PROFESSIONAL ENGINEERING SERVICES

WWA PROJECT NO. 221028.00

PROJECT MANUAL

WASTEWATER TREATMENT PLANT IMPROVEMENTS

TOWN OF CULPEPER, VIRGINIA

COMMONWEALTH OF VIRGINIA
JASON A. CLARK
Lic. No. 33605
4/29/2022
PROFESSIONAL ENGINEER

BID SET

April 29, 2022

COMMONWEALTH OF VIRGINIA
HERBERT F. WHITE III
Lic. No. 12257
4-29-22
PROFESSIONAL ENGINEER

Prepared by:

968 Olympia Drive, Suite 1
Charlottesville, VA 22911
Phone: 434-984-2700

WW ASSOCIATES
ENGINEERS SURVEYORS PLANNERS
www.wwassociates.net

PO Box 4119
Lynchburg, VA 24502
Phone: 434-316-6080

Section 01000
Table of Contents

SECTION

Division 1 – General Requirements

Advertisement for Bids 01100

Instructions to Bidders 01200

Bid Form 01300

General Requirements 01400

Supplementary Conditions 01500

Standard Contract Forms 01600

Town of Culpeper – Uniform Guidance Procurement Policy For Use When Spending Federal Money

Town of Culpeper – Uniform Guidance: Conflict of Interest Policy When Spending Federal Funds

Division 2 – Site Work

Demolition 02050

Earthwork 02200

Paving and Surfacing 02500

Wastewater Piping System 02730

Pipe Supports and Anchors 02735

Seeding 02936

Division 3 – Concrete

Cast-in-Place Concrete 03300

Division 4 (Not Used)

Division 5 – Metals

Structural Steel Framing 05120

Metal Fabrications 05500

Pipe Guard Railing 05521

Aluminum Gratings 05530

Division 6 (Not Used)

Division 7 – Thermal and Moisture Protection

EPDM Single Ply Membrane Roofing 07531

Roof Accessories 07720

Division 8 – Doors and Windows

Commercial Hollow Metal Doors and Frames 08110
Finish Hardware 08710

Division 9 – Finishes

Painting 09900

Division 10 (Not Used)

Division 11 – Equipment

Sluice Gates and Weir Type Slide Gates 11290
Wastewater Pumping Equipment 11300
Sludge Pumping Equipment 11301
Self-Cleaning Mechanical Filter Screen 11310
Electric Motor Valve Actuators 11315
Septage Receiving Station Equipment 11320
Aerobic Digester Equipment 11330
Centrifuge Sludge Dewatering Equipment (Owner Furnished) 11350
Chemical Piping and Appurtenances 11430
Pipe Supports and Anchors for Chemical Piping 11450

Division 12 – Furnishings (Not Used)

Division 13 – Special Construction

Precast Concrete Building Systems 13100
Flow, Level, and Pressure Instruments 13300
Basic Instrumentation and Control Systems Requirements 13700
Data Submittals 13701
Installation Drawings 13702
Installation and Startup 13703
Training 13704
Maintenance 13705
Sequence of Operations 13709

Division 14 -25 (Not Used)

Division 26 – Electrical

Common Work Results for Electrical 260500
Grounding and Bonding for Electrical Systems 260526
Hangers and Supports for Electrical Systems 260529
Raceways and Boxes for Electrical Systems 260533
Underground Ducts and Raceways for Electrical Systems 260543
Power System Analysis 260575
Lighting Control Devices 260923
Low-Voltage Transformers 262200
Panelboards 262416
Motor-Control Centers 262419
Wiring Devices 262726
Enclosed Switches and Circuit Breakers 262816
Motor Starters 262920
Packaged Engine Generator 263213
Transfer Switches 263600
Surge Protection Devices 264313
Variable Frequency Drives 264820
Lighting 265000
Lighting Poles and Standards 265613
LED Exterior Lighting 265619

Appendix

Alfa Laval Centrifuge Specification ..... A
Alfa Laval Centrifuge Equipment Proposal, dated July 12, 2021 ..... B

End of Table of Contents

Section 01100
Advertisement for Bids

Re: Wastewater Treatment Plant Improvements
Town of Culpeper, Virginia

Sealed bids on the referenced project will be received by the Director of Public Services at the Public Works Building, 15038 Service Lane, Culpeper, VA 22701 until 2:00 P.M., local prevailing time, Thursday, July 14, 2022, and then publicly opened.

Bids may be withdrawn using the procedure set forth in Virginia Code § 2.2-4330(B)(2).

The project will consist of construction of the following work:

- Conversion of two existing 0.42-MG anaerobic digesters to aerobic digesters
- Conversion of two existing 0.308-MG secondary clarifiers to aerobic digesters
- Electrical and mechanical equipment improvements for existing Digester Control Building
- Demolition of RAS Pump Station No. 1 Building
- Demolition of existing digester gas collection system and associated boilers
- New septage receiving station and holding tank
- New influent parshall flume
- New mechanical screens and screening compactors in the headworks facility
- New primary clarifier splitter box
- Demolition of existing centrifuge and installation of new Owner-furnished centrifuge, polymer feed systems, and centrifuge control panel
- New digester primary sludge feed pumps
- New septage pumps
- New centrifuge feed pumps
- Drain pump station improvements
- Roof replacement for Building Nos. 12 and 13
- Electrical improvements
- Modifications to existing SCADA system
- Associated site improvements and related incidental work

The Town will award the contract on a lump sum base bid.

Bid documents consisting of project manual and drawings are open to the public for inspection at the following locations:

- Owner: Town of Culpeper, Public Works Building, 15038 Service Lane, Culpeper, VA 22701
- Engineer: WW Associates, Inc., 968 Olympia Drive, Suite 1, Charlottesville, VA 22911; Telephone: 434-984-2700

- WW Associates, Inc., 110 Vista Centre Drive, Suite 1, Forest, VA 24551; Telephone: 434-316-6080
- Valley Construction News, 426 West Campbell Avenue, Roanoke, VA 24016
- Dodge Construction Network, www.construction.com, 877-784-9556
- eVA – Virginia's eProcurement Marketplace, https://eva.virginia.gov/

A pre-bid conference will be held at 10:00 A.M. on Wednesday, June 15, 2022 at the Public Works Building, 15038 Service Lane, Culpeper, VA 22701.

Bid documents in PDF format may be obtained from WW Associates, Inc. at no charge. Bidder must include contact person, email address to receive bid documents, business address and telephone number.

Bid Security: Bids shall be accompanied by a certified check or an acceptable bid bond in the amount of 5 percent of the base bid.

Bidders must be licensed as Contractors in the Commonwealth of Virginia in accordance with Title 54.1, Chapter 11 of the Code of Virginia (1950) as amended.

The Owner reserves the right to reject any Bid for failure to comply with all requirements of this Notice or any of the Contract Documents; however, it may waive any minor defects or informalities at its sole and unfettered discretion. The Owner further reserves the right to reject any and all Bids or to Award the contract which in its judgment is in the best interest of the Owner.

End of Advertisement

Section 01200
Instructions to Bidders

1 General: To be valid for consideration, bids must be completed and submitted in accordance with these instructions to bidders.

1.1 The Contractor is advised to refer to Section 01600 – Standard Contract Forms for contract documents required for this project.

1.2 A pre-bid conference will be held at 10:00 A.M. on Wednesday, June 15, 2022 at the Public Works Building, 15038 Service Lane, Culpeper, VA 22701.

1.3 All procurement activities involving the expenditure of Federal funds must be conducted in compliance with the Procurement Standards codified in 2 C.F.R. § 200.317 through § 200-326 unless otherwise directed in writing by the Federal agency or state pass-through agency that awarded the funds. The Town of Culpeper will follow all applicable local, state, and Federal procurement requirements when expending Federal funds. Should the Town of Culpeper have more stringent requirements, the most restrictive requirement shall apply so long as it is consistent with state and Federal law.

2 Qualification of Bidders

2.1 Contractor Qualifications: The prime Contractor for this project shall represent at least 5 years of experience working in at least five (5) municipal wastewater treatment plants of similar design, to the satisfaction of the Engineer, to be considered qualified to construct this project. The Contractor shall submit, with the bid, a list of similar installations with references, to be considered a qualified bidder.

2.2 Each bidder must be prepared to submit within 5 calendar days of the Owner's request written evidence of his qualifications for the project, including financial data, previous experience, and evidence of authority to conduct business in the jurisdiction where the project is located.

3 Examination of Bid Documents and Site

3.1 Before submitting bids, each bidder must examine bid documents thoroughly; familiarize himself with federal, state and local laws, ordinances, rules, and regulations affecting the work; and correlate his observations with the requirements of the bid documents.

3.2 Bidders are requested and expected to visit the site of the project to alert themselves to local and special conditions, which may be encountered during construction of the project. Failure to make such investigations shall not relieve the successful bidder from performing and completing the work in accordance with the contract documents.

4 Interpretations

4.1 **All questions concerning this project shall be directed to WW Associates, Inc. E-Mail: hwhite@wwassociates.net. Herbert F. White III, P.E. is the point of contact.** No oral interpretations of the bid documents will be made to any bidder. To be given consideration, requests for interpretations must be received in time to allow preparation of written response at least 5 days prior for receipt of bids. Interpretations will be written in the form of written addenda to the bid documents and mailed to all parties recorded by WW Associates as having received bid documents, prior to scheduled receipt of bids. Only interpretations by formal written addenda will be binding.

5 Bid Submission

5.1 Submit one copy of the bid using forms furnished by WW Associates, Inc. and fill in all blank spaces on the form. Repeat notation "Contractor's Current Virginia License No. _____" on outside of inner envelope containing bid and bid security, and place this envelope within another envelope addressed to:

5.1.1 Mr. James E. Hoy, III, P.E.
Director of Public Services
Town of Culpeper
Public Works Building
15038 Service Lane
Culpeper, Virginia 22701

5.2 The inner envelope shall have noted thereon:

5.2.1 "Bid for Construction of Wastewater Treatment Plant Improvements, Town of Culpeper, Virginia."

5.3 Bid security, bidding documents, receipt deadline for bids, and pre-bid conferences shall be as specified herein.

5.3.1 No bidder shall withdraw, modify, or cancel any part of his bid for 90 days following bid opening.

5.4 Modifications and withdrawal of bids: Bids may be modified or withdrawn by appropriate document duly executed (in the manner that a bid must be executed) and delivered to the place where the bids are to be submitted at any time prior to the receipt of bids.

5.5 Withdrawal of bids after date for submission: In accordance with the procedure set forth in Virginia Code §2.2-4330B.2, the bidder will have 2 business days after the opening of bids within which to claim in writing any mistake as defined in said section and withdraw his bid, provided such mistake be proved from the Contractor's work papers. Failure to submit Contractor's work papers will be considered as a waiver of any right of withdrawal of bids after the date for submission.

5.6 Bid documents in Adobe Acrobat (PDF) format may be obtained from WW Associates, Inc. at no charge. Bidder must include contact person, email address to receive bid documents, business address and telephone number.

5.7 Bid Security: Bids shall be accompanied by a certified check or an acceptable bid bond in the amount of 5 percent of the base bid.

5.8 All Base, Additive, and Deductive Bid Items must be completed in their entirety; failure by the Contractor to fully complete the bid form will be considered a non-responsive bid.

5.9 The Contractor is advised to refer to the Line and Grades paragraph in Section 01400 – General Requirements for bidding instructions on construction stakeout services.

6 Agreement, insurance certificate, and bonds shall be drawn on forms identical to those bound within this project manual.

6.1 Bonds shall be with a surety company acceptable to the Owner.

6.2 A Performance Bond and a Payment Bond will be required in the amount of 100 percent of the bid.

7 Award of Contract

7.1 The award of the contract will be as specified in Section 01300 – Bid Form.

7.2 Should the responsive bid from the lowest responsible bidder exceed available funds, the Owner may negotiate with the lowest responsible bidder in accordance with Section 2.2-4318 of the Virginia Public Procurement Act to obtain a contract price within available funds.

7.3 The Owner reserves the right to reject any and all bids and waive any and all informalities and the right to disregard all nonconforming or conditional bids or counterproposals.

7.4 Submission of post-bid information shall be in accordance with the contract documents.

End of Section

Contractor _____ Date _____

VA License No. _____

Section 01300
Bid Form

Gentlemen:

The undersigned, having visited and examined the site and having carefully studied the drawings and project manual for the Wastewater Treatment Plant Improvements, Town of Culpeper, Virginia, hereby proposes to furnish all plant, labor, equipment, materials, and services and to perform all operations necessary to execute and complete the work required for the project, in strict accordance with the drawings and technical specifications prepared by WW Associates, Inc., Engineers • Surveyors • Planners, dated April 29, 2022 together with addenda numbered ____, issued during bidding period and hereby acknowledged, subject to the terms and conditions of the agreement as follows:

Base Bid No. 1: is defined as all work associated with this project excluding Base Bid No. 2 and Additive Bid Item No. 1, for the sum of:

_____Dollars

($_____).

Base Bid No. 2: is defined as all work associated with Aerobic Digester No's 1, 2, 3, and 4, including but not limited to the digestors, blowers, piping, demolition work, and electrical power and controls, and work in the Sludge Thickening Building (No. 9), for the sum of:

_____Dollars

($_____).

Total Base Bid (Base Bid No. 1 and Base Bid No. 2):

_____Dollars

($_____).

Additive Bid Item No. 1: The additional price for all work associated with roofing replacement for Building Nos. 12 and 13:

_____Dollars

($_____).

Deductive Bid Item No. 1: The deductive price for reusing the existing Honey Monster Septage Equipment in lieu of new Honey Monster Septage Equipment as specified in Section 11320 Septage Receiving Station Equipment:

_____Dollars

($_____).

Notes:

a) The basis of award for determining the low bidder shall be the Total Base Bid.

b) The Total Base Bid is founded upon furnishing equipment and materials of specified manufacturers or approved equals.

c) The Owner reserves the right to accept any Base Bid item, additive and deductive Bid Items in any combination.

d) Base Bid Item No. 2 includes the Motor Control Center work in Building 11 (Gas Recovery Building), Digester 1 and 2 standby generator, electrical work in the existing BNR Blower Building with associated ductwork to Digesters 3 and 4.

e) Base Bid Item No. 1 includes providing electrical power for the new centrifuge, from the existing motor control center in Building No. 12, as well as septage pumps, primary pumps and centrifuge feed pumps.

f) Base Bid Item No. 2: deduct electrical power work to existing motor control center in Building No. 12 and add electrical power from Building No. 11.

g) New sludge (primary and TWAS) pumps will pump to anaerobic digesters (primary and secondary) for Base Bid Item No. 1.

h) For Deductive Bid Item No. 1, perform all site improvements shown on plans as part of the Base Bid, including but not limited to, temporary septage services, demolition of primary sludge thickeners, new septage tank, concrete pads, relocation of septage equipment and related work.

It is understood and agreed that the Owner, in protecting his best interest, reserves the right to:

a) Reject any or all bids.

We are properly equipped to execute work as defined in the contract documents and so covered by this bid and will enter into agreement for the execution and completion of the work in accordance with the drawings, project manual, and this bid. We further agree that if awarded the contract, we will commence the work on the date stated in the "Notice to Contractor to Proceed," and will prosecute the work and shall be substantially complete as defined in the general conditions within 720 calendar days and complete all obligations within 750 calendar days.

The Owner and Contractor recognize that time is of the essence with this agreement and that the Owner will suffer financial loss if the work is not completed within 720 calendar days for all work associated with this project. They also recognize the delays, expense, and difficulties involved in proving the actual loss suffered by the Owner if the work is not completed on time. Accordingly, instead of requiring any such proof, the Owner and Contractor therefore agree that, as liquidated damages for delay (but not as a penalty), the Contractor shall pay the Owner one thousand five hundred dollars ($1,500.00) for each day that expires after the time specified for substantial completion of this project.

Enclosed herewith is the following security, offered as evidence that the undersigned will enter into agreement for the execution and completion of the work in accordance with the drawings and project manual:

Certified check for the sum of_____

Name of bank_____

Contractor _____ Date _____

VA License No. _____

Bidder's bond in amount of_____

Bond issued by_____

The undersigned further agrees that in case of failure on his part to execute the said agreement within 10 consecutive calendar days after written notice being given on the award of the contract, the monies payable by the securities accompanying this bid shall be paid to the Town of Culpeper as liquidated damages for such failure; otherwise, the securities accompanying this bid shall be returned to the undersigned.

The Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, coercive practices or otherwise taken any action in the restraint of free and competitive bidding.

This bid is subject to acceptance within a period of 90 days from bid submission date.

SUBMITTED on _____, 20_____.

Contractor's Current Virginia Contractor License No. _____.

If Bidder is:

An Individual

Name (typed or printed): _____

By: _____(SEAL)

(Individual's Signature)

Doing business as:_____

Business Address: _____

_____

Phone No.: _____ Fax No.: _____

A Partnership

Partnership Name: _____(SEAL)

By: _____

(Signature of general partner -- attach evidence of authority to sign)

Name (typed or printed): _____

Business Address: _____

_____

Phone No.: _____ Fax No.: _____

A Corporation

Corporation Name: _____(SEAL)

State of Incorporation: _____

Type (General Business, Professional Service, Limited Liability): _____

Contractor _____ Date _____

VA License No. _____

By: _____

(Signature -- attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____ *(CORPORATE SEAL)*

Attest _____

(Signature of Corporate Secretary)

Business Address: _____

_____

Phone No.: _____ Fax No.: _____

A Joint Venture

Joint Venturer Name: _____(SEAL)

By: _____

(Signature of joint venture partner -- attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

Business Address: _____

_____

Phone No.: _____ Fax No.: _____

Joint Venturer Name: _____(SEAL)

By: _____

(Signature -- attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

Business Address: _____

_____

Phone No.: _____ Fax No.: _____

Phone and Fax Number, and Address for receipt of official communications:

_____

_____

(Each joint venture must sign. The manner of signing for each individual, partnership, and corporation that is a party to the joint venture should be in the manner indicated above.)

Section 01400
General Requirements

1 General

1.1 Summary of Work

1.1.1 The work covered under this contract comprises the furnishing of all labor, materials, equipment, tools and services and the installation and construction of all items, and the performance of all work necessary to complete the work shown or called for on the drawings and/or this project manual.

1.1.2 All units under this Contract shall be operable, shall be installed as designed, and shall conform to the manufacturer's specifications for the particular application.

1.1.3 Owner Furnished Equipment

1.1.3.1 The equipment specified in Section 11350 – Centrifuge Sludge Dewatering Equipment (Owner Furnished) and Appendix A of this project manual has been previously purchased by the Owner, and will be furnished to the Contractor for installation in the Sludge Processing Building at the Town's WWTP as shown on the Contract Drawings.

1.1.3.2 The Contractor shall provide all hoisting equipment, lift trucks, rigging materials, operating and travel permits, personnel, etc. necessary to load, transport, unload, examine, assemble, erect, or place at the site all equipment and materials. Insure that all hoisting and rigging is performed by qualified full-time professionals. Do not use any building structure for the rigging and hoisting equipment. Any damages to elements during transportation, installation, and storage shall be repaired by the Contractor at no additional cost to the Owner.

