: Coordinate with other suppliers for installation of all items specified herein and required to ensure the complete and proper interfacing of all the components and systems.

### 1.2 PERFORMANCE REQUIREMENTS

A. Operating Range

1. Temperature: 32°F to 140°F (0°C to 60°C).

2. Maximum Overpressure:

| | | |
|---|---|---|
| a. | at 0°C to 20°C: | 10 bar. |
| b. | at 30°C: | 5 bar. |
| c. | at 40°C: | 3 bar. |
| d. | at 60°C: | 1 bar. |

B. Measuring range: 2 S.U. to 12 S.U.

C. Resolution: 0.01 S.U.

## 1.3 QUALITY ASSURANCE

A. Acceptable Manufacturers:

1. Furnish pH sensors by the named manufacturers.

2. The named manufacturers have been specified to establish the standard of quality and performance of the equipment to be supplied.

3. Manufacturer shall be ISO 9001 certified.

## 1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

B. Storage and Handling Requirements:

1. Store and handle materials in accordance with manufacturer's instructions.

2. Keep materials in manufacturer's original, unopened containers and packaging until installation.

3. Store materials in clean, dry area indoors.

4. Protect materials during storage, handling, and installation to prevent damage.

5. Temperature range for storage: 23°F to 149°F (-5°C to 65°C).

## 1.5 SUBMITTALS

A. Product Data

1. Sensor operating manual.

2. Mounting bracket / sensor holder installation instructions.

B. Manufacturer's Certifications: Submit manufacturer's certification that materials comply with specified requirements and are suitable for intended application.

C. Warranty documentation.

## PART 2 PRODUCTS

### 2.1 GENERAL

A. Design pH measurement system for continuous monitoring in situ using a combination electrode.

B. Connect pH sensor to field-mounted junction box or Input/Output modules specified in Section 40 95 00 with sensor connecting cable specified in Section 2.3.A.3.

C. pH measuring system components shall be designed to be part of a process control system that is protected from overvoltage due to lightning and power supply fluctuations and covered by manufacturer's warranty when installed using manufacturer's recommended components per manufacturer's instructions.

### 2.2 MANUFACTURER

A. Provide products from the following manufacturer:

1. YSI Incorporated, 1700/1725 Brannum Lane, Yellow Springs, OH 45387. 1-800-765-4974.

### 2.3 MANUFACTURED UNIT

A. The pH measurement system consists of the following:

1. Model SensoLyt® SEA combination double junction electrode.

2. Model SensoLyt® 700IQ sensor assembly:

a. Integrated NTC thermistor.

b. Pre-amplification of electrode signal.

c. Digital signal processing with calibration value storage.

d. The sensor shall include self-diagnostics for monitoring of glass electrode breakage.

e. The sensor shall detach from sensor cable allowing for easy replacement or repair.

3. SACIQ-15 (15 meter) Sensor Connection Cable:

a. 3-conductor shielded cable: communications, power, shield.

b. Conductors: Minimum 18 AWG.

c. Power supply: low voltage (24 V).

d. Quick fasteners.

2.4 MATERIALS

A. Combination Electrode

1. Membrane: glass.

2. Reference electrode: gel polymer solid.

3. Armouring: PVC.

4. O-ring seals: Viton.

5. Watertight S7 plug head connector (IP67).

B. Sensor Assembly

1. Shaft: 316Ti Stainless Steel.

2. Sensor holder: POM.

3. Fixing Ring: POM.

4. Protection cap: PVC.

5. EMI/RFI conformance.

a. EN 61326 Class B.

b. FCC Class A.

6. Safety

a. Certification: CE, cETLus.

7. Protection rating: IP68.

C. Sensor Connection Cable

1. Coupling ring: Stainless Steel 1.4571 (equivalent to 316Ti)

2. Ring: POM

3. Screw: Stainless Steel V4A

4. O-ring: NBR

5. Enclosure: POM

6. Nut: Stainless Steel 1.4571 (equivalent to 316Ti)

7. Protection ring: POM

8. Cable sheath: PUR

9. Protective cap: PVC

10. Protection rating: IP68 (waterproof)

2.5 ACCESSORIES

A. Handrail Sensor mounting assemblies:

1. YSI model BE/ST 170 [-R, -M] Vario floor handrail mounting Stand.

2. YSI model EH/F 170-1.5 Sensoclean swing mounting assembly including 1.5 m boom and chain.

3. YSI model EH1 170 double, or triple sensor holder, depending on number of sensors required.

PART 3 EXECUTION

3.1 INSTALLATION

A. Immersion sensors:

1. Immerse sensor a minimum of 1.5in. (40 mm) below the surface.

2. Protect the probe against the oncoming flow of large objects.

B. Sensor connection cable

1. Bend radius

a. Permanent bend: not less than 3.2 in. (80 mm).

b. One-time bend: not less than 2 in. (50 mm).

3.2 START-UP

A. Install pH sensors in strict accordance with the manufacturer’s instructions and recommendations.

B. Manufacturer's representative will include a half-day of start-up service by a factory-trained technician, if requested.

1. Contractor will schedule a date and time for start-up.

2. Contractor will require representatives of the following be present during the start-up:

a. General contractor

b. Electrical contractor

c. YSI factory-trained representative

d. Owner's personnel

e. Engineer

END OF SECTION

# SECTION 13640

# TOTAL SUSPENDED SOLIDS PROCESS MEASUREMENT DEVICES

## PART 1 GENERAL

### 1.1 DESCRIPTION

A. Section Includes:

1. Instruments and associated equipment for measuring total suspended solids in wastewater treatment systems.

B. Scope

1. Furnish, install, calibrate, test, adjust, and place into satisfactory operation total suspended solids sensors as shown on the Drawings and specified herein.

2. The Drawings and Specifications illustrate and specify functional and general construction requirements of total suspended solids sensors and do not necessarily show or specify all components, wiring, piping, and accessories required to make a completely integrated system. Provide all components, piping, wiring, accessories, and labor required for a complete and integrated system.

C. Coordination: Coordinate with other suppliers for installation of all items specified herein and required to ensure the complete and proper interfacing of all the components and systems.

### 1.2 PERFORMANCE REQUIREMENTS

A. Operating Range:

1. Temperature: 32°F to 140°F (0°C to 60°C)

2. Pressure range: 0.5 bar to 10 bar

3. pH: 4 S.U. to 12 S.U.

B. Measuring Range: 0.003 to 1,000 g TSS / l; 0.0003 to 100% TSS

C. Process Variation Coefficient:

1. Low concentration: < 2%

2. High concentration: < 4%

D. Resolution:

1. 0 to 400.0 mg TSS / l ; 0 to 400.0 ppm TSS : 0.1 mg TSS / l ; 0.1 ppm

2. 0 to 4,000 mg TSS / l ; 0 to 4,000 ppm TSS : 1 mg TSS / l ; 1 ppm

3. 0 to 25.00 g TSS / l ; 0 to 2.500 % TSS : 0.01 g TSS / l ; .001 %

4. 0 to 40.00 g TSS / l ; 0 to 4.000 % TSS : 0.01 g TSS / l ; .001 %

5. 0 to 400.00 g TSS / l ; 0 to 4.000 % TSS : 0.1 g TSS / l ; .01 %

6. 0 to 1,000 g TSS / l ; 0 to 100.0 % TSS : 1 g TSS / l ; .1 %

E. Signal Averaging: User selectable to provide a t90 from 1 to 600 seconds.

1.3 QUALITY ASSURANCE

A. Acceptable Manufacturers:

1. Furnish total suspended solids sensors by the named manufacturers.

2. The named manufacturers have been specified to establish the standard of quality and performance of the equipment to be supplied.

3. Manufacturer shall be ISO 9001 certified.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements: Deliver materials to site in manufacturer’s original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

B. Storage and Handling Requirements:

1. Store and handle materials in accordance with manufacturer’s instructions.

2. Keep materials in manufacturer’s original, unopened containers and packaging until installation.

3. Store materials in clean, dry area indoors.

4. Protect materials during storage, handling, and installation to prevent damage.

5. Temperature range for storage: 23°F to 149°F (-5°C to 65°C).

1.5 SUBMITTALS

A. Product data

1. Sensor operating manual.

2. Mounting bracket / sensor holder installation instructions.

B. Manufacturer's Certifications: Submit manufacturer's certification that materials comply with specified requirements and are suitable for intended application.

C. Warranty documentation.

PART 2 PRODUCTS

2.1 GENERAL

A. Design total suspended solids measurement system for continuous monitoring in situ using optical sensors that measure the intensity of scattered light.

B. Connect total suspended solids sensor to field-mounted junction box or Input/Output modules specified in Section 40 95 00 with sensor connecting cable as specified in Section 2.3.A.2.

C. Total suspended solids measuring system components shall be designed to be part of a process control system that is protected from overvoltage due to lightning and power supply fluctuations and covered by manufacturer's warranty when installed using manufacturer's recommended components per manufacturer's instructions.

2.2 MANUFACTURER

A. Provide products from the following manufacturer:

1. YSI, Incorporated, 1700/1725 Brannum Lane, Yellow Springs, OH 45387. 1-800-765-4974.

2.3 MANUFACTURED UNIT

A. The Total suspended solids measurement system consists of the following:

1. Model ViSolid® 700 IQ Total Suspended Solids Sensor.

a. The sensor shall use an optical method that measures the intensity of scattered light and backscatter from an LED source.

b. The sensor shall be factory-calibrated for low concentration (mixed liquor, return activated sludge) and high concentration (primary sludge, thickened sludge) total suspended solids concentrations.

c. The sensor shall have capability for automatically selecting the optimal resolution for each measured value.

d. The sensor shall include self-diagnostics to detect contamination of optical window and failure of cleaning system.

e. The sensor shall have a non-mechanical integrated ultrasonic cleaning system.

f. The sensor shall have a digital output signal.

g. The sensor shall detach from sensor cable allowing for easy replacement or repair.

2. SACIQ-15 (15 meter) sensor connection cable.

a. 3-conductor shielded cable: communications, power, shield

b. Conductors: Minimum 18 AWG

c. Power supply: low voltage (24 V)

d. Quick fasteners

## 2.4 MATERIALS

A. Sensor

1. Body: V4A Stainless Steel 1.4571 (equivalent to 316Ti)

2. Measuring window: sapphire

3. Safety

a. Certification: CE, cETLus

B. Sensor connection cable

1. Conductors: Tinned copper.

2. Coupling ring: Stainless Steel 1.4571 (equivalent to 316Ti)

3. Ring: POM

4. Screw: Stainless Steel V4A

5. O-ring: NBR

6. Enclosure: POM

7. Nut: Stainless Steel 1.4571 (equivalent to 316Ti)

8. Protection ring: POM

9. Cable sheath: PUR

10. Protective cap: PVC

11. Protection rating: IP68 (waterproof)

2.5 ACCESSORIES

A. Handrail Sensor mounting assemblies:

1. YSI model BE/ST 170 [-R, -M] Vario floor handrail mounting Stand.

2. YSI model EH/F 170-1.5 Sensoclean swing mounting assembly including 1.5 m boom and chain.

3. YSI model EH1 170 double, or triple sensor holder, depending on number of sensors required.

PART 3 EXECUTION

3.1 INSTALLATION

A. Immersion sensors:

1. Immerse sensor a minimum of 4 in. (10 cm) below the surface.

2. Install the sensor at an angle from vertical of 20° to 45° facing upstream.

3. Protect the probe against the oncoming flow of large objects.

4. Install where the optical window does not face into direct light.

5. Install sensor so that window is a minimum distance of 4 in. (10 cm) from floors and walls.

B. Sensor connection cable

1. Bend radius

a. Permanent bend: not less than 3.2 in. (80 mm).

b. One-time bend: not less than 2 in. (50 mm).

## 3.2 START-UP

A. Install total suspended solids sensors in strict accordance with the manufacturer's instructions and recommendations.

B. Manufacturer's representative will include a half-day of start-up service by a factory-trained technician, if requested.

1. Contractor will schedule a date and time for start-up.

2. Contractor will require representatives of the following be present during the start-up:

a. General contractor

b. Electrical contractor

c. YSI factory-trained representative

d. Owner's personnel

e. Engineer

END OF SECTION

# SECTION 13645

# DUAL AMMONIUM AND NITRATE PROCESS MEASUREMENT DEVICES

## PART 1 GENERAL

### 1.1 DESCRIPTION

A. Section Includes

1. Instruments and associated equipment for measuring ammonium and nitrate in water and wastewater treatment systems.

B. Scope

1. Furnish, install, calibrate, test, adjust, and place into satisfactory operation sensors as shown on the Drawings and specified herein.

2. The Drawings and Specifications illustrate and specify functional and general construction requirements of sensors and do not necessarily show or specify all components, wiring, piping, and accessories required to make a completely integrated system. Provide all components, piping, wiring, accessories, and labor required for a complete and integrated system.

C. Coordination: Coordinate with other suppliers for installation of all items specified herein and required to ensure the complete and proper interfacing of all the components and systems.

### 1.2 PERFORMANCE REQUIREMENTS

A. Operating range:

1. Temperature: 32°F to 104°F (0°C to 40°C).

2. Maximum overpressure: 0.2 bar

3. pH

a. Ammonium: 4 S.U. to 8.5 S.U.

b. Nitrate: 4 S.U. to 11 S.U.

B. Measuring range:

1. Ammonium as N: 0.1 mg NH4-N / l to 1,000 mg NH4-N / l

2. Nitrate as N: 0.1 mg NO3-N / l to 1,000 mg NO3-N / l.

3. Potassium as K: 0.1 mg K / l to 1,000 mg K / l.

4. Chloride as Cl: 0.1 mg Cl / l to 1,000 mg Cl / l.

5. Temperature: 32°F to 104°F (0°C to 40°C).

6. Voltage: -2,000 mV to 2,000 mV.

C. Measuring accuracy:

1. Ammonium and nitrate, in standard solutions: ± 5% of measured value or ±0.2 mg/l.

2. Temperature: ± 0.5K

D. Resolution:

1. Ammonium as N:

a. 0.1 mg NH4-N / l to 100.0 mg NH4-N / l: 0.1 mg NH4-N / l.

b. 1 mg NH4-N / l to 1,000 mg NH4-N / l: 1 mg NH4-N / l.

2. Nitrate as N:

a. 0.1 mg NO3-N / l to 100.0 mg NO3-N / l: 0.1 mg NO3-N / l.

b. 1 mg NO3-N / l to 1,000 mg NO3-N / l: 1 mg NO3-N / l.

3. Potassium as K: 1 mg K / l.

4. Chloride as Cl: 1 mg Cl / l.

5. Temperature: 0.1 °C.

6. Voltage: 1 mV.

E. Response Time:

1. Ammonium: 90 percent of the final (true) reading in less than 180 seconds at a temperature of 20°C for a concentration change of 10 mg NH4-N / l to 100 mg NH4-N / l.

2. Nitrate: 90 percent of the final (true) reading in less than 180 seconds at a temperature of 20°C for a concentration change of 5 mg NO3-N / l to 50 mg NO3-N / l.

3. Potassium: 90 percent of the final (true) reading in less than 180 seconds at a temperature of 20°C for a concentration change of 5 mg K / l to 50 mg K / l.

4. Chloride: 90 percent of the final (true) reading in less than 180 seconds at a temperature of 20°C for a concentration change of 10 mg Cl / l to 100 mg Cl / l.

5. Temperature: 95 percent of the final (true) reading in less than 20 seconds.

F. Compensation: Compensation for to 1,000 mg K / l and 1,000 mg Cl / l shall be automatic and dynamic with optional compensation electrodes.

1.3 QUALITY ASSURANCE

A. Acceptable Manufacturers:

1. Furnish dual ammonium and nitrate sensors by the named manufacturers.

2. The named manufacturers have been specified to establish the standard of quality and performance of the equipment to be supplied.

3. Manufacturer shall be ISO 9001 certified.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

B. Storage and Handling Requirements:

1. Store and handle materials in accordance with manufacturer's instructions.

2. Keep materials in manufacturer's original, unopened containers and packaging until installation.

3. Store materials in clean, dry area indoors.

4. Protect materials during storage, handling, and installation to prevent damage.

5. Temperature range for storage: 32°F to 104°F (0°C to 40°C)

1.5 SUBMITTALS

A. Product data

1. Sensor operating manual.

2. Mounting bracket / sensor holder installation instructions.

B. Manufacturer's Certifications: Submit manufacturer's certification that materials comply with specified requirements and are suitable for intended application.

C. Warranty documentation.

## PART 2 PRODUCTS

### 2.1 GENERAL

A. Design dual ammonium and nitrate measurement system for continuous monitoring *in situ* using a potentiometric measurement by means of ion selective electrodes.

B. Connect dual ammonium and nitrate sensors to field-mounted junction box or Input/Output modules specified in Section 40 95 00 with sensor connecting cable specified in Section 2.3.A.3.

C. Dual ammonium and nitrate measuring system components shall be designed to be part of a process control system that is protected from overvoltage due to lightning and power supply fluctuations and covered by manufacturer's warranty when installed using manufacturer's recommended components per manufacturer's instructions.

### 2.2 MANUFACTURER

A. Provide products from the following manufacturer:

1. YSI Incorporated, 1700/1725 Brannum Lane, Yellow Springs, OH 45387. 1-800-765-4974.

### 2.3 MANUFACTURED UNIT

A. The nitrate measurement system consists of the following:

1. Electrodes

a. Model VARiON®Plus NH4 electrode.

b. Model VARiON®Plus NO3 electrode.

c. Model VARiON® Ref reference electrode.