1.1.3.3 The Contractor shall unload, store, assemble, and install all Owner furnished equipment. The Contractor shall furnish and install all piping, controls, supports, foundations, anchor bolts, equipment, structural systems, and appurtenances required to install and render usably complete the Owner furnished equipment in accordance with the recommendations of the equipment manufacturer/supplier, and these contract documents, at no additional cost to the Owner. The installation of the equipment shall be in accordance with the contract drawings in the space provided. Equipment startup and training services shall be provided by Alfa Laval as specified in the technical sections.

1.1.3.4 All other equipment required by the Contract Drawings shall be furnished and installed by the Contractor, unless otherwise noted.

1.2 Contractor Use of Premises

1.2.1 The Contractor shall assume full responsibility for protection and safekeeping of products stored on or off premises.

1.2.2 The Contractor shall coordinate use of premises with the Owner and Engineer, and remove stored products that interfere with the operations of the Owner or other contractors.

1.2.3 The Contractor shall obtain and pay for all additional storage or work areas needed for operations under this Contract. These areas shall be subject to the same conditions as described for the Owner's property.

1.3 Construction and Scheduling Sequence

1.3.1 The wastewater treatment plant shall remain in full operation during the construction period. Phases of the construction which involve the temporary interruption of essential services and demolition of existing items shall be scheduled in consultation with the Owner or their representatives, shall not be of longer duration than essential to accomplish the purpose for such interruptions, and shall be coordinated to give the Owner the ability to maintain water service. Liaison with the Owner in these matters is a salient feature of this contract.

1.3.2 Construct aerobic digesters 3 and 4 and render these digesters usably complete prior to demotion of the existing anaerobic digesters. Continuous sludge processing, without outage, during construction is a salient feature of this contract.

1.3.3 Demolish one influent screen and install a new influent screen usably complete before demolition of the second mechanical screen. Continuous screening, without outage, is a salient feature of this contract. Installation of screens shall be complete and operational prior to start up of new aerobic digesters.

1.3.4 Contractor shall provide temporary pumping and associated piping to perform final connections for the plant flow piping at the headworks facility. Provide a minimum of 12 MGD of temporary pumps for this final connection. Submit a temporary pumping plan for this work.

1.3.5 Contractor shall provide temporary pumping and piping for the drain pump station for making final connections, as well as the replacement of the drain pump station force main. Construct the new drain pump station force main and have it usably complete prior to final connections. Provide a minimum of 750 gpm of temporary pumping and piping for this operation. Submit a temporary pumping plan for this work. Continuous drain pump station pumping, without outage, during construction is a salient feature of this contract.

1.3.6 Contractor shall maintain continuous electrical power supply for all WWTP operations during construction. Construct the new electrical power supply in the new blower building before demolition of the electrical power supplies in Building No. 12. Discrete outages shall be from 12:00 noon to 2 pm for power transfer. Provide temporary power generation as needed to maintain continuous electrical power supply.

1.3.7 Contractor shall maintain continuous sludge dewatering operations during construction. A discrete outage of 36 hours will be allowed for relocation of the existing centrifuge control panel. This outage will start at 6 am. Night time work will be required. Maintain full operational status of the existing centrifuge until the new centrifuge and associated polymer systems are usably complete for operation.

1.3.8 Contractor shall maintain continuous primary sludge service from the primary clarifiers, through the primary sludge pumps, to the anaerobic digesters and aerobic digesters. Provide temporary pumping and piping to facilitate continuous service. Close V117 and V119 (Sheet C24) to facilitate final connections at the primary clarifiers.

1.3.9 The septage receiving facilities shall remain in service during the entire construction period. Once aerobic digesters 3 and 4 are operational, temporarily relocate the existing septage receiving facility, including electrical power supply, to allow for discharge to digesters 3 and 4 prior to other demolition work in the vicinity of the existing septage receiving facility. Once the new septage is installed and operational, demolish the temporary septage receiving facility (Base Bid) including temporary piping, and electrical power supply. Relocate existing septage receiving facility (Deductive Bid Item No. 1). Coordinate location of temporary facility with the Owner.

1.4 Work Restrictions

1.4.1 Occupancy: If the Owner elects to operate any of the water line improvements under partial utilization, prior to the project's final acceptance, neither WW Associates nor the Contractor shall be held responsible for the safety or well being of those occupants beyond the normal care and practice of the construction industry.

1.4.2 Normal working hours for the Contractor shall be 7:00 A.M. to 7:00 P.M., Monday through Friday, excluding state and federal holidays, unless otherwise approved by the Owner and WW Associates.

1.5 Contract Modification Procedures

1.5.1 Change Orders: No amount, in part or in whole, of a change order shall be included in a requisition for payment by the Contractor until the change order has been executed and copies of the change order have been distributed to the Owner and Contractor.

1.5.2 Work Orders: A work order is a device which enables the Owner to promptly order changes in the work which may involve changes in cost or contract time, or both pending preparation and execution of a formal change order.

1.5.3 Request for Change Order Proposal: The Owner may request the Contractor to submit a change order proposal for changes in contract work. The Contractor shall submit the proposal in accordance with contract requirements within 3 days of a request by the Engineer or Owner. The Owner may issue to the Contractor a work order authorizing the required changes for an additional amount not to exceed, or a deduction of not less than the amount shown in the work order. If the Contractor is not in agreement with the amount stipulated in the work order, he shall, within a reasonable time after the issue date of the order, submit to WW Associates an equitable proposal and develop with the Owner a mutually acceptable price for the required change in work.

1.5.4 The Contractor may initiate changes by submitting a written notice to the Engineer containing:

1.5.4.1 Description of the proposed changes.

1.5.4.2 Statement of the reason for making the changes.

1.5.4.3 Statement of the effect on the Contract Sum and the Contract Time.

1.5.4.4 Statement of the effect on the Work of separate Contractors.

1.5.4.5 Documentation supporting any change in Contract Sum or Contract Time, as appropriate.

1.6 Payment Procedures

1.6.1 Applications and Certificates for Payment: The form of each application for payment shall be EJCDC Document C-620 entitled, "Application and Certificate for Payment" accompanied by "Continuation Sheet," and "Stored Material Summary." Each application for payment by the Contractor, excluding the first, shall be accompanied by a "Contractor's Affidavit of Payment of Debts and Claims," AIA Document G706, and "Contractor's Affidavit of Release of Liens," AIA Document G706A. Each application shall be submitted on forms, copies of which are included in this project manual. Payment for stored material delivered but not incorporated in the work will be the invoiced amount only. Submit invoices with application for payment.

1.6.2 Upon recommendation by WW Associates of the Contractor's request for partial payment, the Owner shall pay to the Contractor 95 percent of the total amount due and the Owner shall retain 5 percent of the amount due until final completion and acceptance of all work covered by the contract.

1.6.3 Schedule of Values: Submit complete schedule of values at least 10 days prior to first application for payment.

1.7 Project Meetings

1.7.1 Preconstruction conferences with the Contractor will be held after the effective date of the agreement.

1.7.2 Progress Meetings: Each month, the Contractor, Engineer, and the Owner shall hold a progress meeting to review progress to date and to resolve all questions for the upcoming month.

1.8 Progress Schedules: Submit a detailed construction schedule prior to the preconstruction conference. Revise the schedule prior to each progress meeting. Construction schedule shall be in a form that will clearly show the proposed degree of completeness of each aspect of the construction throughout the life of the contract. Bar graphs and/or PERT diagrams are acceptable forms.

1.9 Submittal Procedures

1.9.1 Shop Drawings, Product Data, and Samples: Prior to the preconstruction conference, prepare a submittal schedule satisfactory to WW Associates fixing the dates for submission of shop drawings, product data, samples, and the like and update this schedule at each progress meeting to reflect the status of each submittal item.

1.9.1.1 Submit an electronic copy of all shop drawings in Adobe Acrobat PDF format.

1.9.1.2 A PDF electronic file of reviewed shop drawings will be returned to the Contractor.

1.9.1.3 Submit shop drawings, product data, samples, and the like as required by applicable specification sections.

1.9.1.4 Identify each item submitted using applicable specification section number and paragraph reference or drawing reference.

1.9.1.5 Shop drawings shall be approved by the Contractor and those subcontractors whose work is associated with the subject equipment as being in accordance with the contract documents prior to submission.

1.9.1.6 Failure to comply with these requirements will result in the submittal being returned unprocessed.

1.9.2 The Engineer’s approval of Contractor’s shop drawings will be general and shall not relieve the Contractor from the responsibility for adherence to the Contract, nor shall it relieve him of the responsibility for any errors that may

exist. Where such errors or omissions are discovered later, they shall be made good by the Contractor, irrespective of any approval by the Engineer.

1.9.3 Equipment/Material Shop Drawings for any piece of equipment or item will be reviewed a maximum of one time by the Engineer. Subsequent reviews will be paid for by the General Contractor to the Engineer at the rate of $165.00 per hour and paid to the Engineer by an Owner deduct from the Contractor's monthly pay request. Contractors are cautioned to select equipment that meets the requirements specified in the contract documents and to require their suppliers to provide detailed and accurate information in their submittal packages which can readily be approved.

1.10 Quality Control

1.10.1 Testing Laboratory Services: The Contractor will employ and pay for the services of an independent testing laboratory to perform testing specified to be done by an independent testing laboratory, unless specifically stated otherwise in other sections of the specifications. Employment of the laboratory shall in no way relieve the Contractor's obligations to perform the work of the contract.

1.11 Temporary Utilities

1.11.1 Temporary Electricity: The Contractor shall make all necessary arrangements for obtaining temporary electric power for construction purposes. No separate payment for electric power for construction purposes or testing other than the payment included in the contract lump sum or unit prices will be allowed.

1.11.2 Temporary Water: The Contractor may use the Town's potable water during construction free of charge. The Contractor must provide an appropriate air gap to prevent cross contamination in the Town's water system. Coordinate and schedule potable water usage with Town personnel prior to construction activities.

1.11.3 Temporary Sanitary Facilities: The Contractor shall provide and maintain in a neat and sanitary condition such accommodations for the use of his employees as will comply with laws and regulations.

1.12 Temporary Controls

1.12.1 Construction Cleaning: The Contractor shall clean daily all areas under construction to ensure minimum interference with roads, streets, sidewalks, and access of adjacent property owners.

1.12.2 Erosion and Sediment Control: These controls shall be in coordination with the appropriate drawings and any requirements of the local authority.

1.12.3 Dust Control: Contractor shall ensure that dust is held to a minimum throughout the length of the project through the application of moisture where applicable.

1.13 Vehicular Access and Parking

1.13.1 Parking and Laydown Areas: The location of Contractor parking and laydown areas shall be as agreed upon by the Owner and the Engineer. Provide gravel in the laydown area and comply with the latest edition of the Virginia Erosion and Sediment Control Handbook.

1.14 E-Mail Address: The Contractor shall provide an e-mail address to allow the Owner and the Engineer to correspond with the Contractor's project manager during the construction period.

1.15 Product Requirements

1.15.1 Quality of Material and Equipment Incorporated into the Work:

1.15.1.1 Design, fabricate and assemble in accordance with the best engineering and shop practices.

1.15.1.2 Manufacture like parts of duplicate units to standard sizes and gauges, to be interchangeable.

1.15.1.3 Two or more items of the same kind shall be identical, by the same manufacturer.

1.15.1.4 Products shall be suitable for services conditions.

1.15.1.5 Equipment capacities, sizes, and dimensions shown or specified shall be adhered to unless variations are specifically approved in writing.

1.15.2 Except as specifically indicated or specified, materials and equipment removed from the existing structure shall not be used in the completed work.

1.15.3 For material and equipment specifically indicated or specified to be reused in the work:

1.15.3.1 Use special care in removal, handling, storage, and reinstallation to assure proper function in the completed work.

1.15.3.2 Arrange for transportation, storage, and handling of products, which require off-site storage, restoration, or renovation. Pay all costs for such work.

1.15.4 Manufacturer's Instructions

1.15.4.1 When contract documents require that installation of work shall comply with manufacturer's printed instructions, obtain and distribute copies of such instructions to parties involved in the installation, including two copies to WW Associates.

1.15.4.2 Maintain one set of complete instructions at the job site during installation and until completion.

1.15.4.3 Handle, install, connect, clean, condition, and adjust products in accordance with such instructions and in conformity with specified requirements.

1.15.5 Transportation and Handling of Materials

1.15.5.1 Arrange deliveries of products in accordance with construction schedules. Coordinate to avoid conflict with work and conditions at the site.

1.15.5.2 Deliver products in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible.

1.15.5.3 Immediately on delivery, inspect shipments to assure compliance with requirements of contract documents and approved submittals, and that products are properly protected and undamaged.

1.15.6 Storage and Protection

1.15.6.1 Store products in accordance with manufacturer's instructions, with seals and labels intact and legible.

1.15.6.2 Store products subject to damage by the elements in weathertight enclosures.

1.15.6.3 Maintain temperature and humidity within the ranges required by manufacturer's instructions.

1.15.6.4 Exterior Storage

1.15.6.4.1 Store fabricated products above the ground, on blocking or skids; prevent soiling or staining; cover products, which are subject to deterioration with impervious sheet coverings; and provide adequate ventilation to avoid condensation.

1.15.6.4.2 Store loose granular materials in a well-drained area on solid surfaces to prevent mixing with foreign matter.

1.15.6.4.3 Protection after Installation: Provide substantial coverings as necessary to protect installed products from damage from traffic and subsequent construction operations. Remove when no longer needed.

1.16 Lines and Grades

1.1.1 The Contractor shall include $13,500.00 in the Total Base Bid to be provided as payment for the initial construction stakeout provided by WW Associates, Inc. Certified Land Surveyor. Should the Contractor disturb the initial stakeout, restaking will be provided on an hourly rate to the Contractor by WW Associates, Inc. Stakeout fees are not subject to retainage. Stakeout will include the location and elevation data to construct structures, pavements, piping, and other improvements associated with this project. Stakeout services for the project will be as follows:

- Stake piping
- Stake new structures
- Stake new building

1.17 Starting of Systems

1.17.1 The Contractor shall initially start up and place all equipment installed by the Contractor into successful operation according to manufacturers' written instructions and as instructed by manufacturers' representatives.

1.17.2 Provide all materials, labor, tools, equipment and expendables required.

1.17.3 Coordinate schedule for start-up of various equipment and systems. Notify the Engineer at least seven days prior to start-up of each item. The Owner's operator and the Engineer will be present during start-up.

1.17.4 When required in individual Specification Sections, the manufacturer shall provide an authorized representative to be present at the site to inspect, check, and approve equipment or system installation, and to supervise placing equipment or system into operation.

1.17.5 Submit a written report that each equipment item or system has been properly installed and is functioning correctly.

1.17.6 General activities include the following:

1.17.6.1 Cleaning.

1.17.6.2 Removing temporary protective coverings.

1.17.6.3 Flushing and replacing greases and lubricants, where required by manufacturer.

1.17.6.4 Lubrication.

1.17.6.5 Check shaft and coupling alignments and reset where needed.

1.17.6.6 Check and set motor, pump and other equipment, rotation, safety interlocks, and belt tensions.

1.17.6.7 Check and correct, if necessary, leveling plates, grout, bearing plates, anchor bolts, fasteners, and alignment of piping which may put stress on equipment connected to it.

1.17.6.8 Test all equipment and systems at normal operating conditions and through the normal operating range.

1.17.6.9 Make all adjustments and balances required.

1.17.7 Minimum Start-Up Procedures

1.17.7.1 Motors: Measure amperage of each motor and compare to nameplate value. Correct conditions which produce excessive current flow, and which exist due to equipment malfunction.

1.17.7.2 Pumps: Check glands and seals for cleanliness and adjustment before operating pump. Inspect shaft sleeves for scoring. Inspect mechanical faces, chambers, and seal rings, and replace, if defective. Verify that piping system is free of debris before circulating liquid through pump. Pump startup shall be performed in accordance with the manufacturer's written recommendations under the supervision of the manufacturer's representatives, and as specified in the technical specifications of this document.

1.17.7.3 Valves: Inspect all valves, clean bonnets and stems. Inspect packing glands to assure no leakage, and tighten or replace as necessary. Verify that control valve seats are free from foreign material and are properly positioned for service.

1.17.7.4 Pipe Joints: Inspect all joints for leakage, and tighten, remake, or replace as necessary.

1.17.7.5 Pipe Supports: Inspect all piping supports to assure adequate restraint to prevent displacement, vibration, or failure of piping and fittings, while allowing for expansion and contraction. Modify and adjust as necessary.

1.17.7.6 Electrical Circuits: Check each electrical control circuit to assure operation complies with specifications and requirements to provide desired performance.

1.17.7.7 Instruments: Test, adjust, and calibrate as required.

1.18 Demonstration and Instructions

1.18.1 Prior to final inspection, demonstrate operation of each system to the Engineer and the Owner.

1.18.2 Instruct the Owner's personnel in operation, adjustment, and maintenance of equipment and systems, using the operation and maintenance manuals as a basis for instruction. Review the contents of all manuals with the Owner's personnel in detail to explain all aspects of operation and maintenance.

1.19 Acceptance for Operation

1.19.1 As soon as the unit, equipment, or system has been properly prepared for operation and it is necessary to be placed into service, bring it on-line; then make an on-line performance test by operating it under approximately normal conditions for a period of 5 consecutive days to demonstrate that all materials and components are in proper working order and free from defects. During this time, the Owner will receive specified instruction on the unit or system by qualified personnel, and be furnished all appropriate operation and maintenance manuals. In event of failure to demonstrate successful performance on the first or any subsequent attempt, make all alternations, adjustments, repairs, and replacements that may be needed; and, if it becomes necessary to shut down the unit or system, or any portion thereof before the on-line test is satisfactorily completed, provide all appropriate measures to resume operations without the unit or system. When the unit or system is again ready for operation, bring it on-line and start a new on-line test. This procedure shall be repeated as often as necessary until the unit or system shall have operated continuously to the satisfaction of the Owner, for a test period duration of 5 consecutive days. The Owner will furnish all operating personnel (other than vendor's or subcontractor's service engineers) needed to operate equipment during the on-line test period; however, said personnel will perform their duties under the Contractor's direction and supervision. Until performance tests are completed and units and systems are accepted by the Owner for operation, the Contractor shall be fully responsible for supervising their operation.

1.19.2 When the on-line test has been completed, the Owner will notify the Contractor to this effect in writing and will then take over the unit or system for purpose of operation. Neither this notice nor the act of taking over any item for operation shall relieve the Contractor from his obligations to complete the facility or perform any other obligations or responsibilities, which extend beyond the completion of the on-line tests.

1.19.3 The Contractor shall maintain full responsibility for the maintenance of all units and systems placed on-line until they have been determined substantially complete. No warranties shall begin prior to the date of substantial completion.

1.19.4 Acceptance Requirements: All equipment shall pass the specified performance testing prior to substantial completion certifications. Partial acceptance of equipment will not be allowed.

1.20 Cleaning

1.20.1 Periodically clean premises of accumulated construction debris.

1.20.2 Prior to final completion, thoroughly remove from premises any debris remaining from construction activities, and properly dispose. Leave premises in a clean, neat, orderly and safe condition.