2. Model VARiON® Plus AN/A set sensor assembly:

a. Integrated NTC thermistor.

b. Pre-amplification of electrode signal.

c. Digital signal processing with calibration value storage.

d. The sensor shall detach from sensor cable allowing for easy replacement or repair.

e. VARIOM Plus Probe, includes reference electrode, & electrodes for Ammonium, Nitrate & Potassium.

3. SACIQ-15 (15 meter) sensor connection cable.

a. 3-conductor shielded cable: communications, power, shield

b. Conductors: Minimum 18 AWG

c. Power supply: low voltage (24 V)

d. Quick fasteners

2.4 MATERIALS

A. Electrodes

1. Ammonium, nitrate, potassium, and chloride electrodes

a. Enclosure: POM.

b. Clamping ring: POM.

c. Membrane: soft PVC with stainless steel protective grating.

d. Sealing ring: Viton®.

e. Connection contacts: gold plated.

2. Reference electrode

a. Enclosure: PVC.

b. Junction: Porous PVDF.

c. Sealing ring: Viton®.

d. Connection contacts: gold plated.

B. Sensor assembly

1. Shaft: V4A stainless steel.

2. Protective hood: POM

3. Fixing Ring: POM

4. Protection cap: PVC

5. EMI/RFI conformance

a. EN 61326 Class B

b. FCC Class A

6. Safety

a. Certification: CE, cETLus

7. Protection rating: IP68

C. Sensor connection cable

1. Coupling ring: Stainless Steel 1.4571 (equivalent to 316Ti)

2. Ring: POM

3. Screw: Stainless Steel V4A

4. O-ring: NBR

5. Enclosure: POM

6. Nut: Stainless Steel 1.4571 (equivalent to 316Ti)

7. Protection ring: POM

8. Cable sheath: PUR

9. Protective cap: PVC

10. Protection rating: IP68 (waterproof)

2.5 ACCESSORIES

A. Handrail sensor mounting assemblies:

1. YSI model BE/ST 170 [-R, -M] Vario floor handrail mounting Stand.

2. YSI model EH/F 170-1.5 Sensoclean swing mounting assembly including 1.5 m boom and chain.

3. YSI model EH1 170 double, or triple sensor holder, depending on number of sensors required.

PART 3 EXECUTION

3.1 INSTALLATION

A. Immersion sensors:

1. Immerse sensor a minimum of 2 in. (50 mm) below the surface.

2. Protect the probe against the oncoming flow of large objects.

B. Sensor connection cable

1. Bend radius

a. Permanent bend: not less than 3.2 in. (80 mm).

b. One-time bend: not less than 2 in. (50 mm).

3.2 START-UP

A. Contractor will install sensors in strict accordance with the manufacturer's instructions and recommendations.

B. Manufacturer's representative will include a half-day of start-up service by a factory-trained technician, if requested.

1. Contractor will schedule a date and time for start-up.

2. Contractor will require representatives of the following be present during the start-up:

a. General contractor

b. Electrical contractor

c. YSI factory-trained representative

d. Owner's personnel

e. Engineer

END OF SECTION

# SECTION 13650

# AMMONIUM PROCESS MEASUREMENT DEVICES

## PART 1 GENERAL

### 1.1 DESCRIPTION

A. Section Includes:

1. Instruments and associated equipment for measuring ammonium in water and wastewater treatment systems.

B. Scope

1. Furnish, install, calibrate, test, adjust, and place into satisfactory operation Ammonium sensors as shown on the Drawings and specified herein.

2. The Drawings and Specifications illustrate and specify functional and general construction requirements of Ammonium sensors and do not necessarily show or specify all components, wiring, piping, and accessories required to make a completely integrated system. Provide all components, piping, wiring, accessories, and labor required for a complete and integrated system.

C. Coordination: Coordinate with other suppliers for installation of all items specified herein and required to ensure the complete and proper interfacing of all the components and systems.

### 1.2 PERFORMANCE REQUIREMENTS

A. Operating range:

1. Temperature: 32°F to 104°F (0°C to 40°C).

2. Maximum overpressure: 0.2 bar

3. pH: 4 S.U. to 8.5 S.U.

B. Measuring range:

1. Ammonium as N: 0.1 mg NH4-N / l to 1,000 mg NH4-N / l

2. Potassium as K: 0.1 mg K+ / l to 1,000 mg K+ / l.

3. Temperature: 32°F to 104°F (0°C to 40°C).

4. Voltage: -2,000 mV to 2,000 mV.

C. Measuring accuracy:

1. Ammonium, in standard solutions: ± 5% of measured value or 0.2 mg/L.

2. Temperature: ± 0.5K

D. Resolution:

1. Ammonium as N:

a. 0.1 mg $NH_4$-N / l to 100.0 mg $NH_4$-N / l: 0.1 mg $NH_4$-N / l.

b. 1 mg $NH_4$-N / l to 1,000 mg $NH_4$-N / l: 1 mg $NH_4$-N / l.

2. Potassium as K: 1 mg K+ / l.

3. Temperature: 0.1 °C.

4. Voltage: 1 mV

E. Response Time:

1. Ammonium: 90 percent of the final (true) reading in less than 180 seconds at a temperature of 20°C for a concentration change of 10 mg NH4-N / l to 100 mg NH4-N / l.

2. Potassium: 90 percent of the final (true) reading in less than 180 seconds at a temperature of 20°C for a concentration change of 5 mg K / l to 50 mg K / l.

3. Temperature: 95 percent of the final (true) reading in less than 20 seconds.

F. Compensation: Compensation for to 1,000 mg K / l shall be automatic and dynamic with optional K electrode.

1.3 QUALITY ASSURANCE

A. Acceptable Manufacturers:

1. Furnish Ammonium sensors by the named manufacturers.

2. The named manufacturers have been specified to establish the standard of quality and performance of the equipment to be supplied.

3. Manufacturer shall be ISO 9001 certified.

## 1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

B. Storage and Handling Requirements:

1. Store and handle materials in accordance with manufacturer's instructions.

2. Keep materials in manufacturer's original, unopened containers and packaging until installation.

3. Store materials in clean, dry area indoors.

4. Protect materials during storage, handling, and installation to prevent damage.

5. Temperature range for storage: 32°F to 149°F (0°C to 65°C).

## 1.5 SUBMITTALS

A. Product data

1. Sensor operating manual.

2. Mounting bracket / sensor holder installation instructions.

B. Manufacturer's Certifications: Submit manufacturer's certification that materials comply with specified requirements and are suitable for intended application.

C. Warranty documentation.

# PART 2 PRODUCTS

## 2.1 GENERAL

A. Design ammonium measurement system for continuous monitoring *in situ* using a potentiometric measurement by means of ion selective electrodes.

B. Connect ammonium sensor to field-mounted junction box or Input/Output modules specified in Section 40 95 00 with sensor connecting cable specified in Section 2.3.A.3.

C. Ammonium measuring system components shall be designed to be part of a process control system that is protected from overvoltage due to lightning and power supply fluctuations and covered by manufacturer's warranty when installed using manufacturer's recommended components per manufacturer's instructions.

2.2 MANUFACTURER

A. Provide products from the following manufacturer:

1. YSI Incorporated, 1700/1725 Brannum Lane, Yellow Springs, OH 45387

2.3 MANUFACTURED UNIT

A. The ammonium measurement system consists of the following:

1. Electrodes

a. Model VARiON®Plus $NH_4$ electrode.

b. Model VARiON® Ref reference electrode.

c. Model VARiON®Plus K electrode. [Optional for most accurate measurements]

2. Model AmmoLyt® Plus 700IQ sensor assembly:

a. Integrated NTC thermistor.

b. Pre-amplification of electrode signal.

c. Digital signal processing with calibration value storage.

d. The sensor shall detach from sensor cable allowing for easy replacement or repair.

3. SACIQ-15 (15 meter) sensor connection cable.

a. 3-conductor shielded cable: communications, power, shield

b. Conductors: Minimum 18 AWG

c. Power supply: low voltage (24 V)

d. Quick fasteners

2.4 MATERIALS

A. Electrodes

1. Ammonium and Potassium electrodes

a. Enclosure: POM.

b. Clamping ring: POM.

c. Membrane: soft PVC with stainless steel protective grating.

d. Sealing ring: Viton®.

e. Connection contacts: gold plated.

2. Reference electrode

a. Enclosure: PVC.

b. Junction: Porous PVDF.

c. Sealing ring: Viton®.

d. Connection contacts: gold plated.

B. Sensor assembly

1. Shaft: V4A stainless steel.

2. Protective hood: POM

3. Fixing Ring: POM

4. Protection cap: PVC

5. EMI/RFI conformance

a. EN 61326 Class B

b. FCC Class A

6. Safety

a. Certification: CE, cETLus

7. Protection rating: IP68

C. Sensor connection cable

1. Coupling ring: Stainless Steel 1.4571 (equivalent to 316Ti)

2. Ring: POM

3. Screw: Stainless Steel V4A

4. O-ring: NBR

5. Enclosure: POM

6. Nut: Stainless Steel 1.4571 (equivalent to 316Ti)

7. Protection ring: POM

8. Cable sheath: PUR

9. Protective cap: PVC

10. Protection rating: IP68 (waterproof)

2.5 ACCESSORIES

A. Handrail sensor mounting assemblies:

1. YSI model BE/ST 170 [-R, -M] Vario floor handrail mounting Stand.

2. YSI model EH/F 170-1.5 Sensoclean swing mounting assembly including 1.5 m boom and chain.

3. YSI model EH1 170 double, or triple sensor holder, depending on number of sensors required.

PART 3 EXECUTION

3.1 INSTALLATION

A. Immersion sensors:

1. Immerse sensor a minimum of 2 in. (50 mm) below the surface.

2. Protect the probe against the oncoming flow of large objects.

B. Sensor connection cable

1. Bend radius

a. Permanent bend: not less than 3.2 in. (80 mm).

b. One-time bend: not less than 2 in. (50 mm).

3.2 START-UP

A. Install ammonium sensors in strict accordance with the manufacturer's instructions and recommendations.

B. Manufacturer's representative will include a half-day of start-up service by a factory-trained technician, if requested.

1. Contractor will schedule a date and time for start-up.

2. Contractor will require representatives of the following be present during the start-up:

    a. General contractor

    b. Electrical contractor

    c. YSI factory-trained representative

    d. Owner’s personnel

    e. Engineer

END OF SECTION

# SECTION 13655

# NITRATE PROCESS MEASUREMENT DEVICES

## PART 1 GENERAL

### 1.1 DESCRIPTION

A. Section Includes

1. Instruments and associated equipment for measuring nitrate in water and wastewater treatment systems.

B. Scope

1. Furnish, install, calibrate, test, adjust, and place into satisfactory operation nitrate sensors as shown on the Drawings and specified herein.

2. The Drawings and Specifications illustrate and specify functional and general construction requirements of nitrate sensors and do not necessarily show or specify all components, wiring, piping, and accessories required to make a completely integrated system. Provide all components, piping, wiring, accessories, and labor required for a complete and integrated system.

C. Coordination: Coordinate with other suppliers for installation of all items specified herein and required to ensure the complete and proper interfacing of all the components and systems.

### 1.2 PERFORMANCE REQUIREMENTS

A. Operating range

1. Temperature: 32°F to 104°F (0°C to 40°C).

2. Maximum overpressure: 0.2 bar

3. pH: 4 S.U. to 11 S.U.

B. Measuring range:

1. Nitrate as N: 0.1 mg NO3-N / l to 1,000 mg NO3-N / l

2. Chloride as Cl: 0.1 mg Cl / l to 1,000 mg Cl / l.

3. Temperature: 32°F to 104°F (0°C to 40°C).

4. Voltage: -2,000 mV to 2,000 mV.

C. Measuring accuracy

1. Nitrate, in standard solutions: ± 5% of measured value or 0.2 mg/l.

2. Temperature: ± 0.5K

D. Resolution:

1. Nitrate as N:

a. 0.1 mg $NO_3$-N / l to 100.0 mg $NO_3$-N / l: 0.1 mg $NO_3$-N / l.

b. 1 mg $NO_3$-N / l to 1,000 mg $NO_3$-N / l: 1 mg $NO_3$-N / l.

2. Chloride as Cl: 1 mg Cl+ / l.

3. Temperature: 0.1 °C.

4. Voltage: 1 mV.

E. Response Time:

1. Nitrate: 90 percent of the final (true) reading in less than 180 seconds at a temperature of 20°C for a concentration change of 5 mg $NO_3$-N / l to 50 mg $NO_3$-N / l.

2. Chloride: 90 percent of the final (true) reading in less than 180 seconds at a temperature of 20°C for a concentration change of 10 mg Cl / l to 100 mg Cl / l.

3. Temperature: 95 percent of the final (true) reading in less than 20 seconds.

F. Compensation: Compensation for up to 1,000 mg Cl / l shall be automatic and dynamic with optional Cl electrode.

1.3 QUALITY ASSURANCE

A. Acceptable Manufacturers:

1. Furnish nitrate sensors by the named manufacturers.

2. The named manufacturers have been specified to establish the standard of quality and performance of the equipment to be supplied.

3. Manufacturer shall be ISO 9001 certified.

## 1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

B. Storage and Handling Requirements:

1. Store and handle materials in accordance with manufacturer's instructions.

2. Keep materials in manufacturer's original, unopened containers and packaging until installation.

3. Store materials in clean, dry area indoors.

4. Protect materials during storage, handling, and installation to prevent damage.

5. Temperature range for storage: 32°F to 104°F (0°C to 40°C)

## 1.5 SUBMITTALS

A. Product data

1. Sensor operating manual.

2. Mounting bracket / sensor holder installation instructions.

B. Manufacturer's Certifications: Submit manufacturer's certification that materials comply with specified requirements and are suitable for intended application.

C. Warranty documentation.

# PART 2 PRODUCTS

## 2.1 GENERAL

A. Design nitrate measurement system for continuous monitoring in situ using a potentiometric measurement by means of ion selective electrodes.

B. Connect nitrate sensor to field-mounted junction box or Input/Output modules specified in Section 40 95 00 with sensor connecting cable specified in Section 2.3.A.3.

C. Nitrate measuring system components shall be designed to be part of a process control system that is protected from overvoltage due to lightning and power

supply fluctuations and covered by manufacturer's warranty when installed using manufacturer's recommended components per manufacturer's instructions.

2.2 MANUFACTURER

A. Provide products from the following manufacturer:

1. YSI Incorporated, 1700/1725 Brannum Lane, Yellow Springs, OH 45387. 1-800-765-4974.

2.3 MANUFACTURED UNIT

A. The nitrate measurement system consists of the following:

1. Electrodes

a. Model VARiON®Plus NO3 electrode.

b. Model VARiON® Ref reference electrode.

c. Model VARiON®Plus Cl electrode. [optional for most accurate measurement]

2. Model NitraLyt® Plus 700IQ sensor assembly:

a. Integrated NTC thermistor.

b. Pre-amplification of electrode signal.

c. Digital signal processing with calibration value storage.

d. The sensor shall detach from sensor cable allowing for easy replacement or repair.

3. SACIQ-15 (15 meter) sensor connection cable.

a. 3-conductor shielded cable: communications, power, shield

b. Conductors: Minimum 18 AWG

c. Power supply: low voltage (24 V)

d. Quick fasteners

2.4 MATERIALS

A. Electrodes

1. Nitrate and chloride electrodes

a. Enclosure: POM.

b. Clamping ring: POM.

c. Membrane: soft PVC with stainless steel protective grating.

d. Sealing ring: Viton®.

e. Connection contacts: gold plated.

2. Reference electrode

a. Enclosure: PVC.

b. Junction: Porous PVDF.

c. Sealing ring: Viton®.

d. Connection contacts: gold plated.

B. Sensor assembly

1. Shaft: V4A stainless steel.

2. Protective hood: POM

3. Fixing Ring: POM

4. Protection cap: PVC

5. EMI/RFI conformance

a. EN 61326 Class B

b. FCC Class A

6. Safety

a. Certification: CE, cETLus

7. Protection rating: IP68

C. Sensor connection cable

1. Coupling ring: Stainless Steel 1.4571 (equivalent to 316Ti)

2. Ring: POM

3. Screw: Stainless Steel V4A

4. O-ring: NBR

5. Enclosure: POM

6. Nut: Stainless Steel 1.4571 (equivalent to 316Ti)

7. Protection ring: POM

8. Cable sheath: PUR

9. Protective cap: PVC

10. Protection rating: IP68 (waterproof)

2.5 ACCESSORIES

A. Handrail sensor mounting assemblies:

1. YSI model BE/ST 170 [-R, -M] Vario floor handrail mounting Stand.

2. YSI model EH/F 170-1.5 Sensoclean swing mounting assembly including 1.5 m boom and chain.

3. YSI model EH1 170 double, or triple sensor holder, depending on number of sensors required.

PART 3 EXECUTION

3.1 INSTALLATION

A. Immersion sensors:

1. Immerse sensor a minimum of 2 in. (50 mm) below the surface.

2. Protect the probe against the oncoming flow of large objects.

B. Sensor connection cable

1. Bend radius

a. Permanent bend: not less than 3.2 in. (80 mm).

b. One-time bend: not less than 2 in. (50 mm).

3.2 START-UP

A. Contractor will install nitrate sensors in strict accordance with the manufacturer’s instructions and recommendations.

B. Manufacturer's representative will include a half-day of start-up service by a factory-trained technician, if requested.

1. Contractor will schedule a date and time for start-up.

2. Contractor will require representatives of the following be present during the start-up:

a. General contractor

b. Electrical contractor

c. YSI factory-trained representative

d. Owner's personnel

e. Engineer

END OF SECTION

# SECTION 14610

# MANUAL DAVIT CRANE

## PART 1 – GENERAL

### 1.01 SCOPE OF WORK

A. The Contractor shall furnish and install one (1) manual davit crane to lift a submersible horizontal propeller pump as shown on the Drawings. The installation shall be in complete conformity with the Drawings and Specifications and the instructions and recommendations of the equipment manufacturer, as approved by the Engineer.

### 1.02 RELATED WORK

A. Shop Drawings, Working Drawings, and Samples: Section 01340.

B. Materials and Equipment: Section 01600.

C. Start-up and Demonstration: Section 01650.

D. Operations and Maintenance Data: Section 01730.

E. Warranties and Bonds: Section 01740.

F. Concrete: Division 3.

G. Painting: Section 09900.

H. Piping, Valve, and Equipment Identification System: Section 09905.

I. Submersible Horizontal Propeller Pump: Section 11209.

### 1.03 QUALIFICATIONS

A. The manual davit crane shall be the standard product of manufacturers who regularly engage in the production of this type of equipment and who are fully experienced, reputable, and qualified in the manufacture of the equipment to be furnished. The equipment shall be designed, constructed, delivered, and installed in accordance with the best practices and methods. Each component and ancillary equipment item furnished under this specification shall be the product of a manufacturer having successful record of operation, manufacturing and servicing

the equipment for a minimum of five (5) years. Manufacturer shall supply Engineer with previous installation details.

B. The manual crane shall be as manufactured by Thern Inc., Series 5PT20 or an approved equal.

1.04 SUBMITTALS

A. Shop Drawings: Submit shop drawings in accordance with Division 1.

B. Operating and Maintenance Manuals: Provide operating and maintenance manuals in accordance with the applicable provisions of Division 1.

1.05 OPERATING INSTRUCTIONS

A. A factory representative who has a complete knowledge of the proper operation and maintenance shall be provided for a minimum of one (1) 8-hour working day to instruct a representative of the Owner and the Engineer on proper operation and maintenance of the equipment. This work may be conducted in conjunction with the inspection of installation and test run as provided under Part 3 – Execution. If there are difficulties in the operation of the equipment due to the manufacturer's design or fabrication, additional service shall be provided at no cost to the Owner.

1.06 GUARANTEE

A. The equipment manufacturer shall guarantee that the equipment furnished is suitable for the purpose intended and free from defects of design, material and workmanship in accordance with Section 01740, Warranties and Bonds. In the event the equipment fails to perform as specified during the guarantee period, the equipment manufacturer shall promptly repair or replace the defective equipment without cost to the Owner.

PART 2 – PRODUCTS

2.01 MANUAL DAVIT CRANE

A. A davit manual crane assembly constructed of Type 304 stainless steel shall be supplied for each horizontal propeller pump. The crane assembly shall be permanently located at each mast in order to facilitate pump removal and replacement for service.

B. The boom shall telescope up to 4 different lengths allowing a maximum hook reach of at least 82 inches measured from mast center to hook center. The entire assembly shall have a minimum load carrying capacity of at least twice the weight

of the pump at the maximum boom arm reach. The weight of the pump is expected to be 625 pounds. Contractor shall coordinate with pump manufacturer to ensure crane is designed for the correct weight.

C. In order to achieve safe and effective rotation of the mast under lifting loads, a turning arm handle shall be located on the mast. Handles located elsewhere will require excessive effort and are deemed unsafe and nonfunctional and will not be considered acceptable. The mast and boom shall rotate 360 degrees in the base on pin bearing and bearing sleeve. Such rotation shall permit the pump to be removed from the tank in a single lifting and rotation motion.

D. Hook height shall be adjustable by moving the boom up or down between 5 degrees above horizontal and 45 degrees from vertical, with a minimum of 54 inches between the lowest position and the highest position with the boom fully extended. Bboom angle shall be adjustable at all times, including when under full rated load, with a hand operated screw jack acting to raise or lower the boom between horizontal and 45 degrees from vertical.

E. A manually operated stainless steel winch assembly shall be supplied with a load capacity equal to at least twice the weight of the pump. Winch shall have machine cut gears, an adjustable handle that mounts securely to the drive shaft, bronze and radial ball bearings, stainless steel fasteners, and a positive load holding Weston style brake able to stop and hold the load automatically if the winch handle is released. Winch shall include the Thern Quick Disconnect feature allowing quick attachment and detachment of wire rope equipped with a swaged ball anchor. The winch shall include ¼" 7 x 19 type 304 stainless steel lifting cable. A 28 ft. length of cable shall be supplied with each assembly.

F. Crane base shall be as manufactured by Thern, Inc., Series 5B20. Crane base shall allow for removal of the mast and shall have a pin bearing to support the end of the mast and a Nyloil MDX bearing sleeve to support the mast at the top of the base. A roller/ball bearings and locking pin kit shall be provided to allow for smooth and easy 360 degree crane rotation under load and to lock the crane in place.

G. The base shall be wall mounted. Anchor bolts shall be Type 316 stainless steel and shall be supplied by the manufacturer.

H. Provide a 304 stainless steel mast extension. The minimum height of the boom shall be 36 inches plus 15 inches from the mast extension between mounting surface and the underside of the boom in all base configurations.

## PART 3 – EXECUTION

### 3.01 GENERAL

A. The equipment manufacturer shall furnish the services of a competent and experienced representative who has complete knowledge of proper operation and maintenance of the equipment for a period of one (1) day to inspect the installed equipment and to provide instructions to the plant personnel. The final copies of operation and maintenance manuals specified in Division 1 must have been delivered to the Engineer prior to scheduling the instruction period with the Owner.

3.02 INSTALLATION

A. Each unit shall be installed in accordance with the manufacturer's instructions and accurately aligned in relation to related equipment.

B. The Contractor shall supply all necessary temporary lifting equipment, labor, and all other requirements for satisfactory installation.

3.03 INSPECTION

A. Upon completion of installation, the Contractor, in the presence of the Engineer and a qualified manufacturer's representative, shall demonstrate the functioning of all component parts to the satisfaction of the Engineer.

END OF SECTION

# SECTION 15000

# MECHANICAL – GENERAL REQUIREMENTS

## PART 1 - GENERAL

### 1.01 DESCRIPTION

A. Scope of Work:

1. All equipment furnished and installed under this contract shall conform to the general stipulations set forth in this Section except as otherwise specified in other Sections.

2. Contractor shall coordinate all details of equipment with other related parts of the Work, including verification that all structures, piping, wiring, and equipment components are compatible. Contractor shall be responsible for all structural and other alternations in the Work required to accommodate equipment differing in dimensions or other characteristics from that contemplated in the Contract Drawings or Specifications.

B. Related Work Described Elsewhere: Other Sections directly referenced in this section include the following:

1. General Requirements: Division 1.

2. Concrete: Division 3.

3. Finishes: Division 9.

4. Equipment: Division 11.

5. Special Construction: Division 13.

6. Electrical: Division 16.

C. Contract Drawings and Specifications: The Contract Drawings and Specifications shall be considered as complementary, one to the other, so that materials and work indicated, called for, or implied by the one and not by the other shall be supplied and installed as though specifically called for by both. The Contract Drawings are to be considered diagrammatic, not necessarily showing in detail or to scale all of the equipment or minor items. In the event of discrepancies between the Contract Drawings and Specifications, or between either of these and any regulations or

ordinances governing work of these Specifications, the bidder shall notify the Engineer in ample time to permit revisions.

1.02 QUALITY ASSURANCE

A. Materials and Equipment: Unless otherwise specified, all materials and equipment furnished for permanent installation in the Work shall conform to applicable standards and specifications and shall be new, unused, and undamaged when installed or otherwise incorporated in the Work. No such material or equipment shall be used by the Contractor for any purpose other than that intended or specified, unless such use is specifically authorized in writing by the Owner. No material shall be delivered to the site without prior acceptance of drawings and data by the Engineer.

B. Equivalent Materials and Equipment:

1. Whenever a material or article is specified or described by using the name of a proprietary product or the name of a particular manufacturer or vendor, the specific item mentioned shall be understood as establishing the type, function, and quality desired. Other manufacturers' products will be accepted provided sufficient information is submitted to allow the Engineer to determine that the products proposed are equivalent to those named. Such items shall be submitted for review in accordance with Section 01340: Shop Drawings, Working Drawings, and Samples.

2. Requests for review of equivalency will not be accepted from anyone except the Contractor and such requests will not be considered until after the contract has been awarded.

C. Governing Standards: Equipment and appurtenances shall be designed in conformity with ANSI, ASME, ASTM, IEEE, NEMA, OSHA, AGMA, and other generally accepted applicable standards. They shall be of rugged construction and of sufficient strength to withstand all stresses which may occur during fabrication, testing, transportation, installation, and all conditions of operations. All bearings and moving parts shall be adequately protected against wear by bushings or other acceptable means. Provisions shall be made for adequate lubrication with readily accessible means.

D. Tolerances: Machinery parts shall conform to the dimensions indicated on the Drawings within allowable tolerances. Protruding members such as joints, corners, and gear covers shall be finished in appearance. All exposed welds shall be ground smooth and the corners of structural shapes shall be rounded or chamfered.

E. Clearances: Ample clearances shall be provided for inspection and adjustment. All equipment shall fit the allotted space and shall leave reasonable access room for servicing and repairs. Greater space and room required by substituted equipment shall be provided by the Contractor and at his expense.

F. Testing:

1. When the equipment is specified to be factory tested, the results of the tests shall be submitted to the Engineer and approval of the test results shall be obtained before shipment of the equipment.

2. When an item of equipment, including controls and instrumentation, has been completely erected, the Contractor shall notify the Engineer, who will designate a time to make such tests as required, and operate the item to the satisfaction of the Engineer. All testing shall be done in the presence of the Engineer. "Completely erected" shall mean that the installation is erected, all necessary adjustments have been made, all required utility connections have been made, required lubricants and hydraulic fluid have been added and the unit has been cleaned and painted.

G. Pressure Test:

1. After installation, all piping shall be pressure tested. Piping shall be tested in accordance with Section 15044: Pressure Testing of Piping.

2. All tests shall be made in the presence of and to the satisfaction of the Engineer and also, to the satisfaction of any local or State inspector having jurisdiction.

a. Provide not less than three (3) days notice to the Engineer and the authority having jurisdiction when it is proposed to make the tests.

b. Any piping or equipment that has been left unprotected and subject to mechanical or other injury in the opinion of the Engineer shall be retested in part or in whole as directed by the Engineer.

c. The piping systems may be tested in sections as the Work progresses but no joint or portion of the system shall be left untested.

3. All elements within the system that may be damaged by the testing operation shall be removed or otherwise protected during the operation.

4. All defects and leaks observed during the tests shall be corrected and made tight in an approved manner and the tests repeated until the system is proven tight.

5. Repair all damage done to existing or adjacent work or materials due to or on account of the tests.

6. Provide test pumps, gauges, or other instruments and equipment required for the performance of all tests. Provide all temporary bracing, test plugs, additional restraint, and thrust blocking which may be required for test pressures above normal working pressures.

7. All tests shall be maintained for as long a time as required to detect all defects and leaks but not less than the duration specified for each type of pipe or piping system in this Division.

H. Failure of Test:

1. Defects: Any defects in the equipment, or deviations from the guarantees or requirements of the Specifications, shall be promptly corrected by the Contractor by replacements or otherwise. The decision of the Engineer as to whether or not the Contractor has fulfilled his obligations under the Contract shall be final and conclusive. If the Contractor fails to correct any defects or deviations, or if the replaced equipment when tested shall fail again to meet the guarantees or specified requirements, the Owner, notwithstanding his having made partial payment for work and materials, may reject that equipment and order the Contractor to remove it from the premises at the Contractor's expense.

2. Rejection of Equipment: In case the Owner rejects a particular item of equipment, then the Contractor hereby agrees to repay to the Owner all sums of money paid to him to deliver to the Contractor a bill of sale of all his rights, title, and interest in and to the rejected equipment provided, however that the equipment shall not be removed from the premises until the Owner obtains from other sources other equipment to take the place of that rejected. The bill of sale shall not abrogate the Owner's right to recover damages for delays, losses or other conditions arising out of the basic Contract. The Owner hereby agrees to obtain the alternate equipment within a reasonable time and the Contractor agrees that the Owner may use the original equipment furnished by him without rental or other charge until the other equipment is obtained.

I. Responsibility During Tests: The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall

neither have nor make any claim for damage which may occur to equipment prior to the time when the Owner formally takes over the operation thereof.

J. Acceptance of Materials:

1. 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 Owner. No material shall be delivered to the work without prior submittal approval of the Engineer.

2. The Contractor shall submit to the Engineer data relating to materials and equipment he proposes to furnish for the work. Such data shall have in sufficient detail to enable the Engineer to identify particular product and to form an opinion as to its conformity to the Specifications.

3. Facilities and labor for handling and inspection of all materials and equipment shall be furnished by the Contractor. If the Engineer requires, either prior to beginning or during the progress of the work, the Contractor shall submit samples of materials for such special tests as may be necessary to demonstrate that they conform to the Specifications. Such sample shall be furnished, stored, packed, and shipped as directed at the Contractor's expense. Except as otherwise noted, the Owner will make arrangements for and pay for tests.

4. The Contractor shall submit data and samples sufficiently early to permit consideration and acceptance before materials are necessary for incorporation in the work.

K. Safety Requirements:

1. In addition to the components shown and specified, all machinery and equipment shall be safeguarded in accordance with the safety features required by the current codes and regulations of ANSI, OSHA, and local industrial codes.

2. The Contractor shall provide for each V-belt drive or rotating shaft a protective guard which shall be securely bolted to the floor or apparatus. The guard shall completely enclose drives and pulleys and be constructed to comply with all safety requirements.

1.03 SUBMITTALS (SEE SECTION 01340: SHOP DRAWINGS, WORKING DRAWINGS, AND SAMPLES)

1.04 MAINTENANCE MATERIALS

A. All grease, oil, and fuel required for testing of equipment shall be furnished 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.

B. The Contractor shall be responsible for changing the oil in all drives and intermediate drives of each mechanical equipment after initial break-in of the equipment, which in no event shall be any longer than three weeks of operation.

PART 2 - PRODUCTS

2.01 FABRICATION AND MANUFACTURE

A. Workmanship and Materials:

1. Contractor shall guarantee all equipment against faulty or inadequate design, improper assembly or erection, defective workmanship or materials, and leakage, breakage or other failure. Materials shall be suitable for service conditions.

2. All equipment shall be designed, fabricated, and assembled in accordance with recognized and acceptable engineering and shop practice. Individual parts shall be manufactured to standard sizes and gages so that repair parts, furnished at any time, can be installed in the field. Like parts of duplicate units shall be interchangeable. Equipment shall not have been in service at any time prior to delivery, except as required by tests.

3. Except where otherwise specified, structural and miscellaneous fabricated steel used in equipment shall conform to AISC standards. All structural members shall be designed for shock or vibratory loads. Unless otherwise specified, all steel which will be submerged, all or in part, during normal operation of the equipment shall be at least 1/4 inch thick.

B. Lubrication:

1. Equipment shall be adequately lubricated by systems which require attention no more frequently than weekly during continuous operation. Lubrication systems shall not require attention during startup or shutdown and shall not waste lubricants.

2. Lubricants of the type recommended by the equipment manufacturer shall be furnished by the Contractor in sufficient quantity to fill all lubricant

reservoirs and to replace all consumption during testing, startup, and operation for the entire warranty period prior to acceptance of equipment by Owner. Unless otherwise specified or permitted, the use of synthetic lubricants will not be acceptable.

3. Lubrication facilities shall be convenient and accessible. Lubrication fittings shall be the zerk type for each piece of equipment. Oil drains and fill openings shall be easily accessible from the normal operating area or platform. Drains shall allow for convenient collection of waste oil in containers from the normal operating area or platform without removing the unit from its normal installed position.

C. Safety Guards: All belt or chain drives, fan blades, couplings, and other moving or rotating parts shall be covered on all sides by a safety guard. Safety guards shall be fabricated from 16 USS gage or heavier galvanized or aluminum-clad sheet steel or 1/2 inch mesh galvanized expanded metal. Each guard shall be designed for easy installation and removal. All necessary supports and accessories shall be provided for each guard. Supports and accessories, including bolts, shall be galvanized. All safety guards in outdoor locations shall be designed to prevent the entrance of rain and dripping water.

D. Equipment Foundation Supports:

1. All foundations, platforms and hangers required for the proper installation of equipment shall be furnished and installed by the Contractor.

2. Unless otherwise indicated or specified, all equipment shall be installed on reinforced concrete bases at least 6 inches high and shall conform to requirements set forth in Division 3 for cast-in-place concrete. Cast iron or welded steel baseplates shall be provided for pumps, compressors, and other equipment. Each unit and its drive assembly shall be supported on a single baseplate of neat design. Baseplates shall have pads for anchoring all components and adequate grout holes. Baseplates for pumps shall have a means for collecting leakage and a threaded drain connection. Baseplates shall be anchored to the concrete base with suitable anchor bolts and the space beneath filled with 1 inch minimum grout. All open equipment bases shall be filled with nonshrinking grout sloped to drain to the perimeter of the base.