1.21 Contract Closeout Procedures

1.21.1 Punch List: Correct All Punch List Items.

1.21.2 Operations and Maintenance Data: Obtain, assemble, and submit to WW Associates three manuals containing comprehensive operating and maintenance instructions and parts lists. Each manual shall be self-contained and include information for efficient servicing of equipment supplied and installed under the contract.

1.21.2.1 Operating instructions shall explain maintenance procedures, methods of checking the systems for safe and normal operation, and recommended procedure for safely stopping and starting the equipment and systems.

1.21.2.2 These requirements shall be fulfilled before any guarantee periods become effective so as to limit the possibility of claims arising from the absence of pertinent information.

1.21.3 Guarantees, Warranties, and Bonds: Submit all required guarantees, warranties and bonds.

1.21.4 Project Record Documents

1.21.4.1 Provide one complete set of drawings and project manual recording all changes to work to indicate actual installation. Changes shall be noted in legible red letters at least ⅛-inch high. These changes shall include, but are not limited to, the following:

1.21.4.1.1 Size, depth or position of foundations.

1.21.4.1.2 Exact location and elevation of all underground utility services.

1.21.4.1.3 Changes in general construction, mechanical, or electrical work above or below ground.

1.21.4.2 These records are a specific contract requirement, and final payment will not be made until these drawings and project manual have been submitted in an acceptable form.

1.21.5 Spare parts and maintenance materials required by these contract documents shall be delivered to the Owner as directed by the Owner.

1.21.6 List of Manufacturers and Suppliers: At the conclusion of the project, the Contractor shall furnish WW Associates with a complete list of subcontractors, manufacturers, and suppliers who participated in the construction or who furnished materials or equipment. The address of each firm shall be included, together with types of materials or work performed.

1.21.7 Affidavit of Payment of Debts and Claims

1.21.8 Affidavit of Release of Liens

End of Section

Section 01500
Supplementary Conditions

1 Supplements

1.1 These supplementary conditions amend or supplement the Standard General Conditions of the Construction Contract, EJCDC Document C-700, 2007 edition, and other provisions of the contract documents to the extent indicated. All provisions that are not so amended or supplemented remain in full force and effect.

2 Definitions

2.1 The terms used in these supplementary conditions that are defined in the Standard General Conditions of the Construction Contract (EJCDC Document C-700, 2007 edition) have the meanings assigned to them in the general conditions.

2.2 The terms "Town" and "Town of Culpeper" refer to the Owner.

3 Preliminary Matters

3.1 Delete Paragraph 2.01 and substitute the following revised Paragraph 2.01 in its place:

"*Conditions Precedent to Formation:*

Before any Contract between the Owner and the Contractor is effective, the following conditions precedent must be satisfied. Satisfaction of these conditions is the responsibility of the Contractor. If, after performance under the Contract, the Owner learns that a condition precedent has not been met, the Owner may, if permitted by law, ratify the Contract by affirmative recorded vote or may disclaim it, in its sole discretion.

1. Insurance: If insurance is required under the Contract, the Contractor must provide proof of insurance in the amounts required by the Contract with an insurance company licensed to do business in the Commonwealth of Virginia.

2. Bonds: If payment and/or performance bonds are required under the Contract, then bonds with surety satisfactory to the attorney for the Owner shall be submitted to the Owner for approval.

3. Permits and Licenses: The Contractor shall obtain all licenses and permits required to perform the Work under the Contract.

4. Payment of Debts: The Contractor must pay all amounts shown as due to the Owner on the Owner's accounts, even if a dispute exists as to the debt's validity or enforceability."

3.2 The Copies of Documents: Modify Article 2.02 as follows: For construction purposes the Contractor will be issued, free of charge, the following documents:

A PDF of the "Issued for Construction" documents.

4 Bonds

4.1 Add the following to Article 5, Paragraph 5.01.

"The Contractor shall secure and provide all bonds, called for in the General Conditions and Instructions to Bidders. All bonds shall be written by sureties or insurance companies licensed to do business in the Commonwealth of Virginia."

5 Insurance: The Contractor shall purchase and maintain the insurance, required by Article 5 of the General Conditions, in at least the following coverage amounts. A sample Certificate of Insurance is included at the end of this Section for use as a template by your agent.

Workers Compensation	Statutory
Employer's Liability-	
Each Accident:	$100,000
Disease, Each Employee:	$100,000
Disease, Policy Limit:	$500,000
General Liability-	
Each Occurrence:	$1,000,000
Personal & Advertising Injury:	$1,000,000
Products Completed Operations Aggregate:	$2,000,000
General Aggregate:	$2,000,000
Excess or Umbrella Liability-	
Each Occurrence:	$2,000,000
General Aggregate:	$2,000,000
Automobile Liability-	
Combined Single Limit	
Each Accident:	$1,000,000
Installation Floater:	Coverage Equal to Value of Materials

5.1 Contractor's workers compensation insurance as required by Federal, State, and Municipal laws for the protection of all Contractors' employees working on or in connection with the project, including broad form all states and voluntary compensation coverages and employers' liability coverage.

5.2 Contractor's general liability insurance shall include the following coverages: premises and operations, explosion, collapse and underground, products completed operations, contractual liability, and personal and advertising injury.

5.3 The Automobile Liability Insurance shall include coverage for owned, non-owned and hired autos.

5.4 All insurance shall be written by insurance companies licensed to do business in the Commonwealth of Virginia.

5.5 The Town of Culpeper and WW Associates, Inc. shall be listed as an additional insured on all policies except workers compensation.

5.6 A waiver of subrogation shall apply in favor of the Town of Culpeper and WW Associates, Inc. on all policies as permitted by law.

5.7 Certificate Holder: Town of Culpeper
400 South Main Street
Culpeper, VA 22701

6 Contractor's Responsibilities

6.1 Labor, Materials, and Equipment: Add the following to Paragraph 6.03

"All material incorporated in the work of this contract shall be free of asbestos and other hazardous materials."

6.2 Delete Subparagraph 6.06(B) and substitute the following revised Subparagraph 6.06(B) in its place:

"Contractor may not subcontract any of the work under this Contract without the prior, written approval of the Town, which will not be unreasonably withheld. The Contractor will, as soon as practicable after award of the Contract, give the Town a written list of each proposed subcontractor and the work to be done by that subcontractor. The Town shall, after reasonable investigation, promptly inform the Contractor if it objects to a particular subcontractor. If the Town objects, the Contractor will not use that subcontractor for any part of the work and will promptly submit in writing for the Town's approval the name of another subcontractor (or propose to use the Contractor's own forces) to perform those portions of the work. The Contractor will not change a subcontractor without giving the Town written notice of the proposed new Subcontractor and receiving the Town's approval after reasonable investigation. If the Town objects, the Contractor will either retain the existing subcontractor or propose a different subcontractor to the Town for approval. It is the Contractor's responsibility to obtain subcontractors whom the Town approves, and no delay due to the Town's objection to a subcontractor will authorize any change in the time required to perform the work. No acceptance by Owner of any such subcontractor, whether initially or as a replacement, shall constitute a waiver of any right of Owner or Engineer to reject defective Work."

6.3 Add new Subparagraph 6.06(H) as follows:

"1. Within seven days after receipt of amounts paid to the Contractor by the Owner for satisfactorily completed performance, the prime contractor agrees to:

a. Pay the subcontractor for the proportionate share of the total payment received from the Owner attributable to the work performed by the subcontractor under that contract; or

b. Notify the Owner and subcontractor, in writing, of his intention to withhold all or a part of the subcontractor's payment with the reason for nonpayment.

2. If the Contractor after having received payment for the Owner fails to pay each subcontractor its proportionate share of the total payment, the Contractor shall be obligated to pay interest to each subcontractor on all amounts that remain unpaid after the seven days following receipt by the Contractor of payment from the Owner. Under no circumstances will the Town pay or reimburse this interest payment.

3. Unless otherwise provided under the terms of this Contract or by statute, interest shall accrue at a rate of one percent per month against the Contractor on any unpaid amounts owed to each subcontractor.

4. The Contractor shall include in each of its subcontracts a provision requiring each subcontractor to include or otherwise be subject to the same payment and interest requirements with respect to each lower-tier subcontractor."

6.4 Delete Subparagraph 6.07(B).

6.5 Laws and Regulations: Add the following to Subparagraph 6.09 D.:

"The Contractor shall be licensed in the Commonwealth of Virginia in accordance with Title 54.1, Chapter 11, Code of Virginia (1950) as Amended."

6.6 Permits

6.6.1 The Contractor shall obtain all required permits for this project at no additional cost to the Owner. The Contractor shall pay any associated fees and post any associated sureties for required permits. Required permits shall include, but not be limited to, the following:

6.6.1.1 Culpeper County Business Registration: Submit a Business Registration Form to the Commissioner of the Revenue. Telephone: (540) 727-3443, Fax: (540) 727-3472, E-Mail: tyowell@culpepercounty.gov.

6.6.1.2 Culpeper County Building Permit: The Contractor shall apply for and obtain the building permit. Comply with all County requirements and provide all required Special Inspections for building construction. Contact the County Building Department

for additional information. Telephone: (540) 727-3405, Fax: (540) 727-3461, E-Mail: kkendall@culpepercounty.gov.

6.6.1.3 Culpeper County Land Disturbance Permit: Contact the County Erosion and Sediment Control Administrator for additional information. Telephone: (540) 727-3404, Fax: (540) 727-3461, E-Mail: ksettle@culpepercounty.gov.

6.7 Taxes: Add the following to Paragraph 6.10:

"This project is an approved pollution control facility and is being certified to the Virginia Department of Taxation for exemption from sales and use taxes according to the Code of Virginia 58.1-3660. The Contractor shall request the applicable Sales and Use Tax Exemption Certificate from the Virginia Department of Taxation through the Northern Regional Office of the Virginia Department of Environmental Quality located in Woodbridge, Virginia."

6.8 OSHA Requirements: The Contractor shall be responsible for all safety at the job site and shall comply with OSHA Regulations for all work associates with this project.

6.9 Delete Subparagraph 6.20(A) and substitute the following revised Subparagraph 6.20(A) in its place:

"1. To the fullest extent permitted by law, the Contractor shall indemnify, defend, and hold harmless the Town and its officers, agents, employees, community representatives, volunteers or others working on behalf of the Town, including the Engineer, from any and all claims, judgments, suits, losses, damages, payments, costs, fines and/or fees levied against the Owner and expenses of every nature and description, including attorney's fees, arising out of, connected or associated with or resulting from the lack of performance or the negligent performance of work as described in this Contract, Contract Documents or any agreement that results from this Contract. Further, if the Contractor subcontracts for work, it will require in its subcontracts that each subcontractor indemnify, defend, and hold harmless the Town and its officers, agents, employees and community representatives, from any and all claims and losses accruing or resulting from the negligent performance of work as described in any agreement that results from this Contract.

2. To the fullest extent permitted by law, the Contractor shall also indemnify, defend, and hold harmless the Town and its officers, agents, employees, community representatives, volunteers or others working on behalf of the Town, including the Engineer, against all costs, including reasonable attorney's fees, arising from liens encumbering the Town's Property filed by subcontractors, sub-subcontractors, material suppliers, and all other persons and entities acting for and under the Contractor, and the Contractor shall immediately discharge or bond such liens off.

3. Virginia is a Dillon Rule state. Unless specifically permitted by statute, indemnification or any attempt to have the Town hold others harmless is invalid and unenforceable as an impermissible waiver of the Town's sovereign immunity which may create potential future debt in violation of Virginia Constitutional and statutory requirements. The Town cannot waive its sovereign immunity. Subparagraph 4.06(g) is hereby deleted."

7 Project Representative

7.1 Add the following to Paragraph 8.01:

"B. The Town Manager will designate a person to serve as the Contract Administrator. The initial Contract Administrator is WW Associates, Inc., but the Town Manager may designate a new Contract Administrator by notice to the Contractor."

7.2 Revise the first sentence in Paragraph 9.03(A) as follows: "As requested by Owner, Engineer or Owner will furnish a Resident Project Representative to assist Engineer in providing more extensive observation of the Work."

In addition, add the following to Paragraph 9.03:

"B. The Resident Project Representative will serve as the Engineer's liaison with the Contractor, working principally through the Contractor's superintendent to assist him in understanding the intent of the Contract Documents.

C. The Resident Project Representative shall conduct on-site observations of the work in progress to confirm that the work is proceeding in accordance with the Contract Documents. He will verify that tests, equipment and systems start-ups and operating and maintenance instructions are conducted as required by the Contract Documents. He will have the authority to disapprove or reject defective work in accordance with Article 13."

7.3. Add the following to Paragraph 9.09:

"F. Except upon written instructions of the Engineer, the Resident Project Representative:

1. Shall not authorize any deviation from the Contract Documents or approve any substitute materials or equipment.

2. Shall not exceed limitations of Engineer's authority as set forth in the Contract Documents.

3. Shall not undertake any of the responsibilities of Contractor, Subcontractors, or Contractor's superintendent, or expedite the Work.

4. Shall not advise on or issue directions related to any aspect of the means, methods, techniques, sequences or procedures of construction unless such is specifically called for in the Contract.

5. Shall not advise on or issue directions as to safety precautions and programs in connection with the Work."

8 Change in Contract Times

8.1 Add new Subparagraph 12.02(C) as follows:

"This Contract may be extended as provided in the Solicitation or by Change Order or amendment. If this is a fixed price contract, however, no extension may increase the price by more than twenty-five percent of the amount of the Contract or $50,000, whichever is greater, without a recorded affirmative vote of the Town Council. The Town may extend the term of this contract for services to allow completion of work undertaken but not completed under its original term."

8.2. Add new Subparagraph 12.03(F) as follows:

"Time shall be of the essence to this Contract.

1. If the Contractor at any time finds that the schedule will not be met for any reason, the Contractor shall so notify the Town in writing.

2. Where Contractor is prevented from completing any part of the Work within the Contract Period due to abnormal weather conditions the Contract Period will be extended in an amount calculated as stated in Paragraph 12.03 F.4. below if a Claim is made therefor in writing and provided to the Town within the time frame and in the manner prescribed and if the performance of the Work is not, was not, or would not have been delayed by any other cause for which the Contractor is not entitled to an extension of the Contract Period under the Contract Documents.

3. Contractor acknowledges and agrees that adjustments in the Contract Period will be permitted for a delay only to the extent such delay (i) is not caused, or could not have been anticipated, by Contractor; (ii) could not be limited or avoided by the Contractor's timely notice to the Town of the delay or reasonable likelihood that a delay will occur; and (iii) is of a duration not less than one day. Such an adjustment of time shall be Contractor's sole and exclusive remedy for the delays described in this Section. Any time extensions for changes in the work will depend upon the extent, if any, by which the changes cause delay in the completion of the various elements of this Contract. The change order granting the time extension may provide that the completion date will be extended only for those specific elements so delayed and that the remaining completion dates for all other portions of the work will not be altered and may further provide for an equitable readjustment of liquidated damages under the new completion schedule.

4. Actual adverse weather delay days must prevent work on critical activities outdoors for fifty percent (50%) or more of Contractor's scheduled workday in order to be counted. The number of actual adverse weather delay days shall include days impacted by actual adverse weather (even if adverse weather occurred in a previous month), be calculated chronologically from the first to the last day of each month, and be recorded as full days. Where Contractor is prevented from completing any part of the Work within the Contract Period due to abnormal weather conditions, the Contract Period will be extended in an amount equal to the time lost due to such delay if a Claim is made therefore as provided herein. Abnormal weather conditions occur only if the total number of actual adverse weather days exceeds the standard for that month as shown in the following table:

Month	Number of Days
January	7
February	7
March	8
April	7
May	8
June	7
July	8
August	8
September	6
October	6
November	6
December	6

5. Upon commencement of on-site activities and continuing throughout construction, Contractor shall record daily the occurrence of adverse weather and resultant impact to normally scheduled work and within 30 days of the last day of any month (hereinafter referred to as the "Reporting Month"), Contractor shall submit a written adverse weather report, including copies of Contractor's daily weather reports and applicable climatological data from the National Oceanic and Atmospheric Administration (NOAA) or similar data for the project location, unless the Town allows, in writing, an additional period of time for the submission of said report. Notwithstanding any other provisions, failure to submit the required written report within the time specified above shall be deemed to be and shall constitute a waiver by Contractor of any and all claims for delay due to adverse weather conditions occurring during said Reporting Month.

6. The Town shall not be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of Engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

7. Contractor shall not be entitled to an adjustment in Contract Price or Contract Period for delays within the control of Contractor. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of Contractor."

9 Payments to Contractor

9.1 Add to end of Subparagraph 14.02(D)(1)(c) the following: ", including, but not limited to, the Town may offset any payment due to Contractor by any debt shown on the Town's accounts, even if a dispute exists as to the debt's validity or enforceability;"

9.2 Delete Subparagraph 14.02(C) and substitute the following revised Subparagraph 14.02(C) in its place:

"Thirty (30) days after presentation of the Application of Payment to Owner with Engineer's recommendation, the amount recommended will (subject to the provisions of Subparagraph 14.02(D) and to Subparagraph 15.03(B) relating to 'Non-appropriation of Funds) become due, and when due will be paid by Owner to Contractor."

10 Suspension of Work and Termination

10.1 Delete Paragraph 15.03 and substitute the following revised Paragraph 15.03 in its place:

"A. Termination for Convenience

1. The Town may terminate this Contract or any work or delivery required hereunder from time-to-time either in whole or in part, whenever the Contract Administrator, with the concurrence of the Town Manager, determines that such termination in the best interest of the Town.

2. Termination may occur in whole or as to any discrete part of the Contract. A partial termination shall set forth the portions of the Contract which are terminated.

3. The effective date of the termination shall be three days after issuance of a Notice of Termination signed by the Contract Administrator and Town Manager and its mailing or delivery to the Contractor, or any later date specifically set forth in the Notice of Termination.

B. Termination for Non-Appropriation

1. If funds are not appropriated for purposes of this Contract for any succeeding fiscal year subsequent to the one in which this Contract is entered into, then the Town may terminate this Contract upon thirty (30) days written notice to the Contractor. The notice shall set forth the grounds for termination and its effective date.

2. If the Town terminates for non-appropriation, the Town shall be liable only for payments due through the effective date of termination.

3. Until the effective date of the termination, the Contractor shall continue to perform its duties under the Contract and is not excused from any portion of the Contract.

C. Claims Upon Termination

1. Upon receipt of a Notice of Termination, the Contractor shall:

    a. Cease any further deliveries or work due under this Contract, on the date, and to the extent, which may be specified in the Notice;

    b. Place no further orders with any subcontractors except as may be necessary to perform any portion of the Contract not subject to the Notice (in the case of partial termination);

    c. Terminate all subcontractors except to the extent necessary to complete work which was not subject to the Notice (in the case of partial termination);

    d. Settle all outstanding liabilities and claims which may arise out of such termination, with the ratification of the Contract Administrator; and

    e. Use its best efforts to mitigate any damages which may be sustained by the Contractor or any of its subcontractors as a consequence of termination under this clause.