3. The Contractor shall furnish, install and protect all necessary guides, bearing plates, anchor and attachment bolts, and all other appurtenances required for the installation of equipment. These shall be of ample size and strength for the purpose intended.

4. All anchor bolts, anchor bolt templates, and location drawings required for the installation of the equipment, support columns, and for all other equipment or machinery included under this Contract shall be furnished by the Contractor. All mechanical equipment shall be anchored using hook anchor bolts, cast-in-place, unless specifically called for otherwise on the Drawings. Anchor bolts, sleeves, and inserts shall be set in place in forms and cast in the concrete by the Contractor. It shall be the responsibility of the Contractor to obtain such anchor bolts, templates, and approved location drawings in proper time to avoid delay, and it shall be his further responsibility to check and approve the location and setting of the anchor bolts, sleeves, and inserts prior to the casting of the concrete. Parts of anchors or metal work that are not built into masonry and concrete shall be coated with approved paint. Anchor bolts for column base plates and other structural elements shall be of galvanized steel unless indicated otherwise; anchor bolts for drives, motors, fans, blowers, and other mechanical equipment shall be of Type 304 stainless steel or high-strength bronze. Anchor bolts shall be of ample size and shall be provided with hexagonal nuts of the same quality of metal as the bolts. All threads shall be clean cut and of U.S. Standard sizes.

5. Expansion bolts shall have malleable iron and lead composition elements of the required number of units and sizes. Expansion bolts, if called for on the Drawings, shall be furnished and installed by the Contractor. No other use of expansion bolts will be allowed without prior approval of the Engineer.

6. Unless specified otherwise, stud, tap, and machine bolts shall be of the best quality refined bar iron. Hexagonal nuts of the same quality of metal as the bolts shall be used. All threads shall be clean cut and shall conform to ANSI B1.1-latest for "Unified and American Screw Threads for Screws, Bolts, Nuts, and Other Threaded Parts."

7. Bolts, anchor bolts, nuts, and washers not specified to be stainless steel shall be zinc-coated by the hot-dip process, after being threaded, in conformity with the ASTM Standard Specification for "Zinc (Hot Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip," Designation A123-latest, or the ASTM Standard Specification for "Zinc Coating (Hot-Dip) on Iron and Steel Hardware," Designation A153-latest, as is appropriate.

8. Anchor bolts and expansion bolts shall be set accurately. Anchor bolts which are set before the concrete has been placed shall be carefully held in suitable templates of approved design provided under this Contract. Where indicated on the Drawings, specified, or required, anchor bolts shall be provided with square plates at least 4" x 4" x 3/8" or shall have square

heads and washers and be set in the concrete forms with suitable pipe sleeves, or both.

9. Structural steel supports and miscellaneous steel required for supporting and/or hanging equipment and piping furnished under this Division shall be provided and installed by Contractor.

10. All foundations, anchor pads, piers, thrust blocks, inertia blocks and structural steel supports shall be built to template and reinforced as required for loads imposed on them.

11. The Contractor shall assume all responsibility for sizes, locations and design of all foundations, anchor pads, pier, thrust blocks, inertia blocks, curbs and structural steel supports.

E. Shop Painting:

1. All steel and iron surfaces shall be protected by suitable paint or coatings applied in the shop. Surfaces which will be inaccessible after assembly shall be protected for the life of the equipment. Exposed surfaces shall be finished smooth, thoroughly cleaned, and filled as necessary to provide a smooth uniform base for painting. Electric motors, speed reducers, starters, and other self-contained or enclosed components shall be shop primed or finished with a high-grade oil-resistant enamel suitable for coating in the field with an alkyd enamel. Coatings shall be suitable for the environment where the equipment is installed.

2. Surfaces to be painted after installation shall be prepared for painting as recommended by the paint manufacturer for the intended service, and then shop painted with one or more coats of the specified primer. Unless otherwise specified, the shop primer for steel and iron surfaces shall be Koppers "No. 10 Inhibitive Primer", or equal.

3. Machined, polished, and nonferrous surfaces which are not to be painted shall be coated with rust-preventive compound, Houghton "Rust Veto 344", Rust-Oleum "R-9", or equal.

F. Nameplates: Contractor shall provide equipment identification nameplates for each item of equipment. Nameplates shall be 1/8 inch Type 304 stainless steel and shall be permanently fastened. Plates shall be fastened using round head metallic drive screws, or where metallic drive screws are impractical, with stainless steel pop rivets. Metallic drive screws shall be brass or stainless steel, Type V and No. 8 by 3/8 inch long. Names and/or equipment designations shall be engraved on the plates and the engraving painted with a primer and black paint system compatible with stainless steel. Contractor shall submit a list of proposed

names and designations for review prior to fabrication of nameplates. At a minimum, each nameplate shall include equipment manufacturer's name, year of manufacture, serial number and principal rating data.

G. Pipe Identification:

1. All pipe (except underground) shall have code letters and flow arrows painted as per Division 9. The Contractor shall ensure that the pipes are properly marked.

2. Underground pipe and tube: Pipe and tube shall be located by laying 2 inch wide plastic tape continuously along the run of pipe or tube per Division 9.

H. Noise Attenuation and Control:

1. Unless otherwise specified, the maximum permissible noise level for a complete installed piece of equipment located within or outside a structure shall not exceed 85 dB at 3 feet. A complete piece of equipment includes the driver and driven equipment, plus any intermediate couplings, gears, and auxiliaries. All equipment provided herein that is specified to be factory and field tested shall be tested as specified herein for noise generation at the equipment manufacturer's expense.

2. Maximum permissible noise (sound pressure) levels shall be in decibels as read on the "A" weighting scale of a standard sound level meter (dB); all measurements shall be made in relation to a reference pressure of 0.0002 microbar. Measurements of emitted noise levels shall be made on a sound level meter meeting at least the Type 2 requirements set forth in ANSI S1.4, Specification for Sound Level Meters. The sound level meter shall be set on the "A" scale and to slow response. Unless otherwise specified for a particular piece of equipment, the point of measurement of sound level shall be made at the specified distance from any major surface along the entire perimeter and at midheight of the piece of equipment, or at the specified distance from an outer major surface encompassing the sound source including inlets or outlets.

I. Fire Hazard Rating:

1. All piping, duct work, and equipment insulation, fastener, and jacketing materials shall have a fire hazard rating not to exceed 25 for flame spread, 50 for fuel contributed, and 50 for smoke developed. Rating shall be determined by ASTM Designation E84, "Surface Burning Characteristics of Building Materials". Corresponding ratings determined by

Underwriters' Laboratories, Inc., UL-723, "Test Method for Fire Hazard Classification of Building Materials", will also be acceptable.

2. Flameproofing treatments will not be acceptable.

2.02 ACCESSORIES

A. Special Tools and Accessories: Equipment requiring periodic repair and adjustment shall be furnished complete with all special tools, instruments, and accessories required for proper maintenance. Equipment requiring special devices for lifting or handling shall be furnished complete with those devices.

B. Fasteners: All nuts, bolts, anchors and other fastening devices shall be a minimum of Type 304 stainless steel.

PART 3 - EXECUTION

3.01 INSTALLATION AND OPERATION

A. Installation: Equipment shall not be installed or operated except by, or with the guidance of, qualified personnel having the knowledge and experience necessary for proper results. When so specified, or when employees of Contractor or his subcontractors are not qualified, such personnel shall be field representatives of the manufacturer of the equipment or materials being installed.

1. The Contractor shall have on site sufficient proper construction equipment and machinery of ample capacity to facilitate the work and to handle all emergencies normally encountered in work of this character. To minimize field erection problems, mechanical units shall be factory assembled when practical.

2. Equipment shall be erected in a neat and workmanlike manner on the foundations and supports at the locations and elevations shown on the Drawings, unless otherwise directed by the Engineer during installation.

3. All equipment shall be installed in such a manner as to provide access for routine maintenance including lubrication.

4. For equipment such as pumping units, which require field alignment and connections, the Contractor shall provide the services of the equipment manufacturer's qualified mechanic, millwright, machinist, or authorized representative, to align the pump and motor prior to making piping connections or anchoring the pump base.

5. Equipment of a portable nature which requires no installation shall be delivered to a location designated by the Owner.

B. Tolerances: Precision gauges and levels shall be used in setting all equipment. All piping and equipment shall be perfectly aligned, horizontally and vertically. Tolerances for piping and equipment installation shall be 1/2 inch to 30 ft. horizontal and vertically. All valves and operators shall be installed in the position shown on the Drawings or as directed by the Engineer, if not shown.

C. Alignment and Level: The equipment shall be brought to proper level by shims (1/4 inch maximum). After the machine has been leveled and aligned, the nuts on the anchor bolts shall be tightened to bind the machine firmly into place against the wedges or shims. Grouting shall be as specified in Division 3.

D. Grouting: The grout shall be tamped into position with a board, steel bar, or other tool. Tamping should not be so hard as to raise or otherwise displace the plate.

E. Contact of Dissimilar Metals: Where the contact of dissimilar metal may cause electrolysis and where aluminum will contact concrete, mortar, or plaster, the contact surface of the metals shall be separated using not less than one coat of zinc chromate primer and one heavy coat of aluminum pigmented asphalt paint on each surface.

F. Cutting and Patching: All cutting and patching necessary for the work shall be performed by the Contractor.

G. Operation: All equipment installed under this Contract, including that furnished by Owner or others under separate contract, shall be placed into successful operation according to the written instructions of the manufacturer or the instructions of the manufacturer's field representative. All required adjustments, tests, operation checks, and other startup activity shall be provided.

## 3.02 OBSERVATION OF PERFORMANCE TESTS

A. Where the specifications require observation of performance tests by the Engineer, such tests shall comply with the quality assurance paragraph in this section.

END OF SECTION

# SECTION 15044

# PRESSURE TESTING OF PIPING

## PART 1 - GENERAL

### 1.01 DESCRIPTION

A. Scope of Work: This Section specifies the hydrostatic testing requirements for plant piping. Hydrostatic pressure and leakage testing shall be completed in accordance with AWWA C600 and C605, latest revision, however, no leakage is allowed.

B. Testing Records:

1. Provide a record of each piping installation during the testing. These records shall include:

   a) Date of test.
   b) Identification of pipeline tested or retested.
   c) Identification of pipeline material.
   d) Identification of pipe specification.
   e) Test fluid.
   f) Test pressure.
   g) Remarks: Leaks identified (type and location), types of repairs, or corrections made.
   h) Certification by Contractor that the leakage rate measured conforms to the Specifications.
   i) Signature of Owner's representative witnessing pipe test.

2. Submit five (5) copies of the test records to the Engineer's representative upon completion of the testing.

## PART 2 - PRODUCTS

### 2.01 GENERAL

A. Testing fluid shall be water for all hydrostatic tests.

B. Provide pressure gauges, pipes, bulkheads, pumps, and meters to perform the hydrostatic testing.

## PART 3 - EXECUTION

### 3.01 TESTING PREPARATION

A. Pipes shall be in place and anchored before commencing pressure testing.

B. Conduct hydrostatic tests on exposed and above ground piping after the piping has been installed and attached to the pipe supports, hangers, anchors, expansion joints, valves, and meters.

C. Before conducting hydrostatic tests, flush pipes with water to remove dirt and debris.

D. Test new pipelines which are to be connected to existing pipelines by isolating the new line from the existing line by means of pipe caps, plugs, special flanges, or blind flanges. After the new line has been successfully tested, remove caps, plugs, or flanges and connect to the existing piping.

E. Conduct hydrostatic tests on buried pipe after the trench has been completely backfilled. The pipe may be partially backfilled and the joints left exposed for inspection for an initial leakage test. Perform the final test, however, after completely backfilling and compacting the trench.

F. Pressure Test:

1. All tests shall be made in the presence of and to the satisfaction of the Owner, Engineer, and any local or State inspector having jurisdiction.

    a. Provide not less than three (3) days notice to the Owner, Engineer, and the authority having jurisdiction when it is proposed to make the tests.

    b. Any piping or equipment that has been left unprotected and subject to mechanical or other injury shall be retested as directed by the Engineer.

    c. The piping systems may be tested in sections as the work progresses, but no joint or portion of the system shall be left untested.

2. All elements within the system that may be damaged by the testing operation shall be removed or otherwise protected during the operation.

3. Repair all damage done to existing or adjacent work or materials due to performance of the tests.

## 3.02 HYDROSTATIC TESTING

A. Hydrostatic Testing of Aboveground or Exposed Piping: Open vents at high points of the piping system to purge air while the pipe is being filled. Subject the piping system to the test pressure indicated. Maintain the test pressure for a minimum of four (4) hours. Examine joints, fittings, valves, and connections for leaks. The piping system shall show no leakage or weeping. Correct leaks and retest until no leakage is obtained.

B. Test pressures for various pipe applications are set forth below.

| Service | Mark | Test Pressure (psig) |
|---|---|---|
| Internal Recycle | IR | 25 |

Notes:

1. Piping not listed and sections of piping in gross discrepancy with listed pressure, with the approval of the Engineer, shall be tested at a minimum of 1.5 times working pressure.

## 3.03 PNEUMATIC TESTING

A. Process Air Piping: All process air piping associated with the aeration system shall be subjected to a pneumatic test. The test shall consist of pressurizing the piping with compressed air to a pressure of 25 psi and observing the rate of pressure change over a 1-hour period. The pressure drop during the test period shall not be detectable using standard pneumatic gauges calibrated in 1 psi increments. If a detectable pressure drop occurs during the test, the system shall be repaired and retested until satisfactory results are obtained.

END OF SECTION

# SECTION 15050

# PROCESS AND UTILITY PIPING, FITTINGS, VALVES, AND ACCESSORIES

## PART 1 – GENERAL

### 1.01 DESCRIPTION

A. Scope of Work: The Work included in this Section consists of furnishing all labor, equipment, and materials and performing all operations necessary for the construction or installation of all process and utility piping, valves, and appurtenances complete and ready for operation as shown on the Drawings and specified herein.

B. Related Work Described Elsewhere

1. Project Coordination: Section 01040.
2. Operating and Maintenance Data: Section 01730.
3. Concrete: Division 3.
4. Metals: Division 5.
5. Painting: Division 9.
6. Equipment: Division 11.
7. Special Construction: Division 13.
8. Pressure Testing of Piping: Section 15044.
9. Stainless Steel Pipe and Fittings: Section 15066.
10. Hangers and Supports: Section 15126.

### 1.02 QUALITY ASSURANCE

A. Construction Requirements: For underground utilities, changes in horizontal alignment of less than 11-1/4 degrees may be achieved through the use of allowable pipe deflection in lieu of fittings shown on the Drawings at the Contractor's option, but subject to approval of the Engineer as to layout. Said deflection shall not exceed 75 percent of the maximum allowable deflection stated in the pipe manufacturer's installation instructions.

B. Pipe Inspection: The Contractor shall obtain from the pipe manufacturers a certificate of inspection stating that the pipe and fittings supplied for this Contract have been inspected at the plant and that they meet the requirements of these Specifications. All pipe and fittings shall be subject to visual inspection at time of delivery and also just before they are lowered into the trench to be laid. Joints or fittings that do not conform to these Specifications will be rejected and must be removed immediately by the Contractor. The entire product of any plant may be rejected when, in the opinion of the Engineer, the methods of manufacture fail to secure uniform results, or where the materials used are such as to produce inferior pipe or fittings.

1.03 SUBMITTALS

A. Shop Drawings

1. The Contractor shall prepare and submit for approval a complete detail drawing of all valves in accordance with the requirements of the General Provisions and Division 1. At a minimum, the submittal shall show all proposed material types to be used as well as interior and exterior coating manufacture, coating type, and proposed minimum dry film thickness.

2. In general, the following Shop Drawings shall be submitted to the Engineer for approval prior to construction:

a. Mill test certificates or certified test reports on pipe and fittings.

b. All valves, including butterfly and check valves.

c. Electric motor operators.

d. Joint lubricant.

e. Detailed piping layout drawings and pipe laying schedule (see below).

f. Temporary plug and anchorage system for hydrostatic pressure test.

2. Tabulated layout schedule for each pipe system including:

a. Pipe elevation at each change of alignment.

b. The limits of each reach of pipe thickness class.

c. Locations of valves and other mechanical equipment.

d. Methods and locations of supports.

e. Details of special elbows and fittings.

3. Full calculations for each size of motor operator indicating forces, full load and locked rotor current and horsepower shall be furnished to the Engineer for approval.

4. For Valves submit product literature that includes information on the performance and operation of the valve, materials of construction, dimensions and weights, elastomeric characteristics, headloss, flow data, and pressure ratings.

5. A separate shop drawing submittal will be required for each major item listed above and for each different type of an item within a major item. For example, separate submittals will be required for ductile iron pipe, butterfly and check valves, electric motor operators, etc. All submittals shall be in accordance with the General and Special Conditions and Section 01340: Shop Drawings, Working Drawings, and Samples.