2. After complying with the foregoing provisions, the Contractor shall submit a termination claim within thirty days unless an extension is granted by the Contract Administrator. This termination claim shall document all amounts due under this provision.

    a. Upon receipt of the Contractor's termination claim, the Town, with the approval of the Town Manager, shall pay from the Using Department's budget the reasonable costs of termination, including a reasonable amount for profit on services delivered or completed. In no event shall this amount be greater than the original contract price, reduced by any payments made prior to Notice of Termination, and further reduced by the price of the goods or services not delivered, or those goods or services not provided. The calculation of the amount to be paid the Contractor shall be documented and made a part of the Contract file.

    b. If the parties cannot agree on the whole amount to be paid to the Contractor by reason of termination under this clause, the Town shall pay the Contractor from the Using Department's budget the amounts determined as follows, without duplicating any amount which may have already been paid under the preceding paragraph of this clause:

i. With respect to all Contract performance prior to the effective date of Notice of Termination, the total of:

- Cost of the goods delivered or work performed; and
- The cost of settling and paying any reasonable claims as provided above; and
- A sum as profit on work performed determined by the Town Procurement Officer to be fair and reasonable.

ii. The total sum to be paid shall not exceed the Contract price, as reduced by the amount of payments otherwise made, and as further reduced by the Contract price of goods or services not terminated.

c. If the Contractor is not satisfied with any payments which the Contract Administrator determines to be due under this provision, the Contractor may appeal any claim accordance with the provisions of Paragraph 10.05 and Article 16, Dispute Resolution.

3. The Contractor shall include similar provisions for termination in any subcontractors and shall require subcontractors to make reasonable efforts to mitigate damages if the Contract is terminated. Failure to include such provisions shall bar the Contractor from any recovery from the Town whatsoever for loss or damage sustained by a subcontractor as a consequence of termination."

10.2 In Subparagraph 15.04(A), the seven (7) days written notice to Owner and Engineer is changed to ten (10) business days written notice to Owner and Engineer.

11 Dispute Resolution

11.1 Add the following new Subparagraph 16.01(D):

"Before the Contractor may exercise any legal remedy it may have in relation to rights arising out of this Contract, it must comply fully and strictly with each of the applicable conditions below. Failure to comply fully and strictly with an applicable condition precedent bars the Contractor from exercising any legal remedies it may otherwise have in relation to this Contract until it complies with the condition precedent or the Town knowingly and intentionally waives the condition precedent.

1. Submission of Disputes: A Contractor must submit any dispute arising out of this Contract to the Town for adjustment. In doing so, it shall provide all relevant evidence that bears on the Town's liability for the amount claimed or responsibility to grant any non-monetary relief requested.

2. Disputes by the Contractor with respect to this Contract shall be decided within fifteen (15) days from submission by the Town Manager's designee, who shall reduce his/her decision to writing, and mail or otherwise furnish a copy thereof

to the Contractor. This decision shall be final and binding unless within five (5) days from the date of such decision the Contractor mails or otherwise furnishes the Town Manager a written appeal addressed to the Town Council. The Town Council shall consider the appeal and render its written decision within forty (40) days. The decision of the Town Council shall be final and binding unless set aside by a court of competent jurisdiction as fraudulent, capricious, arbitrary, or so grossly erroneous as necessarily to imply bad faith, or as not supported by any evidence. Pending a final determination of a properly appealed decision of the Town Manager's designee, the Contractor shall proceed diligently with the performance of the Contract in accordance with that decision."

11.2 Add the following new Subparagraph 16.01(E):

"Any action brought under this Contract must be brought in the state courts for the County of Culpeper and may not be removed to the Federal Court system."

11.3 Add the following new Subparagraph 16.01(F):

"Any action brought under this Contract, except an action for breach of warranty, shall be brought within the shorter of the statutory limitations period and the period of three years from the date of final payment without any tolling of this statutory limitations period for any reason whatsoever."

11.4 Add the following new Subparagraph 16.01(G):

"In any action brought under this Contract, the parties expressly waive their right to trial by jury and agree to submit all questions of fact to the judge as trier of fact."

12 Miscellaneous

12.1 Delete Paragraph 17.05 and substitute the following revised Paragraph 17.05 in its place:

"This Contract is governed by the law of the Commonwealth of Virginia, including but not limited to the Virginia Public Procurement Act (VPPA), Sections 2.2-4300 et seq. of the Code of Virginia (1950), as amended. This Contract is also governed by the applicable Town Policies."

12.2 Add the following new Paragraph 17.07:

"In all contracts, regardless of contract amount, the Contractor will abide by the provisions of the Americans with Disabilities Act, and will require each sub-contractor to do so. If this Contract is for a consideration in excess of Ten Thousand Dollars ($10,000.00), then during the performance of this Contract, the Contractor agrees as follows:

a. The Contractor will not discriminate against any employee or applicant for employment because of race, religion, color, sex, national origin, age, disability, or other basis prohibited by state law relating to discrimination in employment,

except where there is a bona fide occupational qualification reasonably necessary to the normal operation of the Contractor. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the provisions of this non-discrimination clause.

b. The Contractor, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, will state that such Contractor is an equal opportunity employer.

c. Notices, advertisements, and solicitations placed in accordance with Federal law, rule, or regulation shall be deemed sufficient for the purpose of meeting the requirements of this paragraph.

d. The Contractor will include the provisions of this Contract paragraph in every subcontract or purchase order over $10,000, so that the provisions will be binding upon each subcontractor or vendor."

12.3 Add the following new Paragraph 17.08:

"The provisions contained in Chapter 43, Article 6, Sections 2.2-4367 through 2.2-4377 of the Virginia Public Procurement Act, as set forth in the 1950 Code of Virginia, as amended, apply to this contract. The provisions of Article 6 of Chapter 43 supplement, but do not supersede, other provisions of law including, but not limited to, the Virginia Conflict of Interest Act (§ 2.2-3100 et seq.), the Virginia Governmental Frauds Act (§ 18.2-498.1 et seq.) and Articles 2 and 3 of Chapter 10 of Title 18.2. The provisions apply notwithstanding the fact that the conduct described may not constitute a violation of the Virginia Conflict of Interests Act."

12.4 Add the following new Paragraph 17.09:

"During the performance of this contract, the Contractor agrees to:

1. Provide a drug-free workplace for the Contractor's employees.

2. Post in conspicuous places, available to employees and applicants for employment a statement notifying employees that the unlawful manufacture, sale, distribution, dispensation, possession, or use of a controlled substance or marijuana is prohibited in the contractor's workplace and specifying the actions that will be taken against employees for violations of such prohibition.

3. State in all solicitations or advertisement for employees placed by or on behalf of the contractor that the contractor maintains a drug-free workplace.

4. Include the provisions of the foregoing clauses in every subcontract or purchase order of over $10,000.00, or so that the provisions will be binding upon each subcontractor or vendor."

12.5 Add the following new Paragraph 17.10:

"The Town of Culpeper in procuring goods and services, or in making disbursements pursuant to this section, shall not discriminate against a faith-based organization on the basis of the organization's religious character or impose conditions that restrict the religious character of the faith-based organization, except funds provided for expenditure pursuant to contracts with public bodies shall not be spent on religious worship, instruction, or proselytizing, or impair, diminish, or discourage the exercise of religious freedom by the recipients of such goods, services, or disbursement."

12.6 Add the following new Paragraph 17.11:

"Foreign and Domestic Businesses Authorized to Transact Business in the Commonwealth:

1. A Contractor organized as a stock or nonstock corporation, limited liability company, business trust, or limited partnership or registered as a registered limited liability partnership shall be authorized to transact business in the Commonwealth as a domestic or foreign business entity if so required by Title 13.1 or Title 50 or as otherwise required by law.

2. A Contractor organized as a stock or nonstock corporation, limited liability company, business trust, or limited partnership or registered as a registered limited liability partnership shall not allow its existence to lapse or its certificate of authority or registration to transact business in the Commonwealth, if so required under Title 13.1 or Title 50, to be revoked or cancelled at any time during the term of this contract. The Town may void any contract with a business entity if the business entity fails to remain in compliance with this provision."

12.7 Add the following new Paragraph 17.12:

"A. The Contractor agrees that the Town or any duly authorized representative of the Town may have access to and the right to examine and copy any directly pertinent books, documents, papers, and records of the Contractor involving transactions related to this Contract. This right shall expire on the third anniversary of the issuance of final payment under this Contract.

B. The Contractor further agrees to include in any subcontract for more than $10,000 entered into as a result of this Contract, a provision to the effect that the subcontractor agrees that the Town or any duly authorized representative may have access to and the right to examine and copy any directly pertinent books, documents, papers, and records of such subcontractor involved in transactions related to such subcontract, or this Contract. The term subcontract as used herein shall exclude subcontracts or purchase orders for public utility services at rates established for uniform applicability to the general public. This right expires on the third anniversary of the issuance of final payment to the subcontractor."

12.8 Add the following new Paragraph 17.13:

"The Contractor shall not be excused from performance under this Contract by failure to agree to a Change Order, and it is the express purpose of this provision to permit unilateral changes in the Contract by the Owner subject to the conditions and limitation herein. No claim for changes made by Change Order shall be considered if made after final payment in accordance with the Contract."

12.9 Add the following new Paragraph 17.14:

"This Contract, including its incorporated documents, contains the whole agreement between the parties as to its subject, and no prior or contemporaneous communications, representations, or agreements, written or verbal, may alter, add to, or contradict any provision in it. There are no promises, terms, conditions, or obligations related to the subject of this Contract other than those contained herein. All modifications and changes to the Contract shall be in writing and signed by the party to be charged, or its authorized representative."

12.10 Add the following new Article 4.03B to the Agreement between the Owner and Contractor:

"Alternatively, if performance is so delayed, the Town may terminate this Contract in whole or in part under the Default clause in this Contract and in that event, the Contractor shall be liable for fixed, agreed and liquidated damages accruing until the time the Town may reasonably obtain performance of similar services. The liquidated damages shall be in addition to any increased costs occasioned the Town in completing the work."

ACORD

CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY)

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER	CONTACT NAME:
PLEASE SEND THIS SAMPLE CERTIFICATE TO YOUR AGENT	PHONE (A/C, No, Ext): FAX (A/C, No):
	E-MAIL ADDRESS:
	PRODUCER CUSTOMER ID #:

INSURED	INSURER(S) AFFORDING COVERAGE	NAIC #
	INSURER A :	
	INSURER B :	
	INSURER C :	
	INSURER D :	
	INSURER E :	
	INSURER F :	

COVERAGES **CERTIFICATE NUMBER:** **REVISION NUMBER:**

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSR	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS		
	GENERAL LIABILITY						EACH OCCURRENCE	$	1,000,000
	X COMMERCIAL GENERAL LIABILITY	Y	Y				DAMAGE TO RENTED PREMISES (Ea occurrence)	$	
	CLAIMS-MADE X OCCUR						MED EXP (Any one person)	$	
	X Primary Coverage						PERSONAL & ADV INJURY	$	1,000,000
	X Contractual Liability & XCU						GENERAL AGGREGATE	$	2,000,000
	GEN'L AGGREGATE LIMIT APPLIES PER:						PRODUCTS - COMP/OP AGG	$	2,000,000
	X POLICY PRO-JECT LOC							$	
	AUTOMOBILE LIABILITY						COMBINED SINGLE LIMIT (Ea accident)	$	1,000,000
	ANY AUTO	Y	Y				BODILY INJURY (Per person)	$	
	X ALL OWNED AUTOS						BODILY INJURY (Per accident)	$	
	SCHEDULED AUTOS						PROPERTY DAMAGE (Per accident)	$	
	X HIRED AUTOS							$	
	X NON-OWNED AUTOS							$	
or	X **UMBRELLA LIAB** X OCCUR						EACH OCCURRENCE	$	10,000,000
	X **EXCESS LIAB** CLAIMS-MADE	Y	Y				AGGREGATE	$	10,000,000
	DEDUCTIBLE							$	
	RETENTION $							$	
	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY Y / N						X WC STATU-TORY LIMITS OTH-ER		
	ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED?	N / A	Y				E.L. EACH ACCIDENT	$	100,000
	(Mandatory in NH) If yes, describe under SPECIAL PROVISIONS below						E.L. DISEASE - EA EMPLOYEE	$	100,000
							E.L. DISEASE - POLICY LIMIT	$	500,000
	Builder's Risk	Y	Y				Coverage Equal to Contract Amount		

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (Attach ACORD 101, Additional Remarks Schedule, if more space is required)

Place owner's name and name of project here. (Owner's Name) and WW Associates, Inc. are listed as an additional insured on all policies except workers compensation. A waiver of subrogation shall apply in favor of (Owner's Name) and WW Associates, Inc. on all policies as permitted by law.

CERTIFICATE HOLDER	CANCELLATION
Defined in Supplementary Conditions	SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.
	AUTHORIZED REPRESENTATIVE

End of Section

Section 01600
Standard Contract Forms

The following Engineers Joint Contract Documents Committee (EJCDC) and American Institute of Architects (AIA) documents will be incorporated in this project manual. All forms shall be utilized in accordance with applicable EJCDC and AIA regulations and modified as needed for this particular project:

Agreement

Completed EJCDC Document C-520 (2007) "Suggested Form of Agreement Between Owner and Contractor for Construction Contract", will be a part of this contract.

Performance Bond, and Payment Bond

Completed EJCDC Document C-610, (2007) and EJCDC Document C-615 (2007), will be a part of this contract.

Supplemental Attachment for Accord Certificate of Insurance

Completed AIA Document G715, (1991), will be a part of this contract.

Application and Certificate for Payment and Continuation Sheet

Completed EJCDC Document C-620, (2013), will be a part of this contract.

Affidavit of Payment of Debts and Claims, and Affidavit of Release of Liens

Completed AIA Documents G706 and G706A (1994), will be part of this contract.

Standard General Conditions of the Construction Contract

EJCDC Document C-700 (2007) "Standard General Conditions of the Construction Contract", modified as needed, will be a part of this contract.

Town of Culpeper Uniform Guidance Procurement Policy for use when Spending Federal Money

Town of Culpeper Uniform Guidance: Conflict of Interest Policy when Spending Federal Funds

EJCDC documents are available from the EJCDC online store at www.ejcdc.com.

AIA documents are available at www.AIA.org.

AP-SOP-2019-02 November 1, 2019

Town Manager – UNIFORM GUIDANCE PROCUREMENT POLICY FOR USE WHEN SPENDING FEDERAL MONEY

Approved: _____ Date: 11/14/19
Town Manager

Responsible Person(s): **Finance Director/Town Treasurer**

I. Purpose

The purpose of this Policy is to establish guidelines that meet or exceed the procurement requirements for purchases of goods (apparatus, supplies, materials, and equipment), services, and construction or repair projects when Federal funds are being used in whole or in part to pay for the cost of the contract.

II. Policy

A. **Application of Policy**. This policy applies to contracts for purchases, services, and construction or repair work funded with Federal financial assistance (direct or reimbursed). The requirements of this Policy also apply to any sub-recipient of the funds.

All Federally funded projects, loans, grants, and sub-grants, whether funded in part or wholly, are subject to the Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal awards (Uniform Guidance) codified at 2 C.F.R. Part 200 unless otherwise directed in writing by the Federal agency or state pass-through agency that awarded the funds.

B. **Compliance with Federal Law**. All procurement activities involving the expenditure of Federal funds must be conducted in compliance with the Procurement Standards codified in 2 C.F.R. § 200.317 through § 200-326 unless otherwise directed in writing by the Federal agency or state pass-through agency that awarded the funds. Town of Culpeper will follow all applicable local, state, and Federal procurement requirements when expending Federal funds. Should Town of Culpeper have more stringent requirements, the most restrictive requirement shall apply so long as it is consistent with state and Federal law.

C. **Contract Award**. All contracts shall be awarded only to the lowest responsive responsible bidder possessing the ability to perform successfully under the terms and conditions of the contract.

D. **No Evasion**. No contract may be divided to bring the cost under bid thresholds or to evade any requirements under this Policy or state and Federal law.

E. **Contract Requirements**. All contracts paid for in whole or in part with Federal funds shall be in writing. The written contract must include or incorporate by reference the provisions required under 2 C.F.R § 200.326 and as provided for under 2 C.F.R. Part 200, Appendix II.

F. **Contractors' Conflict of Interest**. Designers, suppliers, and contractors that assist in the development or drafting of specifications, requirements, statements of work, invitation for bids or requests for proposals shall be excluded from competing for such requirements.

G. **Approval and Modification**. The administrative procedures contained in this Policy are administrative and may be changed as necessary at the staff level to comply with state and Federal law.

III. **General Procurement Standards and Procedures**:

Either the Purchasing Department or the Requesting Department shall procure all contracts in accordance with the requirements of this Section of the Policy.

A. **Necessity**. Purchases must be necessary to perform the scope of work and must avoid acquisition of unnecessary or duplicative items. The Purchasing Department and/or the Requesting Department should check with the Federal surplus property agency prior to buying new items when feasible and less expensive. Strategic sourcing should be considered with other departments and/or agencies who have similar needs to consolidate procurements and services to obtain better pricing.

B. **Clear Specifications**. All solicitations must incorporate a clear and accurate description of the technical requirements for the materials, products, or services to be procured, and shall include all other requirements which bidders must fulfill and all other factors to be used in evaluating bids or proposals. Technical requirements must not contain features that restrict competition.

C. **Notice of Federal Funding**. All bid solicitations must acknowledge the use of Federal funding for the contract. In addition, all prospective bidders or offerors must acknowledge that funding is contingent upon compliance with all terms and conditions of the funding award.

D. **Compliance by Contractors**. All solicitations shall inform prospective contractors that they must comply with all applicable Federal laws, regulations, executive orders, and terms and conditions of the funding award.

E. **Fixed Price**. Solicitations must state that bidders shall submit bids on a fixed price basis and that the contract shall be awarded on this basis unless otherwise provided for in this Policy. Cost plus percentage of cost contracts are prohibited. Time and materials contracts are prohibited in most circumstances. Time and materials contracts will not be used unless no other form of contract is suitable and the contract includes a "Not to Exceed" amount. A time and materials contract shall not be awarded without express

written permission of the Federal agency or state pass-through agency that awarded the funds.

F. **Use of Brand Names**. When possible, performance or functional specifications are preferred to allow for more competition leaving the determination of how the reach the required result to the contractor. Brand names may be used only when it is impractical or uneconomical to write a clear and accurate description of the requirement(s). When a brand name is listed, it is used as reference only and "or equal" must be included in the description.

G. **Lease versus Purchase**. Under certain circumstances, it may be necessary to perform an analysis of lease versus purchase alternatives to determine the most economical approach.

H. **Dividing Contract for M/WBE Participation**. If economically feasible, procurements may be divided into smaller components to allow maximum participation of small and minority businesses and women business enterprises. The procurement cannot be divided to bring the cost under bid thresholds or to evade any requirements under this Policy.