B. Acceptance of Material

1. The Contractor shall furnish an affidavit of compliance certified by the pipe manufacturer that the pipe, fittings, and specials furnished under this Contract comply with all applicable provisions of current AWWA and ASTM Standards and these Specifications. No pipe or fittings will be accepted for use in the Work on this project until the affidavit has been submitted and approved by the Engineer.

2. The Owner reserves the right to sample and test any pipe or fitting after delivery and to reject all pipe and fittings represented by any sample which fails to comply with the specified requirements.

C. Operation and Maintenance Manuals: Submit operation and maintenance manuals for applicable components requiring periodic maintenance and/or explanation of operation. Manuals shall be prepared in accordance with Section 01730: Operating and Maintenance Data. Information shall include:

1. Detailed assembly drawings, clear and concise instructions for operating, adjusting, overhauling, troubleshooting and, other maintenance. Include shop drawings previously submitted and approved with all corrections made.

2. A complete lubrication schedule including lubricant types, grades, and recommended frequency of lubrication.

3. A list of parts for all products with catalog numbers and all data necessary for ordering replacement parts. Such instructions and parts lists shall be prepared for the specific product furnished and shall not refer to other types or models.

1.04 DELIVERY, STORAGE AND HANDLING

A. Pipe, fittings, valves, and accessories shall be handled in a manner that will ensure a sound undamaged condition during shipping, delivering and installing.

B. Particular care shall be taken not to injure the pipe coating and linings.

C. Insides of valves and piping shall be kept free of dirt and debris.

1.05 JOB CONDITIONS

A. All necessary precautions shall be taken to prevent the entrance of mud, sand, or other obstructing matter into the pipelines. If on completion of the work any such materials have entered the pipelines, it must be cleaned as directed by the Engineer so that the entire system will be left clean and unobstructed.

1.06 PIPE MATERIAL SCHEDULE

A. Table 15050-A presents a pipe material schedule that designates the types of pipe that are to be used in various applications.

Table 15050-A
Pipe Material Schedule

| Service | Material | Lining |
|---|---|---|
| Internal Recycle | Ductile Iron | Epoxy |
| Process Air | Stainless Steel | None |

PART 2 – PRODUCTS

2.01 GENERAL

A. All references to “stainless steel” or “SS” shall mean 316 stainless steel unless otherwise specified.

B. All valves of the same type shall be from a single manufacturer. Parts of valves of the same type and size shall be interchangeable.

C. All valves shall be carefully erected in their respective positions, free from all distortion and strain, and shall be packed and left in satisfactory operating conditions.

D. All valves shall be given hydrostatic shop pressure test at twice the working pressure specified. The valves shall be tested, first by applying the hydrostatic pressure with the valve open and then with the valve closed. The valves shall be tight and secure under the test pressure.

E. Valves shall receive a factory interior and exterior coating of an approved system in accordance with Specification 09900 unless otherwise specified.

F. Metal surfaces other than stainless steel shall receive a field coat as indicated in Specification 09900.

2.02 DUCTILE IRON PIPE AND FITTINGS

A. Ductile Iron Pipe: Ductile iron pipe shall conform to the requirements of ANSI, A21.51 and AWWA C151, latest revision. The minimum pressure class for underground pipes shall be Class 150. Pipe shall be furnished in laying lengths of 20 feet or less, unless specifically shown otherwise on the Drawings. Flanged pipe shall have a minimum thickness class of Class 53. All pipe and fittings shall be new and unused, no refurbished piping or fittings will be accepted.

B. Coating and Lining

1. Corrosion Resistant Interior Lining: Ductile iron pipe, fittings, and specials shall be lined with Protecto 401 Ceramic Epoxy, Permox Pipe Glaze, PC3-9043, Type II Glass-Flake Filled Epoxy Pipe Coating, or American Poly-bond with a minimum dry film thickness of 40 mils applied by the pipe manufacturer. Storage, surface preparation, application, and safety precautions shall strictly follow manufacturer's instructions.

2. Exterior Coating for Exposed Pipe: Ductile iron pipe, fittings, and specials to be installed aboveground shall be furnished with a shop applied primer on the exterior. The shop primer shall be as specified in Section 09900: Painting.

C. Fittings: Fittings for ductile iron pipe shall be flanged joint as indicated on the Drawings and shall have a minimum working pressure of 250 psi. Fittings shall be ductile iron and shall conform to ANSI/AWWA C110/A21.10, ANSI/AWWA C111/A21.11 and ANSI/AWWA C153/A21.53, latest revisions for flanged and mechanical joint pipe. Fittings shall be coated and lined in the manner specified

above for ductile iron pipe. The rubber gaskets for flanged, mechanical, and push-on joints shall be as described below.

D. Flanged Joints: Flanges shall be Class 125 per ANSI B16.1 with any special drilling and tapping as required to insure correct alignment and bolting.

1. Gaskets:

a. Liquid Service: Fullface, 1/8-inch thick, cloth-inserted rubber: Johns-Manville No. 109, John Crane Co., Style 777, or equal. Gaskets shall be suitable for a water pressure of 350 psi at a temperature of 180°F.

b. Air Service: 1/8-inch thick resilient material rated for an operating temperature of at least 300º F.

2. Bolts, nuts, and washers for flanges shall be of carbon steel conforming to ASTM A307, Grade B. The bolts and all items associated with the bolt assemblies shall be zinc plated.

3. Flanges shall be long-hub type screwed tightly on pipe by machine at the foundry prior to facing and drilling. Flange machine surfaces shall be coated with rust inhibitor immediately after facing and drilling. Field assembled screwed on flanges are prohibited.

2.03 BUTTERFLY VALVES (AIR SERVICE)

A. Valves shall be designed for service with compressed air and for a range of 10 inches Hg vacuum to 25 psig pressure and a temperature range of 40° to 300°F.

1. All butterfly valves shall be of the tight closing, PTFE seat type with PTFE seats that are securely fastened to the valve body. Valves shall be bubble-tight at rated pressures with flow in either direction, and shall be suitable for applications involving throttling service. Valve disc shall rotate 90° from the full open position to the tight shut position.

2. Valve shop drawings shall include Cv data for all valves proposed for the project.

3. Valve Body: Each valve body shall be a fully lugged style cast or ductile iron body.

4. Valve Disc: Disc shall utilize air-profile design. Disc material shall be Type 316 stainless steel.

5. Valve Shaft: Shaft shall be either one-piece through or stub shaft design. The shaft shall be Type 316 stainless steel for 12-inch and smaller valves. The shaft shall be Type 431 stainless steel for valves 14 to 36 inches.

6. Valve Seat: Elastomer seats shall be in the body. Seats shall be Peroxide Cured EPDM and suitable for a maximum operating temperature of 300°F.

7. Valve Bearings: All shaft bearings shall be of the self-lubricating, corrosion resistant, sleeve type, suitable for a maximum operating temperature of 300°F.

8. Valve Packing: All valves shall have adjustable or self-adjustable packing materials. Packing shall be suitable for the temperature of 300°F and service condition.

9. Valve Operators:

    a. All valves shall be manually operated unless otherwise shown or specified. Operators include manual operators with levers, handwheels and electric motor operators with manually operated handwheels.

    b. Valve operators shall be provided complete with all appurtenances necessary for the equipment to perform its intended function. Such appurtenances include, but are not limited to, anchor bolts and other mounting hardware, limit switches, pressure switches, gauges, control switches and control valves, electrical supply connections, air supply piping, control valves and regulating controls, solenoid valves, extension stems, local and remote indicators, torque switches, operating nuts, purge water service with all associated piping valves and controls, push-button controls, indicating lights, floor boxes, and other such items.

    c. Valve operators shall meet the requirements of AWWA C504, except as otherwise shown or specified.

    d. Manually actuated valves 4-inches in size and smaller shall be furnished with a lever operator that includes a locking mechanism for throttling capability. Properly sized gear operators shall be provided for manually actuated valves larger than 4 inches in size. Each gear operator shall include a handwheel and be designed so that a pull of not more than 40 lbs on the manual operator will produce an output torque equivalent to the maximum valve shaft torque required to operate the valve under maximum line pressures and velocities.

e. Manual valve operators shall be of the worm gear type. Worm gear type operators shall include a worm gear and matching drive worm. Bearings shall be provided for each rotating member. Gear operators shall be permanently lubricated, totally enclosed, with adjustable stops for the open and closed positions to prevent over-travel in either direction and shall have a valve disc position indicator.

f. Valves to be equipped with a motorized actuator shall be provided with appropriate appurtenances for connection to the motor valve operator as specified in Paragraph 2.04 of this section.

g. Exterior iron and steel surfaces of all valve operators and appurtenances shall be coated in accordance with Specification 09900.

B. Butterfly valves for air service shall be Keystone Model GRL or an approved equal.

2.04 ELECTRIC MOTOR VALVE OPERATORS

A. Motor operators for butterfly valve service shall meet the requirements of AWWA C504 except as herein specified. Electric motor actuators for butterfly valves within the aeration system shall be designed for modulating service in response to a 4-20 mADC signal. Each actuator shall provide a 4-20 mADC signal to allow remote monitoring of the valve position.

B. Valve motor operators shall be the close-coupled, electric motor-driven screw type. Valve motor operators shall operate the valves from full closed to full open in 30 seconds when the valve is subjected to rated pressure and flow. Motors shall be TEFC, Class B or better insulated, 120 volt, 60 Hz, 1 phase motors especially designed for the intended valve operator service. The design shall combine low inertia with a high starting stalling torque. The motor winding temperature rise shall be NEMA standard for Class B or better insulation at the rated service factor load.

C. Operator enclosures shall be provided with 120-volt compartment heaters.

D. Motor operators shall include motor, motor controller with “Remote-Local” switch, “Open-Stop-Close” pushbuttons for local operation, associated gearing, drive coupling, pedestal limit switches, torques switches, auxiliary handwheel for manual operation and local position indicator. With the “Remote-Local” switch in the remote position, the valve shall respond to a remote, maintained contact for open and close operation and/or a 4-20 mADC signal for modulating service.

With the "Remote-Local" switch in the local position, valve operation shall be from the local "Open-Stop-Close" pushbuttons.

E. Position indicator, pushbuttons, selector switches and indicator lights shall be mounted in a valve-mounted NEMA 4 enclosure. Gear case for the operator shall be cast iron.

F. Joints at the end rings shall be silver soldered, unless the bars of the squirrel-cage winding are cast integrally with the end rings. The operator shall have geared limit switches to stop the movement in each direction and adjustable torque switches to stop the opening or closing movements in case of an obstruction. At the end of two complete operating cycles with no intervening time delay, the motor winding or controller elements shall not exceed a temperature rise of 75 degrees C above an ambient or 40 degrees C when measured by thermometer, or 85 degrees C when measured by resistance.

G. The motor shall be capable of operating the valve against the maximum differential line pressure when voltage at the terminals is within 15 percent of nominal voltage.

H. Drive units shall be arranged to permit the motor to attain full speed before the load is energized. Overload relays shall be provided in each phase of the motor.

G. A handwheel shall be provided for manual operation. The operator must be responsive to manual operation at all times, except when being electrically operated. The handwheel shall not rotate during electric operation. The motor shall not rotate during handwheel operation nor shall a fused motor prevent manual operation. When in manual operating position, the operator shall automatically return to electric operation when the motor is energized and remain in the motor position until manual operation is desired. The movement from motor to manual operation shall be accomplished by a positive declutching mechanism which will disengage the motor mechanically but not electrically. Failure of motor gearing shall not render hand operation impossible. Handwheels shall be removable and adaptor keys provided to permit operation by a portable operator. Electrical operation of the motor shall be as shown or specified.

I. The controller shall be a NEMA rated reversing controller, complete with mechanical interlocks and overload relays, and be an integral part of the operator. Contacts shall be provided for indicating lights as shown, specified, or required. One light on shall indicate that the gate is fully open; the other light on shall indicate that it is fully closed; and both lights on shall indicate that it is in an intermediate position. The internal wiring in the valve operator shall be arranged so that the opening and closing coils cannot be energized simultaneously at any time, regardless of external wiring connections. All operators shall have thermal

overload protection. Positioners for modulating valves shall accept a 4-20 mA input signal.

J. Power gearing shall consist of generated gears of heat-treated steel and worm gearing. The worm shall be of hardened alloy steel with the threads ground and polished after heat treating. The worm gear shall be of chilled nickel bronze. Antifriction bearings shall be used throughout and the operator shall be grease or oil bath lubricated. Lubricants shall be suitable for ambient temperatures from 40 to 150 degrees F.

K. Limit switches and torque switches shall be the adjustable type with auxiliary contacts, operative in either direction of travel. Limit switches shall be "in step" with torque switches at all times whether in motor or manual operation. The operator shall have geared limit switches to stop movement in each direction and torque switches shall be provided for protection against mechanical overload and to stop movement in either direction if an obstruction is encountered.

1. Limit switches shall be provided at the extreme open and closed position of the operator travel. At least six (6) independent switches at each end of the operator travel shall be provided as standard for remote indication and interlocking. Local indicator lights shall be provided on the valve operator for “Open”, “Close” and “Failure”. Travel stops for butterfly valve service shall be provided to ensure positive seating under automatic remote operation. The valve operator enclosure shall be provided with a thermostatically controlled space heater to prevent condensation from forming in the enclosure. The space heater shall be energized whenever the operator is not operating.

2. Torque switches shall be provided in both the open and closed position of the operator travel. The torque switches shall be field adjustable and designed to stop the operator motor when the torque exceeds safe limits for either the operator or the valve. An electrical or mechanical interlock shall be provided to prevent the open torque switch from tripping when unseating a torque seated valve.

L. Terminal blocks shall be provided for all electrical connections, both internal and external remote signals, and power. All electrical devices shall be housed in NEMA 4 enclosures. Operators shall be prewired and factory tested before shipping.

M. When used for valves specified for continuous duty service (but not modulating or throttling continuous duty service), motor operators and all required accessories shall be designed for such service. Such motor operators shall conform to all applicable requirements specified herein. An easily replaceable stem nut shall be provided which can be installed in the top of the unit without removing the

operator from the stand. The stem nut shall be of nylon suitable for continuous duty service without stem lubrication.

N. Motor operators shall be as manufactured by E-I-M Company; QX series by Limitorque Corp.; Rotork, Inc.; or equal.

## 2.05 CHECK VALVES

A. Check Valves shall be all rubber and of the flow operated check type with slip-in cuff or flange connection as shown in the drawings. The entire valve shall be ply reinforced throughout the body, disc and bill, which is cured and vulcanized into a one-piece unibody construction. A separate valve body or pipe used as the housing is not acceptable. The valve shall be manufactured with no metal, mechanical hinges or fasteners, which would be used to secure the disc or bill to the valve housing. The port area of the disc shall contour down, which shall allow passage of flow in one direction while preventing reverse flow. The entire valve shall fit within the pipe I.D. Once installed, the Valve shall not protrude beyond the face of the structure or end of the pipe.

1. Slip-in style CheckMate® Valves shall be furnished with a set of stainless steel expansion clamps. The clamps, which will secure the valve in place, shall be installed inside the cuff portion of the valve, based on installation orientation, and shall expand outwards by means of a turnbuckle. Each clamp shall be pre-drilled allowing for the valve to be pinned and secured into position in accordance with the manufacturer's installation instructions.

2. Flange style valves shall be furnished with a stainless steel, ANSI 125/150 drilled, retaining ring unless specified otherwise.

B. The downstream end of the valve must be circumferentially in contact with the pipe while in the closed positions.

C. Manufacturer must have flow test data from an accredited hydraulics laboratory to confirm pressure drop and hydraulic data. Company name, plant location, valve size patent number, and serial number shall be bonded to the check valve.

D. All valves shall be of the slip-in or flanged CheckMate® as manufactured by Tideflex Technologies, A Division of Red Valve Company, Carnegie, PA 15106 or equal. All valves shall be manufactured in the U.S.A.

## 2.06 VALVE LIMIT SWITCHES

A. Valves shall be provided with suitable mechanical cam gear type limit switches for remote operation, indication and other control as shown, specified, and required. Each limit switch shall be compatible with its associated operation and

suitable for the service intended. Limit switches shall be furnished with valves by the valve manufacturer.

B. Mechanical limit switches shall be 2-pole, 3-pole, or 4-pole gang-mounted in required multiples and with necessary mechanical linkage. Switch contact ratings shall be 120-volt a-c, 20 amperes at 75 to 100 percent power factor, and 124-volt d-c, 5 amperes minimum. Mechanical limit switches shall be Series SL2, 3, of 4HC for normal use, as manufactured by National Acme, Cleveland, Ohio, or equal. All enclosures shall be watertight and oiltight. Operating levers shall be National Acme Series D-1260, or equal. Switches shall be complete with all racks, gears, cam, linkages, mountings, and accessories as required.

## PART 3 - EXECUTION

### 3.01 INSPECTION

A. All pipe, fittings, valves, and other material shall be subject to inspection and approval by the Engineer after delivery, and no broken, cracked, imperfectly coated, or otherwise damaged or unsatisfactory material shall be used. When a defect or crack is discovered, the damaged portion shall not be installed. Cracked pipe shall have the defect cut off at least 12 inches from the break in the sound section of the barrel.

### 3.02 GENERAL INSTALLATION REQUIREMENTS

A. Pipe, fittings, valves, and accessories shall be installed as shown or indicated on the Drawings.

B. All connections to existing piping systems shall be made as shown or indicated on the Drawings after consultation and cooperation with authorities of the Owner. Some such connections may have to be made during off-peak hours (late night or early morning).