I. **Documentation**. Documentation must be maintained by the Purchasing Department and/or the Requesting Department detailing the history of all procurements. The documentation should include the procurement method used, contract type, basis for contractor selection, price, sources solicited, public notices, cost analysis, bid documents, addenda, amendments, contractor's responsiveness, notice of award, copies of notices to unsuccessful bidders or offerors, record of protests or disputes, bond documents, notice to proceed, purchase order, and contract. All documentation relating to the award of any contract must be made available to the granting agency upon request.

J. **Cost Estimate**. For all procurements costing $150,000 or more, the Purchasing Department and/or Requesting Department shall develop an estimate of the cost of the procurement prior to soliciting bids. Cost estimates may be developed by reviewing prior contract costs, online review of similar products or services, or other means by which a good faith cost estimate may be obtained. Cost estimates for construction and repair contracts may be developed by the project designer.

K. **Contract Requirements**. The Requesting Department must prepare a written contract incorporating the provisions referenced in Section II.C of this Policy.

L. **Debarment**. No contract shall be awarded to a contractor included on the Federally debarred bidder's list.

M. **Contractor Oversight**. The Requesting Department receiving the Federal funding must maintain oversight of the contract to ensure that contractor is performing in accordance with the contract terms, conditions, and specifications.

N. **Open Competition**. Solicitations shall be prepared in a way to be fair and provide open competition. The procurement process shall not restrict competition by imposing

unreasonable requirements on bidders, including but not limited to unnecessary supplier experience, excessive or unnecessary bonding, specifying a brand name without allowing for "or equal" products, or other unnecessary requirements that have the effect of restricting competition.

O. **Geographic Preference**. No contract shall be awarded on the basis of a geographic preference.

IV. Specific Procurement Procedures

Either the Purchasing Department or the Requesting Department shall solicit bids in accordance with the requirements under this Section of the Policy based on the type and cost of the contract.

A. **Service Contracts** (except for A/E professional services) and **Purchase Contracts costing less than $3,500** shall be procured using the Uniform Guidance "micro-purchase" procedure (2 C.F.R. § 200.320(a)) as follows:
   1. The contract may be awarded without soliciting pricing or bids if the price of the goods or services is considered to be fair and reasonable.
   2. To the extent practicable, purchases must be distributed among qualified suppliers.

B. **Service Contracts** (except for A/E professional services) and **Purchase Contracts costing $3,500 up to $90,000** shall be procured using the Uniform Guidance "small purchase" procedure (2 C.F.R. § 200.320(b)) as follows:
   1. Obtain price or rate quotes from an "adequate number" of qualified sources (a Federal grantor agency might issue guidance interpreting "adequate number," so the Requesting Department should review the terms and conditions of the grant award documents to confirm whether specific guidance has been issued).
   2. Take affirmative steps to solicit price quotes from M/WBE vendors and suppliers as required under 2 C.F.R. § 200.321.
   3. Cost or price analysis is not required prior to soliciting bids.
   4. Award the contract on a fixed-price basis (a not-to-exceed basis is permissible for service contracts where obtaining a fixed price is not feasible).
   5. Award the contract to the lowest responsive, responsible bidder.

C. **Service Contracts** (except for A/E professional services) and **Purchase Contracts costing $90,000 and above** shall be procured using a combination of the most restrictive requirements of the Uniform Guidance "sealed bid" procedure (2 C.F.R. § 200.320(c)) and state formal bidding procedures (G.S. 143-129) as follows:
   1. Cost or price analysis is required prior to soliciting bids.
   2. Complete specifications or purchase description must be made available to all bidders.
   3. The bid must be formally advertised in a newspaper of general circulation for at least seven full days between the date of the advertisement and the date of the public bid opening. Electronic-only advertising must be authorized by the governing board. The advertisement must state the date, time, and location of the public bid opening, indicate where specifications may be obtained, and reserve to the governing board the right to reject any or all bids only for "sound documented reasons."

4. Take affirmative steps to solicit price quotes from M/WBE vendors and suppliers as required under 2 C.F.R. § 200.321.
5. Open bids at the public bid opening on the date, time, and at the location noticed in the public advertisement. All bids must be submitted sealed. A minimum of 2 bids must be received in order to open all bids.
6. Award the contract to the lowest responsive, responsible bidder on a fixed-price basis. Governing board approval is required for purchase contracts unless the governing board has delegated award authority to an individual official or employee. Any and all bids may be rejected only for "sound documented reasons."

D. **Service Contracts** (except for A/E professional services) **costing $150,000 and above** may be procured using the Uniform Guidance "competitive proposal" procedure (2 C.F.R. § 200.320(d)) when the "sealed bid" procedure is not appropriate for the particular type of service being sought. The procedures are as follows:
   1. A Request for Proposals (RFP) must be publicly advertised. Formal advertisement in a newspaper is not required so long as the method of advertisement will solicit proposals from an "adequate number" of qualified firms.
   2. Take affirmative steps to solicit price quotes from M/WBE vendors and suppliers as provided under 2 C.F.R. § 200.321.
   3. Identify evaluation criteria and relative importance of each criteria (criteria weight) in the RFP.
   4. Consider all responses to the publicized RFP to the maximum extent practical.
   5. Must have a written method for conducting technical evaluations of proposals and selecting the winning firm.
   6. Award the contract to the responsible firm with most advantageous proposal taking into account price and other factors identified in the RFP. Governing board approval is not required.
   7. Award the contract on a fixed-price or cost-reimbursement basis.

E. **Construction and repair contracts costing less than $3,500** shall be procured using the Uniform Guidance "micro-purchase" procedure (2 C.F.R. § 200.320(a)) as follows:
   1. The contract may be awarded without soliciting pricing or bids if the price of the goods or services is considered to be fair and reasonable.
   2. To the extent practicable, contracts must be distributed among qualified suppliers.

F. **Construction and repair contracts costing $3,500 up to $150,000** shall be procured using the Uniform Guidance "small purchase" procedure (2 C.F.R. § 200.320(b)) as follows:
   1. Obtain price or rate quotes from an "adequate number" of qualified sources (a Federal grantor agency might issue guidance interpreting "adequate number," so the requesting department should review the terms and conditions of the grant award documents to confirm whether specific guidance has been issued).
   2. Take affirmative steps to solicit price quotes from M/WBE vendors and suppliers as required under 2 C.F.R. § 200.321.
   3. Cost or price analysis is not required prior to soliciting bids, although price estimates may be provided by the project designer.
   4. Award the contract on a fixed-price or not-to-exceed basis.

5. Award the contract to the lowest responsive, responsible bidder. Governing board approval is not required.

G. **Construction and repair contracts <u>costing $150,000 up to $500,000</u>** shall be procured using the Uniform Guidance "sealed bid" procedure (2 C.F.R. § 200.320(c)) as follows:
   1. Cost or price analysis is required prior to soliciting bids (this cost estimate may be provided by the project designer).
   2. Complete specifications must be made available to all bidders.
   3. Publically advertise the bid solicitation for a period of time sufficient to give bidders notice of opportunity to submit bids (formal advertisement in a newspaper is not required so long as other means of advertising will provide sufficient notice of the opportunity to bid). The advertisement must state the date, time, and location of the public bid opening, and indicate where specifications may be obtained.
   4. Take affirmative steps to solicit price quotes from M/WBE vendors and suppliers as provided under 2 C.F.R. § 200.321.
   5. Open the bids at the public bid opening on the date, time, and at the location noticed in the public advertisement. All bids must be submitted sealed. A minimum of 2 bids must be received in order to open all bids.
   6. A 5% bid bond is required of all bidders. Performance and payment bonds of 100% of the contract price is required of the winning bidder.
   7. Award the contract on a firm fixed-price basis.
   8. Award the contract to the lowest responsive, responsible bidder. Governing board approval is not required. Any and all bids may be rejected only for "sound documented reasons."

H. **Construction and repair contracts <u>costing $500,000 and above</u>** shall be procured using a combination of the most restrictive requirements of the Uniform Guidance "sealed bid" procedure (2 C.F.R. § 200.320(c)) and state formal bidding procedures (G.S. 143-129) as follows:
   1. Cost or price analysis is required prior to soliciting bids (this cost estimate should be provided by the project designer).
   2. Complete specifications must be made available to all bidders.
   3. Formally advertise the bid in a newspaper of general circulation for at least seven full days between the date of the advertisement and the date of the public bid opening. Electronic-only advertising must be authorized by the governing board. The advertisement must state the date, time, and location of the public bid opening, indicate where specifications may be obtained, and reserve to the governing board the right to reject any or all bids only for "sound documented reasons."
   4. Take affirmative steps to solicit price quotes from M/WBE vendors and suppliers as provided under 2 C.F.R. § 200.321.
   5. Open the bids at the public bid opening on the date, time, and at the location noticed in the public advertisement. All bids must be submitted sealed and in paper form. A minimum of 3 bids must be received in order to open all bids.
   6. A 5% bid bond is required of all bidders (a bid that does not include a bid bond cannot be counted toward the 3-bid minimum requirement). Performance and payment bonds of 100% of the contract price is required of the winning bidder.
   7. Award the contract on a firm fixed-price basis.

8. Award the contract to the lowest responsive, responsible bidder. Governing board approval is required and cannot be delegated. The governing board may reject and all bids only for "sound documented reasons."

I. **Construction or repair contracts involving a building <u>costing $300,000 and above</u>** must comply with the following additional requirements under state law:
   1. Formal HUB (historically underutilized business) participation required under G.S. 143-128.2, including local government outreach efforts and bidder good faith efforts, shall apply.
   2. Separate specifications shall be drawn for the HVAC, electrical, plumbing, and general construction work as required under G.S. 143-128(a).
   3. The project shall be bid using a statutorily authorized bidding method (separate-prime, single-prime, or dual bidding) as required under G.S. 143-129(a1).

J. **Contracts for Architectural and Engineering Services <u>costing under $150,000</u>** shall be procured using the state "Mini-Brooks Act" requirements (G.S. 143-64.31) as follows:
   1. Issue a Request for Qualifications (RFQ) to solicit qualifications from qualified firms (formal advertisement in a newspaper is not required). Price (other than unit cost) shall not be solicited in the RFQ.
   2. Take affirmative steps to solicit price quotes from M/WBE vendors and suppliers as provided for under 2 C.F.R. § 200.321.
   3. Evaluate the qualifications of respondents based on the evaluation criteria developed by the Purchasing Department and/or Requesting Department.
   4. Rank respondents based on qualifications and select the best qualified firm. Price cannot be a factor in the evaluation. Preference may be given to in-state (but not local) firms.
   5. Negotiate fair and reasonable compensation with the best qualified firm. If negotiations are not successfully, repeat negotiations with the second-best qualified firm.
   6. Award the contract to best qualified firm with whom fair and reasonable compensation has been successfully negotiated. Governing board approval is not required.

K. **Contracts for Architectural and Engineering Services <u>costing $150,000 or more</u>** shall be procured using the Uniform Guidance "competitive proposal" procedure (2 C.F.R. § 200.320(d)(5)) as follows:
   1. Publically advertise a Request for Qualifications (RFQ) to solicit qualifications from qualified firms (formal advertisement in a newspaper is not required). Price (other than unit cost) shall not be solicited in the RFQ.
   2. Take affirmative steps to solicit price quotes from M/WBE vendors and suppliers as provided under 2 C.F.R. § 200.321.
   3. Identify the evaluation criteria and relative importance of each criteria (the criteria weight) in the RFQ.
   4. Proposals must be solicited from an "adequate number of qualified sources" (an individual Federal grantor agency may issue guidance interpreting "adequate number").

5. Must have a written method for conducting technical evaluations of proposals and selecting the best qualified firm.
6. Consider all responses to the publicized RFQ to the maximum extent practical.
7. Evaluate qualifications of respondents to rank respondents and select the most qualified firm. Preference may be given to in-state (but not local) firms provided that granting the preference leaves an appropriate number of qualified firms to compete for the contract given the nature and size of the project.
8. Price cannot be a factor in the initial selection of the most qualified firm.
9. Once the most qualified firm is selected, negotiate fair and reasonable compensation. If negotiations are not successfully, repeat negotiations with the second-best qualified firm.
10. Award the contract to best qualified firm with whom fair and reasonable compensation has been successfully negotiated. Governing board approval is not required.
11.

V. Exceptions

Non-competitive contracts are allowed only under the following conditions and with the written approval of the Federal agency or state pass-through agency that awarded the Federal funds:

A. **Sole Source**. A contract may be awarded without competitive bidding when the item is available from only one source. The Purchasing Department and/or Requesting Department shall document the justification for and lack of available competition for the item. A sole source contract must be approved by the governing board.

B. **Public Exigency**. A contract may be awarded without competitive bidding when there is a public exigency. A public exigency exists when there is an imminent or actual threat to public health, safety, and welfare, and the need for the item will not permit the delay resulting from a competitive bidding.

C. **Inadequate Competition**. A contract may be awarded without competitive bidding when competition is determined to be inadequate after attempts to solicit bids from a number of sources as required under this Policy does not result in a qualified winning bidder.

D. **Federal Contract**. A contract may be awarded without competitive bidding when the purchase is made from a Federal contract available on the U.S. General Services Administration schedules of contracts.

E. **Awarding Agency Approval.** A contract may be awarded without competitive bidding with the express written authorization of the Federal agency or state pass-through agency that awarded the Federal funds so long as awarding the contract without competition is consistent with state law.

AP-SOP-2019-01 November 1, 2019

Town Manager – UNIFORM GUIDANCE: CONFLICT OF INTEREST POLICY WHEN SPENDING FEDERAL FUNDS

Approved: _____ Date: 11/14/19
Town Manager

Responsible Person(s): **Finance Director/Town Treasurer**

I. Purpose

The purpose of this policy is to establish conflicts of interest guidelines that meet or exceed the requirements under state law and local policy when procuring goods (apparatus, supplies, materials, and equipment), services, and construction or repair projects paid for in part or whole by Federal funds and required under 2 C.F.R. §200.318(c)(l).

II. Policy

This policy applies when procuring goods (apparatus, supplies, materials, and equipment), services, and construction or repair projects funded in part or whole with Federal financial assistance (direct or reimbursed). This policy also applies to any sub-recipient of the funds.

The employee responsible for managing the Federal financial assistance award shall review the notice of award to identify any additional conflicts of interest prohibitions or requirements associated with the award, and shall notify all employees, officers, and agents, including sub-recipients, of the requirements of this policy and any additional prohibitions or requirements.

A. **Conflicts of Interest**. In addition to the prohibition against self-benefiting from a public contract under G.S. 14-234, no officer, employee, or agent of Town of Culpeper may participate directly or indirectly in the selection, award, or administration of a contract supported by a Federal award if he or she has a real or apparent conflict of interest. A real or apparent conflict exists when any of the following parties has a financial or other interest in or receives a tangible personal benefit from a firm considered for award of a contract:

1. The employee, officer, or agent involved in the selection, award, or administration of a contract;
2. Any member of his or her immediate family;
3. His or her partner; or
4. An organization which employs or is about to employ any of these parties.

Any officer, employee, or agent with an actual, apparent, or potential conflict of interest as defined in this policy shall report the conflict to the Town Manager or Director of Finance/Town Treasurer. Any such conflict shall be disclosed in writing to the Federal award agency or pass-through entity in accordance with applicable Federal awarding agency policy.

B. **Gifts**. In addition to the prohibition against accepting gifts and favors from vendors and contractors under G.S.133-32, officers, employees, and agents of the Town of Culpeper are prohibited from accepting or soliciting gifts, gratuities, favors, or anything of monetary value from contractors, suppliers, or parties to subcontracts. Items of nominal value valued at less than $25 (twenty five dollars) which fall into one of the following categories may be accepted:

1. Promotional items;
2. Honorariums for participation in meetings; or
3. Meals furnished at banquets.

Any officer, employee or agent who knowingly accepts an item of more than nominal value allowed under this policy shall report the item to the Town Manager or Director of Finance/Town Treasurer.

III. Violation

Employees violating this policy will be subject to discipline up to and including termination. Contractors violating this policy will result in termination of the contract and may not be eligible for future contract awards.

Section 02050
Demolition

1 GENERAL

1.1 Description: This section specifies removal and offsite disposal or relocation of the following:

1.1.1 Existing equipment as indicated on the drawings.

1.1.2 Disconnecting, capping, or sealing and removal of existing utilities and site piping as indicated on the drawings.

1.2 Definitions

1.2.1 Remove: Remove and legally dispose of items except those indicated to be reinstalled, salvaged, or to remain the Owner's property.

1.2.2 Remove and Salvage: Items indicated to be removed and salvaged remain the Owner's property. Remove, clean and pack or crate items to protect against damage. Identify contents of containers and deliver to the Owner's designated storage area.

1.2.3 Remove and Reinstall: Remove items indicated; clean, service and otherwise prepare them for reuse; store and protect against damage. Reinstall items in locations indicated.

1.2.4 Existing to Remain: Protect construction indicated to remain against damage and soiling during demolition. When permitted by WW Associates, items may be removed to a suitable, protected storage location during demolition and then cleaned and reinstalled in their original location.

1.3 Materials Ownership

1.3.1 Except for items or materials indicated to be reused, salvaged, or otherwise indicated to remain the Owner's property, demolished materials shall become the Contractor's property and shall be removed from the site and be disposed of by the Contractor.

1.3.2 Historical items, relics, and similar objects, which may be encountered during demolition, remain the Owner's property. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to the Owner.

1.4 Quality Assurance

1.4.1 Regulatory Requirements: Comply with governing Environmental Protection Agency (EPA) notification regulations before starting demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

1.5 Project Conditions

1.5.1 The Owner assumes no responsibility for actual condition of structures to be demolished.

1.5.2 Storage or sale of removed items or materials onsite will not be permitted.

1.5.3 Asbestos: It is not expected that asbestos will be encountered in the course of this contract. If any materials suspected of containing asbestos are encountered, do not disturb the materials. Immediately notify WW Associates and the Owner.

1.5.4 All material indicated to be demolished may be salvaged for the Owner's use at the discretion of the Owner. All other material shall be disposed of off the plant site.

1.6 Scheduling

1.6.1 Arrange demolition schedule so as not to interfere with the Owner's onsite operations.

2 PRODUCTS

2.1 Flowable Backfill

2.1.1 Hydraulic cement, fly ash, water, aggregates, admixtures, and granulated iron blast furnace slag used in flowable backfill shall conform to the requirements of the latest edition of the Virginia Department of Transportation (VDOT) Road and Bridge Specifications.

2.1.2 Flowable backfill shall have a 28-day design compressive strength of 30 to 200 psi when tested in accordance with AASHTO T23. Mix design shall result in a fluid product having a slump of 8 to 48 inches at the time of placement.

2.1.3 Mixing, transporting, and placement of flowable backfill shall be performed in accordance with the latest edition of the VDOT Road and Bridge Specifications.

2.1.4 Temperature of flowable backfill shall be a minimum of 50^{o}F at the time of placement. Material shall be protected from freezing for a minimum of 24 hours after placement.

3 EXECUTION

3.1 General

3.1.1 Work shall be performed in such manner as not to endanger the safety of the workmen or the public or cause damage to nearby structures.

3.1.2 Provide all barriers and precautionary measures in accordance with the Owner's requirements and other authorities having jurisdiction.