C. Above-Ground and Exposed Piping: Piping shall be cut accurately to measurements established at the job site and shall be worked into place without springing or forcing, properly clearing all equipment access areas and openings. Changes in sizes shall be made with appropriate reducing fittings. Pipe connections shall be made in accordance with the details shown and manufacturer's recommendations. Open ends of pipelines shall be properly capped or plugged during installation to keep dirt and other foreign material out of the system. Pipe supports and hangers shall be provided where indicated or as required to insure adequate support of the piping.

## 3.03 INSTALLATION OF DUCTILE IRON PIPE

A. Flanged Joints: Flanged joints shall be made up by inserting the gasket between the flanges. The threads of the bolts and the faces of the gaskets shall be coated with suitable lubricant immediately before installation.

1. Bolt holes of flanges shall straddle the horizontal and vertical centerlines of the pipe. Clean flanges by wire brushing before installing flanged fittings. Clean flange bolts and nuts by wire brushing and lubricate bolts with oil and graphite.

2. Insert the nuts and bolts (or studs), finger tighten, and progressively tighten diametrically opposite bolts uniformly around the flange to the proper tension.

3. Exercise care when tightening joints to prevent undue strain upon valves, pumps, and other equipment.

4. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reset or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.

## 3.04 INSTALLATION OF VALVES

A. Valves of the size and type shown on the Drawings shall be set plumb and installed at the locations indicated on the Drawings. Valves shall be installed in accordance with manufacturer's installation instructions and with the details shown on the Drawings.

B. Valves shall be installed such that they are supported properly in their respective positions, free from distortion and strain. Valves shall be installed such that their weight is not borne by pumps and equipment that are not designed to support the weight of the valve.

C. Valves shall be carefully inspected during installation; they shall be opened wide and then tightly closed and the various nuts and bolts shall be tested for tightness. Special care shall be taken to prevent any foreign matter from becoming lodged in the valve seat. Check and adjust all valves for smooth operation.

D. Install valves with the operating stem in either horizontal or vertical position.

E. Allow sufficient clearance around the valve operator for proper operation.

F. Clean iron flanges by wire brushing before installing flanged valves. Clean carbon steel flange bolts and nuts by wire brushing, lubricate flange bolt threads with oil

or graphite, and tighten nuts uniformly and progressively. Clean threaded joints by wirebrushing or swabbing. Apply Teflon joint compound or Teflon tape to pipe threads before installing threaded valves. Joints shall be watertight.

G. Valves shall be tested in place by the Contractor, as far as practical, and any defects in valves or connections shall be corrected to the satisfaction of the Engineer. Valves shall be pressure and leakage tested, concurrently with the pipeline in which they are installed. Protect or isolate any parts of valves, operators, or control and instrumentation systems whose pressure rating is less than the pressure used for the pressure tests. If valve joints leak during pressure testing, loosen or remove the nuts and bolts, reseat or replace the gasket, reinstall or retighten the bolts and nuts, and hydrostatically retest the joints.

H. Following installation, all above-ground valves shall be painted in accordance with the painting system specified in Section 09900: Painting.

3.05 HYDROSTATIC PRESSURE AND LEAKAGE TESTING – See Section 15044.

3.06 OBTAINING POTABLE WATER FOR TESTING AND FLUSHING

A. The potable water supply shall be protected with an air gap or a reduced pressure principle backflow preventer approved by the Owner, if potable water is used for testing and flushing.

B. To obtain potable water service during construction, the Contractor shall be required to install a temporary water meter, if public supply is available. The piping, fittings, backflow preventer, and appurtenances required for the temporary construction water service shall be supplied by the Contractor.

C. The Contractor shall coordinate with the Owner for temporary construction water service connection, usage, and flushing.

3.07 MAIN CLEANING AND FLUSHING

A. Following the hydrostatic and leakage tests, all piping provided under this contract shall be cleaned and flushed to remove sand, loose dirt, and other debris. Air service lines shall be flushed using air. Other pipes shall be flushed using water. Flushing velocity shall be a minimum of 2.5 fps. Flushing shall continue until clean water flows from the pipe. However, the Contractor shall endeavor to use the minimum amount of flushing water required to complete the work.

END OF SECTION

# SECTION 15066

# STAINLESS STEEL PIPE AND FITTINGS

## PART 1 - GENERAL

### 1.01 DESCRIPTION

A. Scope of Work: Furnish all labor, materials, equipment and incidentals required and install all stainless steel pipe and fittings shown on the Drawings and/or specified herein for the following applications:

1. Diffused Aeration Piping.

B. Related Work Described Elsewhere:

1. Project Coordination: Section 01040.

2. Painting: Section 09900.

3. Piping, Valve, and Equipment Identification: Section 09905.

4. Pressure Testing of Piping: Section 15044.

5. Process and Utility Piping, Fittings, Valves, and Accessories: Section 15050.

6. Pipe Hangers and Supports: Section 15126.

### 1.02 QUALITY ASSURANCE

A. All stainless steel pipe, fittings and appurtenances shall be furnished by a single manufacturer who is fully experienced, reputable, and qualified in the manufacture of the items to be furnished. The stainless steel pipe, fittings and appurtenances shall be fabricated and installed in accordance with the best practices and methods and shall comply with these Specifications.

### 1.03 SUBMITTALS

A. Materials and Shop Drawings:

1. Submit shop drawings in accordance with Section 01340.

2. Submit materials list showing material of pipe and fittings with ASTM reference and grade.

3. Piping subcontractor shall submit a list of welders who will work on this project along with a welder's current certification (less than one year old) and two sample weld coupons. Only approved welders will be allowed to work on the Project.

4. Submit detailed drawings showing dimensioned pipe layouts. Include schedule of all pipe, fittings, valves, hangers and supports, and other appurtenances.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. The equipment provided under this section shall be shipped, handled and stored in accordance with the manufacturer's written instructions, and in accordance with Section 01600 - Materials and Equipment.

PART 2 – PRODUCTS

2.01 MATERIAL COMPATIBILITY

A. Gaskets, O-rings, and other resilient sealing items shall be suitable for the intended services. Such sealing materials shall not contain asbestos and shall meet all applicable regulatory agency requirements.

2.02 STAINLESS STEEL PIPING AND FITTINGS

A. All stainless steel pipe and fittings shall be fabricated from Type 304L extra low carbon grade austenitic stainless steel sheet.

1. Pipe shall conform to ASTM A-778 and be die-formed or rolled true to dimension and round within specified tolerances.

2. The two edges of sheet shall be brought to line so as not to leave a shoulder on the inside of the pipe. Fittings shall conform to ASTM A-774.

3. Ends of pipe and fittings shall be true and perpendicular to the longitudinal axis with the edges deburred.

4. Pipes shall be furnished in the longest lengths commercially available unless otherwise shown, specified, or required. Pipes shall be straight within maximum of 1/8-inch deviation over 10 feet.

5. Longitudinal seams on pipe and fittings shall be welded by either the tungsten gas plasma, flux coved or the metallic-gas method. Welding rod

or wire shall be of same composition or superior to the pipe and fittings material.

6. Weld deposit at the seams shall have a slight crown on both sides of the weld and no cracks or crevices shall be allowed. Excessive weld deposits, slag, weld spatter and projections into interior of pipe shall be removed by grinding. The interior welds shall be smooth, even and shall not have an internal bead higher than 1/16 inch.

7. All pieces shall be marked with gauge and type of stainless steel.

8. Pipe and fittings shall be immersed in pickling solution in manufacturer's plant and scrubbed and washed until discoloration and possible iron, picked up from manufacturing process, is removed. In lieu of pickling, slag, dirt, soot, stains, and discoloration may be removed by other cleaning methods to provide a reasonably uniform appearance.

B. Dimensions

1. Dimensions of pipe shall conform to ANSI B36.10 unless otherwise specified.

2. Stainless steel pipe and fittings 6-inches in size and larger shall be Schedule 5S or 12 gauge. Stainless steel pipe and fittings smaller than 6 inches in size shall be Schedule 10S or 12 gauge.

C. Fittings:

1. Fittings smaller than 2 inches shall be socket-weld type fittings conforming to ASTM A-182 forged, Class WP, and be of the same material as the pipe. The fittings shall have the same wall thickness as the pipe and conform to ANSI B16.11.

2. Fittings for buried or submerged pipe 2 inches and larger shall be butt-welded, conforming to ASTM A 774, same material and wall thickness as the pipe, conforming to ANSI B16.9. Elbows shall be long radius.

3. Fittings for above ground or exposed pipe 2 inches and larger shall be butt-welded except when flanged or coupled, as shown on the Drawings, conforming to ASTM A 774, same material and wall thickness as the pipe, conforming to ANSI B16.9. Elbows shall be long radius.

4. Joints:

   a. Joints for pipes smaller than 2 inches shall be socket welded, same material as the pipe, 3,000 pound WOG, conforming to ANSI B16.11.

   b. Joints for buried or submerged pipe 2 inches and larger shall be butt-welded.

   c. Joints for above-ground or exposed pipe 2 inches and larger shall be butt-welded except where flanges or grooved end joints are shown on the Drawings.

5. Flanges:

   a. Provide weld-neck flanges conforming to ANSI B16.5 to connect to flanged valves, fittings, or equipment. Flanges shall be Class 150 per ANSI B16.5 unless specified otherwise. Material for flanges shall conform to ASTM A 182, Grade F304L. Flanges shall match the connecting flanges on the adjacent fitting, valve or piece of equipment. Slip-on flanges and Vanstone angle-type face rings with backing flanges are also acceptable in lieu of weld-neck flanges. Type 304L stainless steel backing flanges shall be used in all applications.

   b. Determine the pressure class of the flanges based on the test pressure specified in Section 15044.

   c. Where a raised face steel flange connects to a flat face flange, remove the raised face on the steel flange.

   d. Gaskets for flanges shall be Viton suitable for an air pressure of 50 psi at a temperature of 300°F.

6. Field welding will be allowed when approved by the Engineer. All field welding shall be performed by a certified welder and shall be tested for verification of weld.

7. Pipe shall have the manufacturer's name, initials or trademanrk rolled into the surface, and the year of manufacture shall be suitably marked on the pipe.

8. Bolts and nuts for flanges shall be of Type 316 stainless steel. Provide washer for each nut. Washers shall be of the same material as the nuts.

## 2.03 QUALITY CONTROL

A. Contractor shall follow Manufacturer's and Supplier's recommended product quality control specifics as required for project.

B. Welding of pipe joints where shown, specified, permitted, or required shall meet the requirements of ANSI B31.1, Code for pressure piping, unless otherwise specified. Pipe and fittings with a wall thickness of 3/16-inch and greater shall have ends beveled for welding.

C. All welding on steel pipes shall be performed by certified welders having current certificates conforming to requirements of the ANSI code.

D. Welds should be made as rapidly as possible, with the least amount of generated heat.

E. All shop welds shall be visually inspected by the fabricator’s quality control division. Each weld shall be marked with an inspection stamp, certifying that the weld is acceptable.

# PART 3 - EXECUTION

## 3.01 HANDLING

A. During loading, transportation, and unloading, extraordinary care shall be taken to prevent injury to the pipes. Loading and unloading shall be done slowly with each pipe under perfect control at all times. Under no circumstances shall a pipe be dropped. Suitable skids or blocks shall be placed under each pipe in the shop and the pipe shall be securely wedged during transportation to ensure the least possible injury to pipe.

B. Pieces shall be examined for defects and no piece shall be installed which is known to be defective. If any defective piece should be discovered after having been installed, it shall be removed and replaced with a sound one in a satisfactory manner by the Contractor at his own expense.

## 3.02 INSTALLATION

A. Pipe shall be furnished, fabricated, erected, and otherwise installed to the lines, elevations, locations, and dimensions shown, specified, and required for a complete installation. The Contractor shall verify all dimensions shown on the plans and shall take such field dimensions that may be necessary to properly fabricate, locate, erect, connect to existing work, and otherwise install all pipe, pipe supports, pipe anchors, and structural frames required. Where temporary

supports are used, they shall be sufficiently rigid to prevent shifting or distortion of the pipe.

B. Stainless steel piping shall be installed true to alignment and rigidly supported.

C. After installation, completed pipe lines shall be washed clean with steam or hot water to remove any foreign material picked up during transportation.

D. Joint welding shall be in accordance with the American Welding Society Standards. The strength of the weld shall develop the strength of the pipe. All field welds shall be treated with pickling paste, scrubbed, and washed with stainless wire brushes until clean.

E. When installing threaded piping, ream, clean and remove burrs from threads. Install pipe without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment.

F. Fabrication, Assembly and Erection of Welded Piping:

1. Beveled ends for butt-welding shall conform to ANSI B16.25. Remove slag by chipping or grinding. Surfaces shall be free of paint, oil, rust, scale, slag, and other material detrimental to welding.

2. Fabrication shall comply with ANSI B31.3, Chapter V. The minimum number of passes for welded joints shall be as follows:

| Steel Cylinder Thickness (inch) | Minimum Number of Passes for Welds |
|---|---|
| Less than 0.1875 | 1 |
| 0.1874 through 0.25 | 2 |
| Greater than 0.25 | 3 |

Welds shall be full circumferential

3. Use the shielded metal arc welding (SMAW) or the tungsten inert gas (TlG) process for welding. Use the SMAW process for any pipe. Use the TIG process only on pipe having a maximum thickness of Schedule 10S.

4. Welding preparation shall comply with ANSI B31.3, Paragraph 327.3. Limitations on imperfections in welds shall conform to the requirements in ANSI B31.3, Tables 327.4.1A and 327.4.1a, and Paragraph 327.4 for visual examination. Identify welds in accordance with ANSI B31.3, Paragraph 327.4.

5. Clean each layer of deposited weld metal prior to depositing the next layer of weld metal, including the final pass, by a power-driven wire brush on the same material.

6. Welding electrodes shall comply with AWS A5.4. Bare wire shall comply with AWS AS.9.

7. Contractor shall install the stainless steel piping system with minimal field welds. All installed stainless steel pipe shall be closed to the atmosphere after connections of pipe, valves or equipment with a nitrogen purge and bagged ends. Provide temporary enclosures as required to complete the piping installation in a clean environment. This area shall remain clean and dust free. If the area is not maintained adequately, the fabrication and welding work will not be accepted.

8. Mark each weld completed in the field and at the manufacturing facility with symbol identifying welder and date of weld.

F. Painting:

1. Exposed stainless steel piping is not required to be painted, however, it will be required to be labeled in accordance with Section 09905.

2. Fitting flanges and other non-stainless steel appurtenances shall be final painted as specified in Section 09900.

3.03 INSPECTION AND TESTING

A. All stainless steel pipe shall be pressure tested in accordance with Section 15044.

END OF SECTION

# SECTION 15126

# PIPE HANGERS AND SUPPORTS

## PART 1 - GENERAL

### 1.01 DESCRIPTION

A. Scope of Work:

1. Furnish all labor, materials, equipment and incidentals and install pipe hangers, supports, concrete inserts, and anchor bolts including all metallic hanging and supporting devices for supporting exposed piping.

B. Number and Location: The Drawings depict only minimum pipe support locations. Adequate pipe supports shall be supplied for all piping systems to provide a rigid overall installation and additional support for pipe ends when equipment is disconnected.

C. Related Work Described Elsewhere:

1. Project Coordination: Section 01040.

2. Concrete: Division 3.

3. Metals: Division 5.

4. Painting: Section 09900.

5. Mechanical: Division 15.

### 1.02 QUALITY ASSURANCE

A. Hangers and supports 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 pipe supports shall be five (5) times the ultimate tensile strength of the material, assuming 10 feet of water filled pipe being supported.

B. All pipe and appurtenances connected to equipment shall be supported in such a manner 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 a certification stating that such requirements have been complied with.

1.03 SUBMITTALS

A. Materials and Shop Drawings:

1. Submit to the Engineer for approval, as provided in the General Conditions and Section 01040, shop drawings of all items to be furnished under this Section.

2. Submit to the Engineer, for approval, samples of all materials specified herein.

1.04 PRODUCT DELIVERY STORAGE AND HANDLING

A. The equipment provided under this section shall be shipped, handled and stored in accordance with the Manufacturer's written instructions.

PART 2 - PRODUCTS

2.01 GENERAL

A. All pipe and tubing shall be supported as required to prevent significant stresses in the pipe or tubing material, valves, and fittings and to support and cure 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. All pipe supports shall be approved prior to installation.

B. The Contractor shall select and design all piping support systems within the specified spans and component requirements. Structural design and selection of support system components shall withstand the dead loads imposed by the weight of the pipes filled with water, plus any insulation. Commercial pipe supports and hangers shall have a minimum safety factor of 5.

C. No attempt has been made to show all required pipe supports in all locations, either on the Drawings or in the details. The absence of pipe supports and details on any drawings shall not relieve the Contractor of the responsibility for providing them throughout the plant.

D. All support anchoring devices, including anchor bolts, inserts and other devices used to anchor the support onto a concrete base, roof, wall or structural steel works, shall be of the proper size, strength and spacing to withstand the shear and pullout loads imposed by loading and spacing on each particular support.

E. All materials used in manufacturing hangers and supports shall be capable of meeting the respective ASTM Standard Specifications with regard to tests and physical and chemical properties, and be in accordance with MSS SP-58.