3.1.3 Prior to the execution of the work, the Contractor, Owner, and Engineer shall jointly survey the condition of the adjoining and/or nearby structures. Photographs and records shall be made of any prior settlement or cracking of structures, pavements, and the like, that may become the subject of possible damage claims.

3.2 Disposal of Material

3.2.1 All debris resulting from the demolition and removal work shall be disposed of by the Contractor as part of the work of this contract. Material designated by the Engineer to be salvaged shall be stored on the construction site as directed. All other material shall be disposed of offsite by the Contractor at his expense in accordance with all federal, state, and local regulations.

3.2.2 Burning of any debris resulting from demolition activities will not be permitted at the site.

3.3 Utility Services

3.3.1 Utility Requirements: Locate, identify, disconnect, and seal or cap off utility services to be removed or abandoned in place as indicated on the drawings.

3.3.2 Maintain existing utilities indicated to remain in service and protect them against damage during demolition operations.

3.3.2.1 Do not interrupt existing utilities serving occupied or operating facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to governing authorities.

3.4 Explosives: Explosives shall not be used for demolition activities.

3.5 Lead Based Paint Removal

3.5.1 Provide a certified industrial hygienist to oversee the removal operation. Submit a lead based paint abatement plan for approval, to be prepared by the certified industrial hygienist.

3.5.2 All Federal Regulations under § 24 CFR 35 must be followed.

3.6 Pollution Controls

3.6.1 Use water mist, temporary enclosures, and other suitable methods to limit the spread of dust and dirt. Comply with governing environmental protection regulations.

3.6.1.1 Do not use water when it may create hazardous or objectionable conditions, such as ice, flooding, or pollution.

3.6.2 Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas. Keep pavement and area adjacent to the site clean and free of mud, dirt, and debris at all times.

3.6.3 Clean adjacent buildings and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to the condition existing before the start of demolition activities.

3.7 Remove above grade improvements such as posts, poles, fences, walls, and other items as specifically indicated or necessary to permit new construction.

3.8 Equipment Removal/Abandonment: Coordinate with the Owner prior to starting demolition activities. Remove and abandon equipment items in place as indicated on the drawings. Use such methods required to complete work within limitations of governing regulations and as follows:

3.8.1 Dispose of demolished items and materials promptly. On-site storage or sale of removed items will be prohibited.

3.8.2 Remove/drain water, sludge, and other organic residuals from structures prior to demolition and abandonment.

3.8.3 Promptly patch and repair holes and damaged surfaces caused to adjacent construction by demolition operations. Completely fill holes and depressions in existing concrete floor slabs and walls to remain with ASTM C 1107 nonshrink grout, applied according to the manufacturer's written recommendations.

3.8.4 Remove and dispose of all mechanical and electrical equipment associated with the existing hydropneumatic tank abandoned in place as indicated on the contract drawings.

3.8.5 Return elements of construction and surfaces to remain to condition existing before the start of demolition operations.

3.9 Filling Below Grade Areas: Completely fill below grade areas and voids resulting from demolition of structures, and pavements with soil materials in accordance with Section 02200 - Earthwork. Fill material shall be completely free of debris and rubbish.

3.9.1 Prior to placement of fill materials, ensure that areas to be filled are free of standing water, frost, frozen material, trash, and debris.

3.9.2 After fill placement and compaction, grade surface to meet adjacent contours and to provide flow to surface drainage structures.

3.10 Damages: Promptly repair damages to adjacent utilities or pavement caused by demolition activities.

3.11 Cleanup

3.11.1 Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site. If the Contractor fails to remove excess debris promptly, the Owner reserves the right to remove it at the Contractor's expense.

3.11.2 Remove promptly salvageable material that becomes property of the Contractor and is not to be reused in construction. Sale of material on the site will be prohibited.

3.11.3 Remove all tools, equipment, and materials from the demolition site, and all rubbish upon completion of the work.

3.11.4 Leave the site clean, neat, orderly, and in condition to begin new construction.

End of Section

Section 02200
Earthwork

1 GENERAL

1.1 References: The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1.1.1 American Society for Testing and Materials (ASTM)

1.1.1.1 ASTM C 136: Sieve analysis of fine and coarse aggregates.

1.1.1.2 ASTM D 698: Moisture-density relations of soils and soil-aggregate mixtures using 5.5-lb (2.49-kg) rammer and 12-inch (305-mm) drop.

1.1.1.3 ASTM D 1140: Amount of material in soils finer than the No. 200 (75-micrometer) sieve.

1.1.1.4 ASTM D 1556: Density of soil in place by the sand-cone method.

1.1.1.5 ASTM D 1557: Moisture-density relations of soils and soil-aggregate mixtures using 10-lb (4.54-kg) rammer and 18-inch (457-mm) drop.

1.1.1.6 ASTM D 2487: Classification of soils for engineering purposes.

1.1.1.7 ASTM D 2922: Density of soil and soil-aggregate in place by nuclear methods (shallow depth).

1.1.1.8 ASTM D 3017: Water content of soil and rock in place by nuclear methods (shallow depth).

1.1.1.9 ASTM D 4318: Liquid limit, plastic limit, and plasticity index of soils.

1.2 Definitions

1.2.1 Hard Materials: Weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of “rock” but which usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

1.2.2 Rock: Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also, large boulders, buried masonry, or concrete other than pavement exceeding ½ cubic yard in

volume. Removal of hard material will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.

1.2.3 Cohesive Materials: Materials ASTM D 2487 classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesive only when the fines have a plasticity index greater than zero.

1.2.4 Cohesionless Materials: Materials ASTM D 2487 classified as GW, GP, SW, and SP. Materials classified as GM and SM will be identified as cohesionless only when the fines have plasticity index of zero.

1.3 Store and use explosives in accordance with federal, state, and local regulations. The Contractor shall be responsible for and shall satisfactorily correct all damage resulting from the use of explosives.

1.4 Submittals: Provide the following in a timely manner in accordance with the approved submittals schedule as specified in Section 01400 – General Requirements.

1.4.1 Two copies of field test reports for fill and backfill tests, select materials tests, and density tests.

1.4.2 Two copies of a detailed blasting plan and schedule including procedures proposed, and qualifications and references of blasting personnel.

1.5 Delivery, Storage, and Handling: Perform in a manner to prevent contamination or segregation of materials.

1.6 Criteria for Bidding

1.6.1 Base bids on the elevations as indicated.

1.6.2 All earthwork excavation shall be unclassified, regardless of material encountered. All earthwork excavation shall be performed to the indicated elevations at no additional cost to the Owner.

1.6.3 Contractor shall retain the services of a geotechnical engineer certified in the Commonwealth of Virginia to certify all building and structure subgrades to be suitable for construction. Submit certifications to WW Associates, Inc., for record.

1.6.4 Blasting will be permitted on this project as specified herein.

1.6.5 Remove material in an approved manner, and provide excavation support structures as required in accordance with the U.S. Army Corps of Engineers "Safety and Health Requirements Manual," EM-385-1-1, Sections 25 A through E.

1.7 Provide barricades, coverings, or other types of protection necessary to prevent damage to existing improvements not indicated to be removed, and improvements on adjoining properties.

1.7.1 Restore all improvements damaged by this work to their original condition, and acceptable to the Owner or other parties or authorities having jurisdiction, unless indicated otherwise.

1.8 Protect existing trees and other vegetation indicated to remain in place against cutting, breaking, or skinning of roots; skinning and bruising of bark; smothering of trees by stockpiling construction materials or excavated materials within drip line; excess foot or vehicular traffic; or parking of vehicles within drip line. Provide temporary fences, barricades, or guards as required to protect trees and vegetation to be left standing.

1.9 Burning of site clearing debris will not be allowed.

1.10 Utility Location: The Contractor shall provide the services of a pipe utility location firm to use nondestructive, air vacuum excavation methods to pothole existing underground utilities within the limits of disturbance on this project to avoid utility conflicts. Pothole excavations shall be performed every 50 linear feet along pipe lines, and at additional locations where requested by WW Associates. Resolution of utility conflicts is the responsibility of the Contractor at no additional cost to the Owner. Utilities shall be marked by the pipe utility location firm prior to construction.

2 PRODUCTS

2.1 Soil Materials: Free of debris, roots, wood, scrap material, vegetation, refuse, soft unsound particles, and frozen deleterious or objectionable materials. The maximum particle diameter shall be one-half the lift thickness at the specified location. The maximum particle diameter for pipe backfill material located less than 1-foot above the pipe crown shall be 1-inch.

2.1.1 Common Fill: Approved, unclassified soil material with the characteristics required to compact to the soil density specified for the intended location.

2.1.2 Backfill and Fill Material: ASTM D 2487, Classification GW, GP, GM, GC, SW, SP, SM, SC with a maximum ASTM D 4318 liquid limit of 35, maximum ASTM D 4318 plasticity index of 12, and a maximum of 25 percent by weight passing ASTM D 1140, No. 200 sieve.

2.1.3 Topsoil: Provide as specified in Section 02936 – Seeding.

2.1.4 Select Material: ASTM D 2487, Classification GW, GP, SW, SP with a maximum of 10 percent by weight passing ASTM D 1140, No. 200 sieve.

2.1.5 Pipe Bedding Material: As shown on the Drawings.

2.1.6 Aggregate Fill (under tank): VDOT No. 57 coarse aggregate.

2.1.7 Riprap: Class A1 dry riprap as defined in the Department of Transportation (VDOT) Road and Bridge Specifications, Section 414, "Riprap."

2.2 Borrow: Obtain borrow materials required in excess of those furnished from excavations from sources off the Owner's property. Provide and submit soil classification testing to ensure borrow materials meet the requirements of this specification.

2.3 Geotextile fabric for riprap bedding material shall be woven polypropylene and shall have the following properties as a minimum:

Physical Property	Specification	Test Method
Apparent Opening Size	Equal to or greater than No. 50 sieve	ASTM D 4751
Grab Tensile Strength Warp / Fill	350 pounds / 250 pounds	ASTM D 4632
Puncture Strength	140 pounds minimum	ASTM D 4833

2.3.1 Acceptable products are Erosion 1 as manufactured by Synthetic Industries, 4019 Industry Drive, Chattanooga, Tennessee 37416, Telephone: (615) 899-0444, and Amoco 1199 as manufactured by Amoco Fabrics and Fibers Company, 900 Circle 75 Parkway, Suite 300, Atlanta, Georgia 30339, Telephone: (404) 984-4444.

2.4 Geotextile fabric beneath access roads shall be woven polypropylene and shall have the following properties as a minimum:

Physical Property	Specification	Test Method
Apparent Opening Size	Equal to or greater than No. 40 sieve	ASTM D 4751
Grab Tensile Strength	315 pounds	ASTM D 4632
Grab Tensile Strength	10%	ASTM D 4632
Mullen Burst Strength	650 psi	ASTM D 3786
Trapezoidal Tear Strength	120 pounds	ASTM D 4533
Puncture Strength	145 pounds minimum	ASTM D 4833
UV Resistance after 500 hours	70%	ASTM D 4355
Permittivity	0.05 sec^{-1}	ASTM D 4491

2.4.1 Acceptable products are Mirafi 600X as manufactured by Mirafi Construction Products, 365 South Holland Drive, Pendergrass, Georgia, 30567, Telephone: (706) 693-2226, or approved equal by Synthetic Industries, or Amoco Fabrics and Fibers Company.

3 EXECUTION

3.1 Clearing

3.1.1 Remove from the site trees, stumps, roots, brush, shrubs, down timber, rotten wood, rubbish, other vegetation, as well as fences and incidental structures necessary to allow for new construction.

3.1.2 Clearing work shall be restricted to area within "Construction Limits" specified in this Section and as indicated on the drawings.

3.1.3 Undisturbed stumps and roots, a minimum of 5 feet below finished grade and not located under or within 10 feet of any structure, may be left in place. Tops of stumps left in place shall not be more than 6 inches above original grade.

3.2 Existing Trees and Shrubs

3.2.1 Trees and shrubs that are to remain will be indicated on the drawings or conspicuously marked on site.

3.2.2 Ownership of Trees: Unless otherwise noted, trees removed to allow for new construction shall become the property of the Contractor and shall be removed from the site.

3.2.3 Provide protection for roots and branches over 1½ inches in diameter that are cut during construction operations. Coat the cut faces with an emulsified asphalt or other coating especially formulated for horticultural use on cut or damaged plant tissues. Temporarily cover all exposed roots with wet burlap to prevent roots from drying out. Provide earth cover as soon as possible.

3.3 Grubbing

3.3.1 Grub areas within and to a point 10 feet outside of all structures, areas to receive fill where finished grade will be less than 3 feet above existing grade, cut areas where finished grade will be less than 2 feet below existing grade, transitional areas between cut and fill, and any area to receive control fill.

3.3.2 Remove from the ground to a depth of 24 inches all stumps, roots ½-inch diameter and larger, organic material, and debris.

3.3.3 Use only hand methods for grubbing inside the drip lines of trees that are to remain.

3.4 Land Disturbance and Construction Limit Criteria for Utility Construction

3.4.1 General Requirements Applying to all Areas

3.4.1.1 The Contractor shall plan construction to minimize disturbance to properties adjacent to the proposed utilities. The Contractor shall flag the proposed limits of construction and mark all proposed

trees to be cut for review and approval by the Engineer prior to any clearing being performed.

3.4.1.2 The Engineer reserves the right to limit the width of land to be disturbed and to designate on the drawings or in the field certain areas or items within this width to be protected from damage.

3.4.1.3 The Contractor shall be responsible for damages to area or items designated by the Engineer to be protected. Repairs to, replacement of, or reparations for areas or items damaged shall be made to the satisfaction of the Engineer before acceptance of the completed project.

3.4.1.4 Unless otherwise noted on the contract drawings, all trees cut shall be removed from this project. Brush, laps, roots, and stumps from trees shall also be removed from the site.

3.4.1.5 All buildings or structures located along the line shall be protected by the Contractor. Hand trenching, shoring, or other methods may be required.

3.4.1.6 Any fences disturbed by the Contractor shall be repaired with new materials to a condition equal to or better than their original condition or to the satisfaction of the Engineer. Provide new fencing where indicated on the drawings.

3.4.1.7 The Contractor shall obtain written permission from property owners for use of any access points other than ones located within right-of-ways. Written permission shall contain conditions for use and restoration agreements between property owner and Contractor.

3.4.1.8 All areas disturbed shall be restored to a condition equal to or better than their original condition and shall be graded to drain.

3.4.1.9 The Contractor shall replace or repair all damaged or destroyed property corners.

3.4.1.10 All trees located beyond 10 feet of the utility centerline shall be protected unless the Contractor obtains written authorization from the Engineer to remove them. The Engineer reserves the right to designate other trees located closer to the centerline for protection where possible.

3.4.1.11 All shrubs, hedge, or other ornamental plantings located along the line shall be protected or moved and replanted by the Contractor.

3.4.1.12 The Contractor shall grub only brush, roots, and stumps of removed trees. Damage to lawns shall be kept to an absolute minimum necessary for construction.

3.4.1.13 Topsoil shall be removed from trench line to a depth of 6 inches and stockpiled for use in final restoration. Topsoil shall be replaced to the same depth.

3.4.1.14 Excavated or blasted rock shall be removed from the site unless otherwise ordered by the Engineer.

3.4.1.15 Restoration and fine grading shall follow within 1 week from the time an area is disturbed or within 500 feet from the immediate work site, whichever occurs first. Seeding shall follow as specified in Section 02936 – Seeding.

3.4.2 Construction Limits

3.4.2.1 The Contractor shall not disturb any areas outside the construction limits indicated on the drawings without express written permission from the Engineer. Construction limits are defined as the limits of clearing.

3.4.2.2 No clear-cutting of timber shall be permitted within the construction limits. The Contractor shall make select cutting of trees, taking the smallest trees first, that are mandatory for the construction of the utility line. The Engineer's decision shall be final on determination of which trees are to be cut.

3.5 Clean up debris resulting from site clearing operations continuously with the progress of the work.

3.6 Remove debris from the site in such a manner as to prevent spillage. Keep pavement and areas adjacent to site clean and free from mud, dirt, and debris at all times.

3.7 Surface Preparation

3.7.1 Stripping: Strip existing topsoil, when present, to a depth of 6 inches without contamination by subsoil material. Stockpile topsoil separately from other excavated material and locate convenient to finish grading area.

3.7.2 Unsuitable Material: Remove unsuitable soil materials, waste material, vegetation, debris, decayed vegetable matter, sod, and mulch from the construction site. Dispose of the unsuitable material off the Owner's property in accordance with all federal, state, and local regulations.

3.8 Protections

3.8.1 Protection Systems: Provide shoring, bracing, and sheeting as required in accordance with the U.S. Army Corps of Engineers "Safety and Health Requirements Manual," EM-385-1-1, Sections 25 A through E.

3.8.2 Site Drainage: Provide for the collection and disposal of surface and subsurface water encountered during construction.

3.8.2.1 Surface Drainage: Completely drain the construction site during periods of construction to keep soil materials sufficiently dry. Provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified in this section at no additional cost to the Owner.

3.8.2.2 Subsurface Drainage: Consider site surface and subsurface conditions, available soil, and hydrological data. Remove water by benching, sump pumping, deep well pumping, or other methods to prevent softening of surfaces exposed by excavation. Use filters on dewatering devices to prevent removal of fines from soil. Provide erosion control at the outlet of piping to prevent erosion. Operate dewatering system continuously until construction work below existing water levels is complete.

3.8.3 Underground Utilities: Location of existing utilities indicated on the drawings is approximate. The Contractor shall physically verify the location and elevation of the existing utilities, whether indicated or not, prior to starting construction. The Contractor shall contact Miss Utility and respective utility owners for exact locations prior to any excavation near utilities.

3.8.4 Machinery and Equipment: Movement of construction machinery and equipment over pipes during construction shall be at the Contractor's risk. Repair or remove and provide new pipe for existing or newly installed pipe that has been displaced or damaged at no additional cost to the Owner.

3.8.5 Flotation: The Contractor shall take all necessary precautions to prevent the flotation of new piping and structures during installation and the period before the new piping and associated structures are backfilled and placed in service.

3.9 Excavation

3.9.1 Excavate to the elevations and dimensions indicated and as specified in this section. Reuse excavated materials that meet the specified requirements for the material type required at the intended location. When soil not meeting the requirements specified in this section is encountered during excavation, remove the unsuitable soil material and replace with select material as

specified in this section. Removal and disposal of unsuitable soil material and placement and compaction of select material shall be performed at no additional cost to the Owner.

3.9.2 Keep excavations free from water. Excavate soil disturbed or weakened by the Contractor's operations, and soils softened or made unsuitable for subsequent construction due to exposure to weather. Refill with select material and compact to 95% of ASTM D 698 maximum density. Unless specified otherwise, refill excavations cut below indicated depth with select material and compact to 95% of ASTM D 698 maximum density. Side slopes when allowed shall be protected with 6-mil polyethylene sheeting.

3.9.3 Pipe Trenches: Excavate to the dimensions indicated and as specified herein. Trenches in public roadways shall be excavated in accordance with the latest edition of the VDOT Road and Bridge Specifications. Where rock is encountered, excavate and remove rock to a minimum depth of 6 inches below the pipe invert. Grade bottom of trenches to provide uniform support for each section of pipe after pipe bedding placement.

3.9.4 Unsuitable Subgrade Soil Materials: Subgrades which are determined to be unsuitable for bearing new equipment, structures, or piping, shall have the unsuitable subgrade soil materials removed and disposed of, and replaced with select material at no additional cost to the Owner.

3.10 Filling and Backfilling: Fill and backfill to elevations and dimensions indicated. Compact each lift before placing overlaying lift.

3.10.1 Common Fill Placement: Provide for general site. Place in 6-inch lifts. Compact areas not accessible to rollers or compactors with mechanical hand tampers. Aerate material excessively moistened by rain to a satisfactory moisture content. Provide a smooth finish surface by blading, rolling with a smooth roller, or both.

3.10.2 Backfill and Fill Material Placement: Place in 6-inch lifts. Place backfill material adjacent to structures as the structural elements are completed and accepted. Backfill against concrete only when approved. Place and compact material to avoid loading upon or against structures. Place backfill and fill materials to 5 feet outside of structures.

3.10.3 Select Material Placement: Provide under all structures and concrete slabs. Select materials shall be provided from approved borrow areas. In addition, provide stone where indicated on the drawings. Place in 6-inch lifts. Backfill adjacent to structures shall be placed as structural elements are completed and accepted. Backfill against concrete only when approved. Place and compact material to avoid loading upon or against structures.

3.10.4 Trench Backfilling: Backfill as rapidly as construction, testing, and acceptance of work permits. Place and compact initial backfill and backfill materials in 6-inch lifts to the top of the trench. Trenches in public

roadways shall be backfilled and compacted in accordance with the latest edition of the VDOT Road and Bridge Specifications.

3.10.5 Bedding Requirements: Except as specified otherwise in the individual piping sections, provide bedding for buried piping as specified herein. Ductile iron piping shall be bedded in VDOT No. 57 coarse aggregate to a depth of ⅛ the outside pipe diameter (minimum depth of 6 inches) beneath the pipe invert in accordance with the Class C condition shown in the Town Standard Detail 20.1 entitled "Pipe Bedding Details."

3.11 Compaction: Expressed as a percentage of maximum density. Determine in-place density of the existing subgrade; if required density exists, no compaction of the existing subgrade will be required.

3.11.1 General Site: Compact underneath areas designated for vegetation and areas outside the 10-foot line of structures to 90% of ASTM D 698.

3.11.2 Concrete Slabs: Compact top 12 inches of subgrade to 98% of ASTM D 698. Compact fill, backfill, and select materials to 98% of ASTM D 698.

3.11.3 Pipe Trenches: Compact fill, backfill, and select materials placed in pipe trenches to 95% of ASTM D 698.

3.11.4 Adjacent Areas: Compact areas within 10 feet of structures to 95% of ASTM D 698.

3.11.5 Paved Areas: Compact top 12 inches of subgrade to 100% of ASTM D 698. Compact fill, backfill, and select materials to 100% of ASTM D 698. In addition to the specified compaction requirements, fill and backfill materials shall be compacted to develop a California Bearing Ratio (CBR) of 10.

3.12 Finish Operations

3.12.1 Grading: Finish grades as indicated within one-tenth of 1 foot. Grade areas to drain water away from structures. For existing grades that will remain but which were disturbed by the Contractor's operations, grade as directed.

3.12.2 Seeding: Provide as specified in Section 02936 – Seeding.

3.12.3 Protection of Surfaces: Comply with all local requirements and the latest edition of the Virginia Erosion and Sediment Control Handbook to control erosion and sedimentation. Protect newly graded areas from traffic, erosion, and settlements that may occur. Repair or reestablish damaged grades, elevations, or slopes.

3.12.3.1 No more than 100 feet of trench shall be open at any one time.

3.12.3.2 During pipe installation activities, the Contractor shall provide seeding and mulch restoration to ensure no more than 10,000

square feet of disturbed area remains unrestored at any given time.

3.12.3.3 Install silt fence on downhill side of pipe trenches and at other locations to prevent sediment from entering drainageways.

3.12.3.4 Apply permanent or temporary soil stabilization to denuded areas within 15 days after final grade is reached on any portion of the site. In addition, apply soil stabilization within 15 days to denuded areas which may not be at final grade but will remain dormant (undisturbed) for longer than 60 days. Soil stabilization practices include vegetative establishment, mulching, and the early application of gravel base on areas to be paved.

3.12.3.5 Install straw bale dam or silt fence around soil stockpiles and excavations.

3.12.3.6 Take all applicable erosion and siltation control measures prior to grading.

3.12.3.7 Protect and maintain storm sewer and culvert inlets with silt traps.

3.12.3.8 Inspect all erosion and sediment control devices at the close of each work day and after each rainstorm. Make necessary repairs or clean up immediately to maintain effectiveness of the device.

3.12.3.9 Where consistent with job safety requirements, easement conditions, and construction methods, place all excavated material on the uphill side of the trench. When the soil is placed on the downhill side of the trench, divert maximum drainage toward the trench.

3.12.3.10 Repair after cleanup: Upon completion of construction work and after spoils and debris have been removed, regrade any areas disturbed by the operations.

3.12.3.11 Water discharged from dewatering activities shall not be discharged directly to any stream or body of water. Comply with Specification 3.26, "Dewatering Structure," of the latest edition of the Virginia Erosion and Sediment Control Handbook.

3.13 Riprap: Riprap shall be installed in accordance with the latest edition of the VDOT Road and Bridge Specifications, Section 414, "Riprap." Geotextile fabric shall be placed under all riprap.

3.14 Geotextile Fabric: Geotextile fabric shall be installed in accordance with the latest edition of the Virginia Erosion and Sediment Control Handbook and the manufacturer's written recommendations.

3.15 Disposition of Surplus Material: Waste soil materials off the Owner's property as directed by the Owner and WW Associates in accordance with federal, state, and local regulations.

3.16 Blasting is not allowed on this project.

3.17 Field Quality Control: The Contractor shall employ an independent testing firm to provide all soil testing required for this project.

3.17.1 Sampling: Take the number and size of samples required to perform the following tests.

3.17.2 Testing: Perform one of each of the required tests for each material used. Provide additional tests for each source change and as requested by WW Associates.

3.17.2.1 Fill and Backfill: Test fill and backfill material in accordance with ASTM C 136 for conformance to ASTM D 2487 gradation limits; ASTM D 1140 for material finer than the No. 200 sieve; ASTM D 423 for liquid limit and ASTM D 424 for plastic limits; ASTM D 698 or ASTM D 1557 for moisture density relations, as applicable.

3.17.2.2 Select Material: Test select material in accordance with ASTM C 136 for conformance to ASTM D 2487 gradation limits; ASTM D 1140 for material finer than the No. 200 sieve; ASTM D 698 or ASTM D 1557 for moisture density relations, as applicable.

3.17.2.3 Density Tests: Test soil density in accordance with ASTM D 698, or ASTM D 2922 and ASTM D 3017. When ASTM D 2922 and ASTM D 3017 density tests are used, verify density test results by performing an ASTM D 698 density test at a location already ASTM D 2922 and ASTM D 3017 tested as specified herein. Perform an ASTM D 698 density test at the start of the project, and for every 10 ASTM D 2922 and ASTM D 3017 density tests thereafter. Test each lift at randomly selected locations every 500 square feet of existing grade in fills for structures and concrete slabs, every 500 square feet for other fill areas, every 1,000 square feet of subgrade in cut, and every 250 linear feet for pipe line installation (minimum one test per pipe line), and additional tests as requested by WW Associates.

End of Section

Section 02500
Paving and Surfacing

1 GENERAL

1.1 Reference specifications where applicable to work under this section are referred to by abbreviation as follows:

1.1.1 American Association of State Highway and Transportation Officials..... AASHTO

1.1.2 American Society for Testing and Materials..... ASTM

1.1.3 Virginia Department of Transportation..... VDOT

1.2 Submittals: Provide the following in a timely manner in accordance with the approved submittals schedule as specified in Section 01400 – General Requirements.

2 PRODUCTS

2.1 Aggregate base course for pavement shall be Type 1, Size No. 21A, graded aggregate base material as defined in VDOT Road and Bridge Specifications, Section 203, "Coarse Aggregate," and Section 208, "Subbase and Aggregate Base Material."

2.2 Aggregate base course for construction entrances shall be Size No. 1, graded aggregate base material as defined in VDOT Road and Bridge Specifications, Section 203, "Coarse Aggregate."

2.3 Aggregate base course for gravel roads shall be Type 1, Size No. 21A, graded aggregate base material as defined in VDOT Road and Bridge Specifications, Section 203, "Coarse Aggregate."

3 EXECUTION

3.1 Aggregate base course construction methods and equipment shall conform to requirements of Section 309, "Aggregate Base Course," of VDOT Road and Bridge Specifications.

3.2 Subgrade Preparation: Subgrade preparation shall consist of the final machining of the subgrade immediately prior to placing the aggregate base course. The surface shall be true to line and grade. Construction methods and equipment shall conform to applicable portions of Section 305, "Subgrade and Shoulders," of VDOT Road and Bridge Specifications.

3.3 Asphalt concrete pavement construction methods shall conform to Section 315, "Asphalt Concrete Pavement," of VDOT Road and Bridge Specifications.

3.3.1 Apply prime coat at rate of 0.20 to 0.50 gallon per square yard over compacted aggregate base in accordance with VDOT Road and Bridge Specifications, Section 311, "Prime Coat."

3.3.2 Apply tack coat to contact surfaces of previously constructed asphalt or hydraulic cement concrete and surface abutting or projecting into asphalt concrete pavement. Apply at rate of 0.05 to 0.15 gallon per square yard of surface in accordance with VDOT Road and Bridge Specifications, Section 310, "Tack Coat."

3.4 Pavement Repairs

3.4.1 Pavement repairs shall be performed at any point where excavations disturb existing asphalt and per the repair details shown on design drawings. Pavement repairs shall be performed using either permanent or temporary asphalt concrete pavement as specified herein as soon as possible or as directed by the Engineer. Unless directed otherwise, pavement repairs shall be made no later than fourteen (14) calendar days following disturbance of asphalt. Temporary stone repairs to match the existing pavement prior to pavement repairs shall be dressed at the end of each day and as directed. Repair costs shall be included in the lump sum of bid item 1 for this project.

3.4.2 Contractor shall match the existing subgrade, base, and overlay elevations when installing repairs. Repairs shall bring trench area to the same elevation as the surrounding area.

3.4.3 Pavement, curb and gutter, or sidewalks that will be disturbed must be saw cut. No jagged edges will be allowed. Make the cut in a straight line, parallel to, and 6 inches wider than the trench, on each side, to provide an undisturbed shoulder under the new work.

3.4.4 Where trenches cross a street, the Contractor shall disturb no more than one half of the street width at one time, and restore the first trench opening to satisfactory travelable condition before the second half is excavated. Avoid placement of excavated material on existing pavement wherever possible. Clean the pavement by an approved method. Do not use cleated equipment on pavements. Any pavements damaged by equipment or Contractor's operation shall be repaired at the Owner's discretion at no additional cost. Alter normal traffic flow only with permission from the Owner.

3.4.5 Replace aggregate base course in layers not to exceed 6 inches in thickness to a depth of 1½ times the thickness of the original aggregate base. In no case shall the replaced base be less than 8 inches thick.

3.4.6 Replace asphalt concrete base course equal to the original pavement asphalt base.

3.4.7 Replace asphalt finished surface course equal to the original pavement surface course.

3.4.8 Restore private entrances to the original condition or provide no less than 6 inches of aggregate base course, whichever condition is better.

3.4.9 Apply pavement markings following final asphalt patch.

3.5 Temporary Repairs

3.5.1 When existing asphalt pavement is disturbed in streets and parking lots and permanent pavement repairs cannot be performed immediately, or when asphalt concrete pavement is unavailable during winter months, furnish and place temporary cold patch asphalt material as required to maintain traffic until permanent asphalt concrete pavement repairs can be made. Cold patch material shall be installed in accordance with the manufacturer's written recommendations. Cold patch asphalt pavement material shall be placed at minimum 2-inch thickness. The Contractor shall maintain the temporary pavement repairs to the satisfaction of the Owner until permanent pavement repairs are made.

3.5.2 Within 30 calendar days of permanent hot patch asphalt concrete pavement becoming available, remove all temporary cold patch material and replace with permanent hot patch material.

3.6 All finished pavement edges shall be clean and straight. The final paving quality control shall be the responsibility of the Contractor and shall be acceptable to the Owner based on surface thickness and smoothness.

3.7 Do not block private entrances except for short periods, and maintain ingress and egress to adjacent property at all times.

3.8 Do not clog street drainage. Maintain shoulders, gutters, and ditches affected by trenching operations to carry drainage flows. New pavement overlays shall not block existing drainage flow conditions.

3.9 Sweep and clean surface prior to painting pavement markings. Restore pavement markings to the original condition after pavement repairs have been completed. Use yellow for no parking zones and white for all other markings.

3.10 Restore concrete sidewalks, curbs, and combination curb and gutter to the original condition and per the details shown on the design drawings. Construct concrete sidewalks in accordance with VDOT Road and Bridge Specifications, Section 504, "Sidewalks, Steps, and Handrails." Construct concrete curbs and combination curb and gutter in accordance with VDOT Road and Bridge Specifications, Section 502, "Incidental Concrete Items."

3.11 Upon completion of construction work and after spoils and debris have been removed, regrade any areas disturbed by the operations.

End of Section

Section 02730
Wastewater Piping System

1 GENERAL

1.1 Description: This section specifies all wastewater piping work on this project. These piping systems shall include, but not be limited to, the following applications:

1.1.1 Pump suction and discharge piping

1.1.2 Force main piping

1.1.3 Plant flow piping

1.1.4 Sanitary sewer

1.1.5 Sludge piping

1.1.6 Digested sludge (DS)

1.1.7 Supernatant/decant piping

1.1.8 Nonpotable water (NPW) piping

1.1.9 Drain/ floor drain piping

1.1.10 All other wastewater piping unless otherwise noted

1.2 Related Requirements: The following sections contain requirements that relate to this section.

1.2.1 Section 02735 – Pipe Supports and Anchors

1.2.2 Section 09900 – Painting

1.2.3 Section 11300 – Wastewater Pumping Equipment

1.2.4 Section 11301 – Sludge Pumping Equipment

1.2.5 Section 13300 – Flow, Level, and Pressure Instruments

1.3 Reference specifications are referred to by abbreviation as follows:

1.3.1 American National Standards Institute..... ANSI

1.3.2 American Society for Testing and Materials..... ASTM

1.3.3 American Water Works Association ..... AWWA

1.3.4 Uni-Bell PVC Pipe Association ..... UNI-B

1.3.5 Virginia Department of Health ..... VDH

1.3.6 Virginia Department of Transportation ..... VDOT

1.4 Project Conditions: Separation of Water Lines and Sanitary Sewers

1.4.1 Follow VDH standards for the separation of sanitary sewer and water distribution systems.

1.4.2 Parallel Installation

1.4.2.1 Normal Conditions: Sewer lines and manholes shall be constructed at least 10 feet horizontally from a water line whenever possible. The distance shall be measured edge-to-edge.

1.4.2.2 Unusual Conditions: When local conditions prevent a horizontal separation of at least 10 feet, then maximum horizontal separation shall be provided with vertical separation of bottom of water line at least 18 inches above top of sewer. Where this vertical separation cannot be obtained, the sewer shall be constructed of AWWA approved water pipe pressure-tested in place to 50 psi without leakage prior to backfilling. The sewer manhole shall be of watertight construction and tested in place.

1.4.3 Crossing

1.4.3.1 Normal Conditions: Sewers crossing under water lines shall be laid to provide a separation of at least 18 inches between the bottom of water line and the top of the sewer whenever possible.

1.4.3.2 Unusual Conditions: When local conditions prevent a vertical separation described in "Crossing, Normal Conditions," paragraph above, the following construction shall be used.

1.4.3.2.1 Sewers passing over water lines shall be laid to provide:

1.4.3.2.1.1 Vertical separation of at least 18 inches between bottom of sewer and top of water line,

1.4.3.2.1.2 Adequate structural support for the sewers to prevent excessive deflection of the joints and settling on and breaking the water line,

1.4.3.2.1.3 Maximum separation of water and sewer line joints,

1.4.3.2.1.4 Sewers passing over or under water lines shall be constructed of cast or ductile iron

with mechanical joints as described in "Parallel Installation, Unusual Conditions," paragraph above.

1.4.4 Sanitary Sewers or Sewer Manholes: No water pipes shall pass through or come in contact with any part of a sewer or sewer manhole.

1.5 Submittals: Provide the following in accordance with the approved submittals schedule as specified in Section 01400 – General Requirements.

1.5.1 Pipe and Fittings: Catalog cuts and certificates of compliance for pipe, fittings, linings, and materials for approval. Certificates shall state that materials furnished comply with the standards specified in this section.

1.5.2 Pipe Restraint Devices

1.5.3 Valves: Catalog cuts and certificates of compliance for valves

1.5.4 Valve Boxes

1.5.5 Flexible Couplings

1.5.6 Cleanouts

1.5.7 Precast Concrete Manhole, Valve Vault, and Tank Section Details

1.5.8 Manhole Frames and Covers

1.5.9 Manhole and Valve Vault Steps

1.5.10 Pipe to Manhole Connection Details

1.5.11 Certification Reports for Manhole and Sanitary Sewer/Force Main Piping Testing

2 PRODUCTS

2.1 Piping Application

2.1.1 All below grade wastewater piping, larger than 3 inches in diameter, shall be constructed of restrained joint Special Thickness Class 52 ductile iron pipe unless otherwise indicated. Pipe restraint shall be provided as specified herein unless otherwise indicated.

2.1.2 All below grade wastewater piping systems, smaller than 3 inches in diameter, shall be constructed of solvent welded Schedule 80 polyvinyl chloride (PVC) pipe unless otherwise indicated.

2.1.3 All above grade wastewater piping and piping systems in building, tanks, wetwells, and vaults, 3 inches and larger in diameter, shall be constructed of

flanged joint Special Thickness Class 53 ductile iron pipe unless otherwise indicated.

2.1.4 All above grade wastewater piping and piping systems in buildings, tanks, wetwells, and vaults, smaller than 3 inches in diameter, shall be constructed of threaded joint Schedule 40 galvanized steel pipe unless otherwise indicated.

2.1.5 Pressure piping systems shall include, but not be limited to, the following applications:

2.1.5.1 Plant flow piping

2.1.5.2 Pump suction and discharge piping

2.1.5.3 Force main piping

2.1.5.4 Sludge piping (primary, secondary, thickened, waste activated)

2.1.5.5 Digested sludge (DS) piping

2.1.5.6 Nonpotable water (NPW) piping

2.1.5.7 Supernatant/decant piping

2.1.6 Accessories: Provide flanges, connecting pieces, transition glands, transition sleeves, and other adapters as required for complete and operable piping systems for service indicated. Provide restrained joints where indicated on the drawings and as specified in this section.