F. Hangers and supports shall be spaced in accordance with ANSI B31.1.0 except that the maximum unsupported span shall not exceed 10 feet unless otherwise specified herein.

G. All pipe supports, hangers, and hardware shall be Type 316 stainless steel.

H Unless otherwise specified herein, pipe hangers and supports shall be as manufactured by Cooper Industries B-line, National Pipe Hanger Corporation, or equal. Any reference to a specific figure number of a specific manufacturer is for the purpose of establishing a type and quality of product, and shall not be considered as proprietary. Any item comparable in type, style, quality, design and performance will be considered for approval.

2.02 MATERIALS AND EQUIPMENT

A. Pipe Supports for Metal Pipe:

1. Wall or column supported pipes shall be supported by welded steel brackets equal to Cooper Industries B3065, B3066 and B3067 or National Pipe Fig. 700, 705and 710, as required, for pipe sizes up to and including 20-inch diameter. Additional wall bearing plates shall be provided where required.

a. Where the pipe is located above the bracket, the pipe shall be supported by an anchor chair and U-bolt assembly supported by the bracket for pipes 4 inches and larger and by a U-bolt for pipes smaller than 4 inches. Anchor chairs shall be Cooper Industries Fig. B3147. U-bolts shall be equal to Cooper Industries Fig. B3188, National Pipe Hanger Fig. 165, or equal.

b. Where the pipe is located below the bracket, the pipes shall be supported by pipe hangers suspended by Type 316 stainless steel rods from the bracket. Hangers and stainless steel rods shall be as specified above.

2. Floor supported pipes 3-inches and larger in diameter shall be supported by either cast-in-place concrete supports or adjustable pipe saddle supports as directed by the Engineer. In general, concrete supports shall be used when lateral displacement of the pipes is probable (unless lateral support.l

provided), and adjustable pipe saddle type supports shall be used where later displacement of pipes is not probable.

a. Each concrete support shall conform to the details shown on the Drawings. Concrete shall be poured after the pipe is in place with temporary supports. Concrete piers shall conform accurately to the bottom 1/3 to 1/2 of the pipe. Top edges and vertical corners of each concrete support shall have l-inch bevels. Each pipe shall be secured on each concrete support by a Type 316 stainless steel anchor strap anchored to the concrete with cast-in-place bolts or with expansion bolts. Where directed by the Engineer, vertical reinforcement bars shall be grouted into drilled holes in the concrete floor to prevent overturning or lateral displacement of the concrete support. Unless otherwise approved by the Engineer, maximum support height shall be five (5) feet.

b. Concrete piers used to support base elbows and tees shall be similar to that specified above. Piers may be square or rectangular.

c. Each adjustable pipe saddle support shall be screwed or welded to the corresponding size 150 pound companion flanges or slip-on welding flanges respectively. Supporting pipe shall be of Schedule 40 steel pipe construction. Each flange shall be secured to the concrete floor by a minimum of two (2) expansion bolts per flange. Adjustable saddle supports shall be equal to Cooper Industries Fig. B3092 or National Pipe Hanger Fig. 539. Where used under base fittings, a suitable flange shall be substituted for the saddle.

3. Vertical piping shall be supported as follows:

a. Where pipes change from horizontal to vertical, the pipes shall be supported on the horizontal runs within 2 feet of the change in direction by pipe supports as previously specified herein.

b. For vertical runs exceeding 15 feet, pipes shall be supported by approved pipe collars, clamps, brackets, or wall rests at all points required to insure a rigid installation.

c. Where vertical piping passes through a steel floor sleeve, the pipe shall be supported by a friction type pipe clamp which is supported by the pipe sleeve. Pipe clamps shall be equal to Cooper Industries Fig. B3180 or National Pipe Hanger Fig. 136.

4. Anchor bolts shall be equal to Kwik-Bolt as manufactured by the McCullock Industries, Minneapolis, Minnesota, or Wej-it manufactured by Wej-it Expansion Products, Inc., Bloomfield, Colorado.

5. All rods, hangers, inserts, brackets, and components shall be Type 316 stainless steel.

B. Pipe Hangers and Supports for Plastic Pipe:

1. Single plastic pipes shall be supported by pipe supports as previously specified herein.

2. Multiple, suspended, horizontal plastic pipe runs, where possible, and rubber hose shall be supported by ladder type cable trays such as the Electray Ladder by Husky-Burndy, the Globetray by the Metal Products Division of United States Gypsum, or equal. Ladder shall be of 316 SST construction. Rung spacing shall be approximately 18 inches for plastic pipe and 12 inches for rubber hose. Tray width shall be approximately 6-inch for single runs of rubber hose and 12 inches for double runs of rubber hose. 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 equal to Globe Model M-CAC, Husky-Burndy Model SCR or approved equal. Spacing between clamps shall not exceed 9 feet. The cable trays shall provide continuous support along the length of the pipe.

3. Individual clamps, hangers, and supports in contact with plastic pipe shall provide firm support but not so firm as to prevent longitudinal movement due to thermal expansion and contraction.

C. Pipe Supports for Small Diameter PVC and Steel Pipe:

1. Small diameter Schedule 80 PVC piping 3-inches in diameter and smaller, and steel piping 2-inches in diameter and smaller shall be supported with "SUPPORT" system arrangements as manufactured by Universal Suspension Systems Inc. of Gillette, New Jersey or an equal approved by the Engineer. Clamping halves for the pipe support shall be manufactured of molded polypropylene and shall support and fit closely for 360° around the pipe. To support piping carrying non-corrosive fluids or gases and located in noncorrosive, indoor environments, all hardware for the "SUPPORT" system shall be Type 316 stainless steel. To support piping carrying corrosive fluids or gases, piping located in corrosive environments or piping located outdoors, all hardware for the system shall be manufactured of Type 316 stainless steel.

2. In some cases, to adequately support small diameter PVC or steel piping, a metal frame support structure may be required for support of the "SUPPORT" system specified above. Where required, metal frame support structures shall be constructed using channels, fittings, brackets, hardware and other accessories as manufactured by B-Line Systems, Inc. of Highland, Illinois, or an equal approved by the Engineer. The materials for the frame structure shall be Type 316 stainless steel unless otherwise noted on the Drawings. Hardware used to construct the frame support structure shall be Type 316 stainless steel.

3. Pipe supports for small diameter PVC and steel piling shall be located wherever necessary in the opinion of the Engineer to adequately support the pipe, however, they shall have a maximum spacing as specified below for straight pipe runs. Adequate supports shall especially be used adjacent to valves and fittings in pipelines. The following table is based on spacing requirements for Schedule 80 PVC or Standard Weight (Schedule 40) steel pipe carrying a fluid with a Specific Gravity of 1.0 at a temperature not exceeding 120°F. Support spacing for PVC or steel piping carrying fluids with Specific Gravities or temperatures exceeding those stated above shall be approved by the Engineer.

| Nominal Pipe | Support Spacing, Feet | |
|---|---|---|
| Diameter, Inches | PVC Pipe | Steel Pipe |
| 3/8" | 3.0 | 4.0 |
| 1/2" | 3.5 | 4.5 |
| 3/4" | 4.0 | 5.0 |
| 1" | 4.5 | 5.5 |
| 1-1/4" | 5.0 | 6.5 |
| 1-1/2" | 5.0 | 7.5 |
| 2" | 5.5 | 8.0 |
| 2-1/2" | 5.5 | - |
| 3" | 6.0 | - |

2.03 ACCESSORIES (Not Applicable)

2.04 SPARE PARTS (Not Applicable)

2.05 QUALITY CONTROL

A. Contractor shall follow Manufacturer's and Supplier's recommended product quality control specifics as required for this project.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All pipes, horizontal and vertical, shall be rigidly supported from the building structure by approved supports. Supports shall be provided at changes in direction and elsewhere as shown in the Drawings or specified herein. No piping shall be supported from other piping or from metal stairs, ladders, and walkways, unless it is so indicated on the Drawings, or specifically directed or authorized by the Engineer.

B. All pipe supports shall be designed with liberal strength and stiffness to support the respective pipes under the maximum combination of peak loading conditions to include pipe weight, liquid weight, liquid movement, and pressure forces, thermal expansion and contraction, vibrations, and all probable externally applied forces. Prior to installation, all pipe supports shall be approved by the Engineer.

C. 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 utilized to support connecting pipes.

D. Pipe supports shall be provided as follows:

| Nominal Pipe Diameter (inches) | Support Spacing, Feet | | | |
|---|---|---|---|---|
| | Copper | Ductile Iron | Plastic | Steel |
| 1/2 | 4.0 | N/A | 3.5 | 4.5 |
| 3/4 | 4.0 | N/A | 4.0 | 5.0 |
| 1 | 4.0 | N/A | 4.5 | 5.5 |
| 1-1/4 | 6.0 | N/A | 5.0 | 6.5 |
| 1-1/2 | 6.0 | N/A | 5.0 | 7.5 |
| 2 | 6.0 | N/A | 5.5 | 8.0 |
| 2-1/2 | 6.0 | N/A | 5.5 | 8.0 |
| 3 | 6.0 | N/A | 6.0 | 8.0 |
| 4 | N/A | 8.0 | 7.0 | 8.0 |
| Larger than 4 | N/A | See Note | N/A | See Note |

Note: Cast iron, ductile iron and steel shall be supported at a maximum support spacing of 10 feet, 0-inches with minimum of one support per pipe section at the joints. Refer to AWWA standard of practice.

D. Supporting Vertical Piping:

1. Support at a maximum of 10 feet spacing.

2. Support at all points necessary to insure rigid installation with adequate provisions to allow expansion and contraction and prevent vibration.

3. Support by approved pipe collars, clamps, brackets, or wall rests.

E. Effects of thermal expansion and contraction of the pipe shall be accounted for in pipe support selection and installation.

F. Inserts for pipe supports shall be installed on forms before concrete is poured. Before setting these items, all Drawings and figures shall be checked which have a direct bearing on the pipe location. Responsibility for the proper location of pipe supports is included under this Section.

G. Continuous metal inserts shall be embedded flush with the concrete surface.

H. Standard Pipe Supports:

1. Horizontal Suspended Piping:

a. Single Pipes: Adjustable swivel-ring, splint-ring, or clevis hangers.

b. Grouped Pipes: Trapeze hanger systems.

c. Furnish protection shield and oversized hangers for all insulated pipe.

d. Furnish precut sections of rigid insulation with vapor barrier at hangers for all insulated pipe.

2. Horizontal Piping Supported From Walls:

a. Single Pipes: Wall brackets or wall clips attached to wall with anchors. Clips attached to wall mounted framing also acceptable.

b. Stacked Piping:

1) Wall mounted framing system and clips acceptable for piping smaller than 3-inch minimal diameter.

2) Piping clamps which resist axial movement of pipe through support not acceptable.

c. Wall mounted piping clips not acceptable for insulated piping.

3. Horizontal Piping Supported From Floors:

a. Stanchion Type:

1) Pedestal type; adjustable with stanchion, saddle, and anchoring flange.

2) Use yoke saddles for piping whose centerline elevation is 18 inches or greater above the floor and for all exterior installations.

3) Provide neoprene waffle isolation pad under anchoring flanges, adjacent to equipment or where otherwise required to provide vibration isolation.

b. Floor Mounted Channel Supports:

1) Use for piping smaller than 3-inch nominal diameter running along floors and in trenches at piping elevations lower than can be accommodated using pedestal pipe supports.

2) Attach channel framing to floors with anchor bolts.

3) Attach pipe to channel with clips or pipe clamps.

c. Concrete Cradles: Use for piping larger than 3-inch along floor and in trenches at piping elevations lower than can be accommodated using stanchion type.

4. Vertical Pipe: Support with wall brackets and base elbow or riser clamps on floor penetrations.

5. Standard Attachments:

a. To Concrete Ceilings: Concrete inserts.

b. To Steel Beams: I-beam clamp or welded attachments.

c. To Wooden Beams: Lag screws and angle clips to members not less than 2-1/2 inches thick.

d. To Concrete Walls: Concrete inserts or brackets or clip angles with anchor bolts.

6. Existing Walls and Ceilings: Install as specified for new construction, unless shown otherwise.

3.02 INSPECTION AND TESTING (Not Applicable)

3.03 START-UP AND INSTRUCTION (Not Applicable)

END OF SECTION

# 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 that will require conduit and wire to complete the installation as required.

3. The Contractor shall furnish and install the necessary cables, transformers, panel boards, protective devices (surge protection), conductors, exterior electrical system, etc., to serve motor 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 all permitting.

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.

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 that 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.

12. Provide demolition, cutting, patching and repair to match existing conditions.

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. Interpretation of Drawings:

1. The Drawings are not intended to show exact location of conduit runs.

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.

D. 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.

E. 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.

F. 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.

1.02 SUBMITTALS

A. Material and Shop Drawings:

1. As specified under Section 01040: Project Coordination, 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. Disconnect Switches

b. Wire and Cable

c. Supporting Devices

3. The manufacturer’s name and product designation or catalog numbers shall be submitted for the following material:

a. Conduit

b. Receptacles

c. Boxes and Fittings

d. Switches

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.

## 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. All outlet boxes shall be wall or column mounted.

## 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 SEQUENCE OF CONSTRUCTION

A. Contractor shall be responsible for coordinating sequence of construction, means and methods for completion of work. Contractor shall be responsible for coordinating all work with owner and scheduling all shut downs a minimum of 7 calendar days in advance of actual work start. Contractor shall be responsible for providing temporary power for equipment to maintain operation.

### 3.03 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 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 shall be Rigid Aluminum Conduit and fittings, except for raceway systems motor or connections to vibrating equipment which shall be liquidtight non-metallic flexible conduit. Raceway systems for process shielded instrumentation, telephone, data and VFD motor leads wiring shall be rigid aluminum conduit. Raceway systems for interior administration areas or in air-conditioned areas shall be EMT steel conduit.

### 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. (U.L.).

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 01040.

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 352 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 350 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 aluminum (not die-cast aluminum or zinc) 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 3/4-inch shall be used.

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 conduits 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.

F. Single conduits shall be supported by means of one-hole aluminum or stainless steel 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

stainless steel horizontal members and stainless steel 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 stainless steel 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 conduits shall be run perfectly straight and true.

I. No broken run shall exceed 300 feet in length. This length shall be reduced by 75 feet for each 90 degree elbow.

J. Conduit terminating in boxes shall have aluminum Myers hubs 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 non-metallic 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. 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 prior to 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. Raceways which do not have conductors furnished under this division of specification shall be left with an approved nylon pullcord in the raceway.

U. 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.

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/THWN solid.

2. Wire for all power feeder and motor circuits outside of the administration building shall be type XHHW, stranded.

3. Single conductor wire for control, indication and metering shall be type XHHW 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. 18 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. (U.L.)

3. American Society for Testing and Materials (ASTM)

B. Manufacturers:

1. 600 volt wire and cable.

    a. Okonite Co.

    b. Rome Cable Co.

    c. American Insulated Wire Corp.

    e. Or equal

2. Instrumentation and Control Cable:

    a. Belden.

    b. Rome Cable Corp.

    c. Okonite Co.

    d. Or Equal.

1.03 SUBMITTALS

A. Materials and Shop Drawings:

1. The requirements of Section 01040: Project Coordination shall be met.

1.04 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 XHHW shall be cross-linked polyethylene (XLP).

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. Lubrications shall be used to facilitate wire pulling. Lubricants shall be U.L. 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 aluminum 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 prior to cable installation and mandrel with device of one size smaller than conduit and mandrel with wire brush one size larger than conduit.

K. All control and signal wiring shall be identified with snap-on or slip-on PVC wire markers, machine printed and numbered.

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 1000-VDC. A cable test data form shall be provided for Engineer review.

B. 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. Related Work Described Elsewhere

1. Raceways: Section 16110

2. Supporting Devices: Section 16190

C. 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. (U.L.)

2. Federal Specifications

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 - General Provisions.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Boxes and fittings shall be stored indoors protected from damage.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Boxes shall be constructed as follows:

1. 14-gauge 316 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.
5. Aluminum back plate with grounding lug.

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. Control Stations

f. Ground Fault Interrupter Receptacles

B. Related Work Described Elsewhere:

1. General Provisions: Section 16050.

2. Raceway: Section 16110.

### 1.02 QUALITY ASSURANCE

A. Standards:

1. Underwriters Laboratories Inc. (UL).

2. National Electric Manufacturers Association (NEMA).

3. National Electrical Code (NEC).

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. 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 Federal Specification 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 the purpose of 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. 1l991-L.

    f. Momentary contact, 2 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, 1 25V, 2P, 3W; Arrow-Hart, Catalog No. 5351 and WLRD-l 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. 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 316 stainless steel bolts, 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 prior to 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 as provided in Section 01040: Project Coordination: 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 A.C., premium efficient, and motors: below 1/2 horsepower shall be rated 115/230 volt, 1-phase, 60/Hertz A.C.

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 totally enclosed fan cooled construction or 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 B 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 316 stainless steel. 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, pipe tapped for conduit and shall be attached to the motor frame with Stainless Steel 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 316 stainless steel 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. Stainless steel 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. Motors shall be rated for use in a highly corrosive atmosphere—mill and chemical duty.

    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.

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 one 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 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 safety switches in outdoor or corrosive areas shall be heavy duty and have stainless steel NEMA 4X enclosures. Safety switches indoor in air conditioned areas shall have NEMA 12 enclosures.

2. All switches shall have stainless steel 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, non-teasible, positive, quick make-quick break mechanism, switch assembly plus operating handle as an integral part of the enclosure base. Disconnects shall be non-fused unless otherwise noted.

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.

### 1.02 QUALITY ASSURANCE

A. Standards:

1. National Electrical Manufacturer's Association (NEMA).

2. Underwriter's Laboratories (UL).

3. Federal Specifications.

4. National Electrical Code (NEC).

B. Manufacturer:

1. Switches shall be as manufactured by SQ-D, Siemens, GE, or approved equal.

1.03 SUBMITTALS

A. Materials and Shop Drawings:

1. See Section 16050 - General Provisions.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. All switches shall be stored indoors protected from damage.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. All parts exposed to the weather or in hose down areas shall be stainless steel.

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 N.E.C. and shall be verified with the Engineer before installation.

C. All mounting appurtenances shall be 316 stainless steel including fasteners.

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. Wire: Section 16120.

2. Conduit: Section 16110.

### 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 01040: Project Coordination.

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 stainless steel 3/4 inch x 20 foot, minimum depth. Ground rods shall be (exothermic) 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.

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 insure 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 a 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 16485

# VARIABLE FREQUENCY DRIVES

## PART 1 - GENERAL

### 1.01 SCOPE OF WORK

A. Provide all labor, materials, equipment and incidentals required, and install, place in operation and field test variable frequency drive(s) (VFD's).

B. The variable frequency drive shall be a space vector Pulse-Width Modulated (PWM) design. Modulation methods which incorporate "gear-changing" techniques are not acceptable. The final responsibility of distributor or packager modifications to a third-party standard product will reside with the VFD manufacturer. The VFD manufacturer shall have overall responsibility for the drives. The City has officially standardized on Yaskawa America, Inc. VFD's – no alternates will be considered. The Standardizaition Certificate of Conditions and Circumstances is included hereinafter.

C. VFD's shall be six pulse units. Refer to 2.02A.8 for the power unit rating requirements of the VFD.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Pumps, General

B. Section 16050 - Motors

C. Division 13 – Special Contstruction

### 1.03 QUALITY ASSURANCE

A. The entire VFD system as described in section 2.01B shall be factory assembled and system tested by the VFD manufacturer to assure a properly coordinated system.

B. Codes: Provide equipment in full accordance with the latest applicable rules, regulations, and standards of:

1. Local Laws and Ordinances.
2. State and Federal Laws.
3. National Electric Code (NEC).
4. Underwriters Laboratories (UL).
5. American National Standards Institute (ANSI).
6. National Electrical Manufacturers Association (NEMA).

7. Institute of Electrical and Electronics Engineers (IEEE).

C. The complete drive system shall be UL listed.

D. Acceptable Manufacturers:

1. Yaskawa America, Inc.

1.04 SUBMITTALS

A. Submittals shall conform in all respects to Section 01040 Project Coordination.

B. Submittals shall be custom prepared by the VFD manufacturer for this specific application.

C. Submittal information shall include, but not be limited to:

1. Equipment dimensions, including stub-up locations, shipping splits and shipping weights.

2. Catalog cuts of major components.

3. Spare parts list, per Paragraph 3.03.

4. Certifications, including:

a. Warranty.

b. Efficiencies, per section 2.02.A.1.

5. Harmonic Distortion Analysis, per section 2.01D.

PART 2 - PRODUCTS

2.01 Material and Equipment

A. Any modifications to a standard product required to meet this specification shall be performed by the VFD manufacturer only. Distributor or system integrator changes to the VFD manufacturer's product are specifically disallowed.

B. The VFD system shall consist of a main circuit breaker/disconnect, 3% input line reactor, 6 pulse converter section, control logic section, output inverter section, and 3% output reactor. Isolation and bypass contactors shall be provided to allow across-the-line starting if the VFD fails. All components listed shall be integral to the VFD lineup, factory wired and tested as a complete system. The entire VFD

system shall meet the requirements of NEC article 409 and IEEE 508A for fault current withstand ratings as indicated on the project electrical drawings.

C. Input circuit breaker, interlocked with the enclosure door, with through-the-door handle to provide positive disconnect of incoming AC power and shall be capable of being locked in the open position.

D. VFD system shall maintain a 0.95 minimum true power factor throughout the entire speed range.

2.02 VARIABLE FREQUENCY DRIVES

A. Ratings

1. VFD must have the range of horsepower ratings: 0.75 to 175 HP at 240 VAC; 0.75 to 1000 HP at 480 VAC; 1 to 250 HP at 600 VAC. VFD must have Variable Torque ratings and to optimize the VFD size for fan and pump applications.

2. Rated Input Power: 460 Volts 60 Hz, +10%, -5% at rated load, 3-phase.

a. Voltage Dip Ride-Through: VFD shall be capable of sustaining continued operation with a 40% dip in nominal line voltage. Output speed may decline only if current limit rating of VFD is exceeded.

b. Power Loss Ride-through: VFD shall be capable of a minimum 3 cycle power loss ride-through without fault activation.

3. Output Power: As required by motors supplied.

4. Ambient Temperature Range: 0 to 40°C.

5. Elevation: Up to 3300 feet (1000 meters) above MSL without de-rating.

6. Atmosphere: Non-condensing relative humidity to 95%.

7. AC Line Frequency Variation: +/- 3 Hertz.

8. Power Unit Rating Basis: 110% rated current continuous, 150% rated current for one minute, at rated temperature. If the power unit rating of the VFD does not meet the above requirements, provide VFD with one standard size larger than the nameplate motor horsepower.

9. Displacement Power Factor: 0.98 over entire range of operating speed and load.

10. Service Factor: 1.0

11. Vibration: 9.81m/s$^2$ (1 G) from 10 to 20 Hz; 2.0 m/s$^2$ (0.2 G) from 20 Hz to 55 Hz.

12. Minimum Efficiency: 96% at half speed; 98% at full speed.

13. Starting Torque: 120% starting torque shall be available from 3 Hz to 60 Hz.

14. Overload capability: 120% of rated FLA for 60 seconds; 170% of rated FLA peak.

15. Controlled speed range: 40:1.

B. Construction

1. The controller shall produce an adjustable AC voltage/frequency output. It shall have an output voltage regulator to maintain correct output V/Hz ratio despite incoming voltage variations.

2. The controller shall have a continuous output current rating of 100% of motor nameplate current.

3. The converter section shall be 6 pulse utilizing diodes.

4. The inverter output shall be generated by IGBTs. Pulse Width Modulation strategy will be of the space vector type implemented to generate a sine-coded output voltage. The VFD shall not induce excessive power losses in the motor. The worst case RMS motor line current measured at rated speed, torque and voltage shall not exceed 1.05 times the rated RMS motor current for pure sine wave operation. The inverters shall be able to sustain 1600 volt surges.

5. The controller(s) shall be suitable for use with any standard NEMA-B squirrel-cage induction motor(s) having a 1.15 Service Factor or with existing standard NEMA-B squirrel-cage induction motor(s) with nameplate data as shown on the plans. Provide drives with dV/dT output filters. At any time in the future, it shall be possible to substitute any standard motor (equivalent horsepower, voltage and RPM) in the field.

6. The control logic section shall be fully digital and not require analog adjustment pots or fixed selector resistors. A power failure will not necessitate a reload of any drive parameter or configuration.

7. Minimum Starting Speed: When called to operate, the VFD shall amp to a minimum speed. The minimum speed shall be adjustable but initially set at 60% of maximum speed. The 4-20 mA speed signal from the PLC and

potentiometer on the front of the drive shall modulate the signal between the minimum speed set point and the maximum output speed of the drive; i.e., at the 4 mA signal, the VFD shall run at the minimum speed. At the 20 mA signal, the VFD shall run at full speed. The potentiometer shall also adjust speed between the minimum speed set point and the maximum running speed. Below the minimum speed set point, the potentiometer shall have no effect.

8. All 6 pulse VFD's shall be provided with 3% line and load reactors.

C. Basic Features

1. The door of each power unit shall include: a keypad with a manual speed device, "HAND / OFF / REMOTE/BYPASS" mode selector switch, "POWER ON" light, "VFD FAIL" light, VFD "RUNNING" light, fault reset pushbutton, "MOTOR OVER TEMPERATURE" light, "MOTOR SEAL LEAK ON" light, "ENCLOSURE OVER TEMPERATURE" light, "DRIVE LOCKOUT" light, CONTROL POWER ON light, START and STOP pushbuttons and a TEST / NORMAL selector switch. All lights shall be LED type.

2. The VFD shall include a customer selectable automatic restart feature. When enabled, the VFD shall automatically attempt to restart after a trip condition resulting from instantaneous overcurrent, overvoltage, out of saturation or overload. For safety, the drive shall shut down and require manual reset and restart if the automatic reset/restart function (programmable for up to 3 attempts) is not successful within a customer programmable time period. Auto-Restart shall be programmable to allow for individual fault selection.

3. A door-mounted membrane keypad with integral 2-line minimum, 24-character LCD display shall be furnished, capable of controlling the VFD and setting drive parameters. The keypad shall include the following features:

   a. The digital display must present all diagnostic message and parameter values in English engineering units when accessed, without the use of codes.

   b. The digital keypad shall allow the operator to enter exact numerical settings in English engineering units. A user menu written in plain English (rather than codes) shall be provided in software in nonvolatile memory as a guide to parameter setting and resettable in the field through the keypad. Multiple levels of password security shall be available to protect drive parameters from unauthorized personnel. The drive set up parameters must be able to be transferred to new boards to reprogram spare boards.

c. The following digital door-mounted keypad indications may be selectively displayed:

1) Speed demand in percent.
2) Output current in amperes.
3) Output Frequency in hertz.
4) Input voltage.
5) Output voltage.
6) Total 3-phase KW.
7) Kilowatt hour meter
8) Elapsed time running meter.
9) RPM.
10) DC bus voltage.

d. VFD shall have the capability of communicating via an RJ-45 Ethernet port with a General Electric RX3i PLC using MODBUS Ethernet protocol.

e. VFD parameters, fault log and diagnostic log shall be downloadable via a RJ-45 Ethernet port.

4. Refer to the VFD wiring diagram in the Drawings for remote signals and alarms.

D. Enclosure

1. All VFD components shall be factory mounted and wired on a dead front, grounded, NEMA-12 enclosure. If a free-standing enclosure is provided, it shall be suitable for mounting on a concrete housekeeping pad. Properly size enclosure to dissipate heat generated by VFD within limits of specified service conditions. Provide NEMA enclosure type as specified on drawings. Provide integral fans or cooling systems as required by the application. Circuit breaker interlocks to be able to be bypassed via lever on front door surface. NEMA 12 type enclosures to have keypad controls located on exterior of enclosure. Provide visual alarm indicator on cabinet door.

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

1. Instantaneous overcurrent and overvoltage trip.

2. Undervoltage and power loss protection.

3. Power unit overtemperature alarm and protection. Upon sensing an overtemperature condition, the VFD is to automatically trip.

4. Electronic motor inverse time overload protection.

5. Responsive action to motor winding temperature detectors or thermostatic switches. A dry contact (NC) input to the VFD is required.

6. When power is restored after a complete power outage, the VFD shall be capable of catching the motor while it is still spinning and restoring it to proper operating speed without the use of an encoder.

7. The VFD shall be protected from damage due to the following, without requiring an output contactor:

    a. Three-phase short circuit on VFD output terminals.

    b. Loss of input power due to opening of VFD input disconnecting device or utility power failure during VFD operation.

    c. Loss of one (1) phase of input power.

8. The VFD shall continue to operate at a reduced capacity under a single-phase fault condition.

9. The VFD shall be able to withstand the following fault conditions without damage to the power circuit components:

    a. Failure to connect a motor to the VFD output.

    b. VFD output open circuit that may occur during operation.

    c. VFD output short circuit that may occur during operation.

10. Three phase lightning and surge protection across the line input at each VFD.

F. Parameter Settings

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

    a. Motor Nameplate Data.
        1) Motor frequency.
        2) Number of poles.

3) Full load speed.
4) Motor volts.
5) Motor full load amps.
6) Motor HP.
7) Current limit, max.

b. VFD Configuration Parameters.
1) Independent accelerate/decelerate rates.
2) Max/Min speed (frequency)
3) Catch-a spinning load selection.
4) No load boost.
5) Full load boost.
6) Volts/Hertz ratio.
7) Overspeed trip.
8) Overload trip curve selection.
9) Overload trip time selection
10) Adjustable Ramp Stop.

c. Automatic VFD Control.
1) PID utilizing an internal or external setpoint.
2) Three selectable critical speed avoidance bands with programmable bandwidths.
3) Auto start functions: On/Off, Delay On/Off. Operable from a 4-20mA signal or from the PID output, command, or feedback signal.
4) Speed Profile: Programmable entry and exit points.
5) Programmable loss of signal control: Stop, maintain last speed, or default to preselected setpoint.

2. All drive setting adjustments and operation parameters shall be stored in a parameter log which lists allowable maximum and minimum points as well as the present set values. This parameter log shall be accessible via a RJ-45 Ethernet port capable of communicating with a GE RX3i PLC using MODBUS Ethernet protocol as well as on the keypad display.

G. Input/Output Features

1. Two programmable analog inputs: VFD speed in, spare.
2. Three programmable analog outputs: VFD speed output, Drive (output) current in Amps, spare.
3. Two programmable digital inputs: Run, spare.
4. Ten programmable digital outputs: VFD fault, VFD running, VFD in remote, 6 spare.
5. One Pot input (three wire control, +10 V, wiper and common).

6. System Program providing built-in drive control or application specific configuration capability.

H. Diagnostic Features and Fault Handling

1. The VFD shall include a comprehensive microprocessor based digital diagnostic system that monitors its own control functions and displays faults and operating conditions.

2. A “Fault Log” shall be accessible via a RJ-45 Ethernet link capable of communicating with a GE RX3i PLC using MODBUS Ethernet protocol as well as line-by-line on the keypad display. The "FAULT LOG" shall record, store, display and output to a serial port upon demand, the following for the 64 most recent events:

   a. Date and time of day.

   b. Type of fault.

   c. All faults and events shall be stored and displayed in English, not fault codes.

3. A "HISTORIC LOG" shall record, store, and output via a RJ-45 Ethernet link port capable of communicating with a GE RX3i PLC via MODBUS Ethernet protocol upon demand, the following selectable control variables at 1 msec. intervals for the 58 intervals immediately preceding and the 20 intervals immediately following a fault trip:

   a. Torque demand.
   b. Torque command.
   c. Torque feedback.
   d. Torque error.
   e. Torque maximum.
   f. Current demand.
   g. Peak current.
   h. Motor current.
   i. DC bus voltage.
   j. Line voltage.
   k. Velocity demand.
   l. Velocity reference.
   m. PI min/max limit.
   n. Boost.
   o. VFD mode (Auto/Manual).

## PART 3 - EXECUTION

### 3.01 FACTORY TESTING

A. The VFD manufacturer shall provide as a minimum, the following quality assurance steps within his factory:

1. Incoming inspection of components and raw materials based on strategic supplier base and experience. Sampling plans based on MIL STD 105E.

2. MIL STD 45662 calibration system.

3. All products subject to 100% testing and final inspection; no sampling plans permitted.

### 3.02 PRE-DELIVERY TESTING COORDINATION

A. One VFD unit of each specified type and application shall be shipped to the pump manufacturer's test facility for complete operational testing. The VFD Manufacturer shall provide a qualified representative at the pump Manufacturer's test facility during testing. All costs incurred by the VFD Manufacturer to meet this requirement shall be included in the bid.

B. Certified test reports shall be submitted to the ENGINEER before the equipment is shipped to the project site.

### 3.03 STARTUP AND TRAINING

A. VFD manufacturer shall provide the services of a factory technician for startup assistance and training. Verification of VFD input harmonic voltage and current distortion limits specified must be verified as part of final startup and acceptance. If harmonic distortion requirements are not met, it is the responsibility of the VFD supplier to meet the specification at the supplier's expense. A recording type Fluke 41 or equivalent harmonic analyzer displaying individual and total harmonic currents and voltages must be utilized.

B. A 10% payment retainage will be released upon field test verification of harmonic specification requirements and final acceptance.

### 3.04 SPARE PARTS

A. The following spare parts shall be furnished:

1. Three of each type of fuse rated 460V or less.
2. Two of each type of converter power semiconductor.
3. Two of each type of inverter power semiconductor.
4. One of each type of type control printed circuit board and gate firing boards.
5. One keypad assembly.

## 3.05 FIELD QUALITY CONTROL

A. Functional Test:

1. Conduct on each VFD.

2. Inspect controller for electrical supply termination connections, interconnections, proper installation, and quiet operation.

3. Vibration Test: Complete assembly, consisting of motor, load, and flexible shafting, connected and in normal operation, shall not develop amplitudes of vibration exceeding limits recommended by current edition of Hydraulic Institute Standards. Where pumps and motors are separated by intermediate flexible shafting, measure vibration both at top motor bearing and at two points on top pump bearing, 90 degrees apart.

4. Record test data for report.

B. Performance Test:

1. Conduct on each VFD.

2. Perform under actual or approved simulated operating conditions.

3. Test for continuous 48-hour period without malfunction.

4. Demonstrate performance by operating the continuous period while varying the application load, as the input conditions allow, in order to verify system performance.

5. Record test data for report.

END OF SECTION