2.1.7 All above-ground piping shall be labeled.

2.2 Pipe

2.2.1 Ductile Iron Pipe

2.2.1.1 Ductile iron pipe shall be Special Thickness Class 52 unless otherwise indicated and shall meet requirements of ANSI/AWWA C150 and C151. Flanged pipe shall be Special Thickness Class 53 unless otherwise indicated and shall meet requirements of ANSI/AWWA C115.

2.2.1.2 Fittings shall meet requirements of ANSI/AWWA C110 and C153 with pressure rating not less than that of the pipe.

2.2.1.3 Provide mechanical joints or restrained push-on joints for underground piping. Jointing materials shall meet requirements of ANSI/AWWA C111.

2.2.1.4 Mechanical joint retainer glands shall be ductile iron and shall be manufactured by EBAA Iron, Inc, American Cast Iron Pipe Company, Clow Corporation, Ford Meter Box Company, Star Pipe Products, Romac Industries, Inc., or approved equal.

2.2.1.5 Restrained push-on joints shall be "FLEX-RING" as manufactured by American Cast Iron Pipe Company, "TR FLEX" as manufactured by U.S. Pipe and Foundry Company, "SNAP-LOK" as manufactured by Griffin Pipe Products Company, or approved equal. Jointing materials shall meet requirements of ANSI/AWWA C111.

2.2.1.6 Push-on joint and rubber gasket shall meet requirements of ANSI/AWWA C111. Restrained push-on joints as specified herein may be used where restrained joints are required. "FIELD-LOK" push-on gaskets or similar products will not be allowed as the sole method of joint restraint.

2.2.1.7 Provide flanged joints for all aboveground piping and as indicated on the drawings. Flanges shall meet requirements of Class 125 ANSI B16.1.

2.2.1.8 Flanged joint gaskets shall be full face, made of rubber, and shall meet requirements of ANSI/AWWA C111/A21.11.

2.2.1.9 Cement mortar lining with bituminous seal coat for ductile iron pipe and cast iron fittings shall meet requirements of ANSI/AWWA C104. Cement mortar lining shall be standard thickness.

2.2.1.10 Exterior, bituminous coating shall meet requirements of ANSI/AWWA C110, C115, C151, and C153, as applicable.

2.2.1.11 Flanged ductile iron pipe and fittings for interior applications shall be provided with the manufacturer's standard primer and receive a field-applied coating system as specified in Section 09900 – Painting.

2.2.2 Galvanized Steel Piping

2.2.2.1 Hot-dipped, zinc-coated galvanized steel piping shall be ASTM A 53 or ASTM A 120, Schedule 40, with threaded end connections.

2.2.2.2 Provide ANSI B16.3 hot-dipped, zinc-coated threaded fittings, ANSI B16.39 hot-dipped, zinc-coated threaded unions, and polytetrafluoroethylene (PTFE) pipe thread tape.

2.2.3 Schedule 80 Polyvinyl Chloride (PVC) Piping

2.2.3.1 Pipe, couplings, and fittings shall be Schedule 80 meeting the requirements of ASTM D 1785, manufactured of material meeting the requirements of ASTM D 1784, Type 1120. Provide ASTM D 2467 Schedule 80 fittings, ASTM D 2564 solvent cement. Joints shall be solvent welded, meeting requirements of ASTM D 2855.

2.2.3.2 Provide screwed joints and flanges as required to connect dissimilar pipe materials, valves, equipment, and appurtenances.

2.3 Valves: Valve leakage will not be allowed.

2.3.1 Check Valves

2.3.1.1 Check valves shall be iron body, bronze mounted, swing check valves, meeting requirements of AWWA C508. Check valves 3 through 12 inches shall have 175-psi non-shock cold water working pressure rating. Valves shall have outside weight and lever. Manufacturer shall be American Darling Valve and Manufacturing Company, Clow Valve, Kennedy Valve Manufacturing Company, M&H Division of Dresser Industries, G-A Industries, Inc., or approved equal.

2.3.2 Plug Valves

2.3.2.1 Plug valves shall be tight closing, resilient faced, non-lubricating variety, meeting requirements of AWWA C517, and shall be of eccentric design such that the plug rises off the body seat contact area immediately upon shaft rotation during the opening movement. Valves shall be watertight at the rated pressure and shall be satisfactory for applications involving throttling service, as well as frequent or infrequent on-off service. The valve-closing member shall rotate approximately 90º from the full-open to the full-closed position and vice versa. All plug valves shall provide watertight shutoff service.

2.3.2.2 The valve body shall be constructed of cast iron conforming to ASTM A 126, Class B. Valves for below grade service shall be mechanical joint meeting the requirements of AWWA C111/ANSI A21.11. Valves for above grade service shall be flanged meeting the requirements of ANSI B16.1, unless otherwise indicated on the drawings.

2.3.2.3 Valves 3 to 12 inches shall have 175-psi non-shock working pressure rating. Valves 14 to 36 inches shall have 150-psi non-shock working pressure rating. Each plug valve shall be tested against the seat at the full rated working pressure and a hydrostatic shell test at twice the rated working pressure.

2.3.2.4 Eccentric plug valves shall have a rectangular shaped port. Port areas for 3 to 20-inch valves shall be a minimum of 80% of full pipe area.

2.3.2.5 Valve seat surface shall welded-in overlay, cylindrically shaped of not less than 90% pure nickel. Seat area shall be raised, with raised area completely covered with weld to ensure proper seat contact. The machined seat area shall be a minimum of ⅛-inch thick and ½-inch wide.

2.3.2.6 The entire plug shall be 100% encapsulated with BUNA-N rubber in all valve sizes. The rubber compound shall be approximately 70 Shore A durometer hardness. The rubber to metal bond must withstand 75-pound pull under test Procedure ASTM D 429, Method B. The plug shall have a cylindrical seating area that is offset from the center of the plug shafts. The plug shafts shall be integral.

2.3.2.7 Upper and lower shaft bearings shall be sleeve type metal bearings, sintered, oil-impregnated, and permanently lubricated 316 stainless steel conforming to ASTM A 743, Grade CF-8M. Thrust bearings shall be Nylatron.

2.3.2.8 Plug valve shaft seals shall be multiple V-ring type and shall be adjustable. All packing shall be replaceable without removing the bonnet or actuator and while the valve is in service. Shaft seals shall be constructed of BUNA-N rubber.

2.3.2.9 Valves smaller than 6 inches in diameter shall have a 2-inch square nut and removable lever for above grade service, sized for 75-psi (minimum) pressure drop across valve. Valves 6 inches and larger shall have totally enclosed gear operators, including adjustable memory stops with handwheel actuators for above grade service.

2.3.2.10 Plug valves shall have port positions indicated on the operating nut or valve casing. Exterior valves shall be suitable for underground service and have a standard 2-inch square operating nut that extends within 12 inches of the prevailing ground surface.

2.3.2.11 Valve stands for exterior valves shall be fabricated from high strength ASTM A 536 Grade 65-45-12 ductile iron, designed to accommodate an electric motor actuator, and shall visually indicate valve open/closed status. Valve extension stems shall be fabricated from stainless steel. Valve stands shall be provided by the valve manufacturer.

2.3.2.12 Valves shall be manufactured by Clow Valve, M&H Division of Dresser Industries, Henry Pratt Company, or approved equal.

2.3.3 Ball Valves: Ball valves shall be Class 150, meeting requirements of ANSI B16.34. Valves shall have ANSI carbon steel bodies and balls. Valves shall have stainless steel stems and trim, and Viton or Teflon seats, body seals, and stem seals. Valves shall be lever operated. Valves shall be manufactured by Velan Valve Corporation, ITT-Grinnell, Worchester, Inc., or approved equal.

2.3.4 Tideflex check valves shall be Series TF-2, all rubber construction, flow operated check type with a slip-on connection as manufactured by Red Valve Company, Inc., Cla-Val Company, or approved equal. Inlet port area shall contour down to a duckbill which shall allow passage of flow in one direction while preventing reverse flow. The flexible duckbill sleeve shall be one piece rubber construction with fabric reinforcement. The check valve shall also have a protective neoprene exterior wrapping for protection against sunlight attack. Company name, plant location, valve size, and serial number shall be bonded to the check valve.

2.3.5 Sewage Air Release Valves

2.3.5.1 Sewage air release valves shall be APCO Model 400 sewage air release valves as manufactured by DeZurik, or approved equal by Val-Matic Valve & Manufacturing Corporation, Cla-Val Company, or ARI USA, Inc. Valves shall have the following dimensions:

2.3.5.1.1 Inlet Diameter: 2-inch NPT

2.3.5.1.2 Outlet Diameter: ½-inch NPT

2.3.5.1.3 Orifice Diameter: ¼-inch

2.3.5.2 Valves shall have cast iron body and cover, bronze mechanism and seat, Buna-N needle, and stainless steel float and lever pins. Valves shall be equipped with valved quick disconnect coupling for backflushing, inlet and blowoff valves, and minimum of 10 feet of hose for backflushing.

2.3.6 Telescoping Valves

2.3.6.1 Telescoping valves shall be provided to allow decanting of supernatant from the top of each aerobic digester.

2.3.6.2 Telescoping valves shall be sized to fit the riser pipe (sized as indicated on the contract drawings) and penetrate the riser pipe a minimum of 9 inches in the up position.

2.3.6.3 The unit shall have a floor stand of 4-inch square stainless steel tube with ⅛-inch wall thickness and mounted to a ½-inch thick stainless steel base plate.

2.3.6.4 The handwheel shall be 16-inch diameter cast aluminum and work in conjunction with a brass lifting nut and 1⅛-inch diameter stainless steel triple lead acme rod, requiring a maximum of 16 turns for one foot of travel. Polymer bearing pads shall be incorporated above and below the brass nut.

2.3.6.5 The slip tube shall be a minimum of 16 gauge stainless steel and incorporate a 150 pound stainless steel companion flange and ¼-inch thick neoprene wipe gasket.

2.3.6.6 Unit shall be guaranteed against defects in material and/or workmanship for a period of 3 years. Telescoping valve assemblies shall be manufactured by Halliday Products, Inc., or approved equal by Trumbull Manufacturing, Inc.

2.4 Valve boxes shall be adjustable cast iron valve boxes of the three-piece type, consisting of lid, two-piece screw-type extension, and base. Base shall be proper type and size for the valve with which it is used. The word "SEWER" shall be cast or embossed on the valve box lid in letters not less than 1-inch high. Valve boxes shall be manufactured by Mueller Company, Dewey Brothers, Tyler, Bingham-Taylor, or approved equal.

2.5 Yard hydrants for nonpotable water shall be automatic draining, freezeless type, with 1½ - inch inlet, 1½ - inch galvanized steel pipe casing, ¼-inch galvanized steel pipe operating rod and 1½ -inch female hose thread galvanized steel toe. Yard hydrants shall be Model U150 manufactured by Woodford Manufacturing Company, or approved equal.

2.6 Flexible couplings for connecting pipes of dissimilar materials shall be as manufactured by Fernco of Davison, Michigan or approved equal.

2.7 Flexible couplings for ductile iron piping shall be of a gasketed, sleeve type. Each coupling shall consist of a steel middle ring, two steel followers, two rubber compounded wedge section gaskets, and sufficient galvanized track head steel bolts to properly compress the gaskets. Couplings shall be of the type to match piping in which installed. Couplings shall be Style 38 manufactured by Dresser Manufacturing Division of Dresser Industries or approved equal by Smith-Blair Products of Rockwell International. All couplings shall be provided with tie rod restraint.

2.8 Expansion Joints

2.8.1 Standard expansion joints shall be Redflex No. J-1 with ⅜-inch galvanized split steel retaining rings as manufactured by Red Valve Company, Inc or approved equal.

2.8.2 Tapered expansion joints shall be Redflex No. J-10 (concentric) or No. J-11 (eccentric) with ⅜-inch galvanized split steel retaining rings as manufactured by Red Valve Company, Inc or approved equal.

2.8.3 Expansion joint body shall consist of fabric and rubber compounds reinforced with steel rings for strength. Body shall contain inner lining constructed of neoprene.

2.9 Flange adapters for joining plain-end pipe to flanged items shall be Style 127 or 128 as manufactured by Dresser Manufacturing Division of Dresser Industries, Series 2100 MEGAFLANGE as manufactured by EBAA Iron, Inc., or approved equal by Smith-Blair Products of Rockwell International.

2.10 Cleanouts

2.10.1 Exposed Metal Cleanouts

2.10.1.1 Standard: ASME A112.36.2M for cast iron for cleanout test tee.

2.10.1.2 Size: Same as connected piping.

2.10.1.3 Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.

2.10.1.4 Closure: Countersunk, cast-iron plug.

2.10.1.5 Closure Plug Size: Same as or not more than one size smaller than cleanout size.

2.10.1.6 Closure: Stainless-steel plug with seal.

2.10.2 Plastic Floor Cleanouts

2.10.2.1 Size: Same as connected branch.

2.10.2.2 Body: PVC.

2.10.2.3 Closure Plug: PVC.

2.10.2.4 Riser: Drainage pipe fitting and riser to cleanout of same material as drainage piping.

2.11 Pipe Labeling

2.11.1 Above grade piping 1-inch in diameter and larger shall be labeled. Provide labeling every 15 linear feet of pipe and spell out the pipe system. Labels shall be either black for light colored piping or white for dark colored piping.

2.11.2 Detectable tape shall be provided for all below grade piping systems and shall have a metallic core protected by a plastic jacket. The tape shall be continuously marked indicating that a sewer line is buried beneath the tape. In addition, a continuous No. 14 gauge copper wire with protective coating shall be provided for all below grade piping systems as indicated on the drawings.

2.12 Manholes

2.12.1 Precast Reinforced Concrete Manhole Section

2.12.1.1 Precast reinforced concrete manhole sections shall meet requirements of ASTM C 478. Section ends shall have o-ring gasket groove provided during manufacturing process. Gaskets for section joints shall meet requirements of ASTM C 443. Joints may also be sealed with flexible butyl resin sealant as manufactured by Concrete Sealants, Inc. Sealant shall be installed in accordance with the manufacturer's written recommendations. Top sections for all manholes shall be designed to withstand HS-20 traffic loading.

2.12.1.2 Protective coating for concrete manhole section interior shall be two coats of coal tar solution such as International protective coat "Intertuf 100" or Pittsburgh Paint "Coal Cat 97-640/97-641" or manufactured with calcareous aggregate so that the finished product shall have an AZ factor equal to 90.

2.12.1.3 Concrete fill for fillets shall be one part Portland cement to three parts sand, with sufficient potable water to produce a stiff grout.

2.12.2 Waterproof manhole frames and covers shall be gray iron castings meeting requirements of ASTM A 48, Class 30, and have 24-inch diameter clear openings such as Neenah Foundry Company Type R-1916-F (24-inch diameter clear opening) or Type R-1916-H (30-inch diameter clear opening) with Type "C" cover and bolt holes for four anchor bolts or approved equal by U.S. Foundry or East Jordan Iron Works. Frames shall be provided with holes for bolting it down to manhole riser section. Each cover shall have cast or embossed on it in letters not less than 1-inch high "SANITARY SEWER." The frame and cover shall weigh at least 330 pounds.

2.12.3 Manhole frames shall be anchored to the top of the manhole riser sections with ¾-inch expansion bolts. Two passes of "ConSeal" bitumastic sealant in 1-inch rope form shall be used to provide watertight seal between frame and manhole riser section. Clean manhole riser and frame thoroughly prior to installation.

2.12.4 Manhole steps shall be "Surefoot" step constructed of a No. 4 steel reinforcing rod encased in corrosion-resistant rubber by Oliver Tire & Rubber Company or approved equal.

2.12.5 Pipe to manhole connection shall be sealed with a flexible boot, gasket, sleeve, or as detailed on drawings and meet requirements of ASTM C 923.

2.12.5.1 When the boot is used, the port shall be cored to the size, shape, surface finish, and location required and not cast in the manhole. Angular adjustments through 20º shall be allowed. The flexible boot shall be a ⅜-inch thick neoprene compound meeting ASTM C

443 specifications. The boot shall be secured to the port with an internal aluminum expanding band and to the pipe with a nonmagnetic corrosion resistant steel external band. Boot seal shall be "Kor-N-Seal" as manufactured by National Pollution Control Systems, Inc or approved equal.

2.12.5.2 When gasket is used, the gasket shall be a rubber pressed wedge gasket cast into the manhole with a maximum deflection of 15º as manufactured by Press-Seal Gasket Corporation or approved equal.

2.12.5.3 When sleeve is used, the sleeve shall be a flexible rubber sleeve cast into the manhole complete with stainless steel strap as manufactured by Interpace Corporation or approved equal.

2.13 Precast Reinforced Concrete Vaults and Tanks

2.13.1 Vaults and tanks shall be manufactured by Rotondo Precast, Americast, Tindall Corporation, Engineered Fluid, Inc., or approved equal. Vaults and tanks shall meet requirements of ASTM C 890 and ASTM C 913. Vaults and tanks shall be manufactured as indicated on the drawings and shall be watertight. Provide wall sleeves, aluminum access hatches, aluminum access ladders with safety posts, vents, and other appurtenances as specified herein and indicated on the drawings to ensure complete assembly.

2.13.2 Concrete/Reinforcing Steel Requirements: Provide an air content of 6%, ±2% and a minimum wall thickness of 6 inches. ASTM A 615 reinforcing bars, ASTM A 497 welded wire fabric, ASTM C 443 gaskets for joint connections. Vaults shall be manufactured with calcareous aggregate so that the finished product shall have an AZ factor equal to 90. Sleeves through concrete or masonry walls or slabs shall be cast iron or Schedule 40 steel. Provide sleeves through walls, floors, and ceilings for all pipe penetrations except where wall pipes are indicated. Valve vaults shall be provided with a precast reinforced concrete anti-buoyancy collar designed to prevent flotation when the vault is empty and the groundwater table is located at the surface.

2.13.3 Protective coating for exterior of concrete valve vault and tank sections shall be two coats of coal tar solution such as International protective coat "Intertuf 100" or Pittsburgh Paint "Coal Cat 97-640/97-641," or approved equal.

2.13.4 Vault and tank steps shall be "Surefoot" step constructed of a No. 4 steel reinforcing rod encased in corrosion-resistant rubber by Oliver Tire & Rubber Company or approved equal.

2.13.5 Provide drainage for vaults as shown on the drawings.

2.14 Sleeves through concrete or masonry walls or slabs shall be cast iron or Schedule 40 steel. Provide sleeves through walls, floors, and ceilings for all pipe penetrations except where wall pipes are indicated.

2.15 Pipe to sleeve sealant shall be grouting compound. Grouting compound shall be as manufactured by 3M Company or be an equivalent product having tensile strength of 80 psi and elongation property of 700% in accordance with ASTM D 3574 Test E, and linear dimension change shall not exceed 18% when subject to wet and dry cycles in accordance with ASTM D 756, Procedure G and ASTM D 1042.

2.16 Mechanical Type Pipe to Wall Sleeve Seals: Mechanical type pipe to wall sleeve seals shall be "Link-Seal" pipe to wall closures manufactured by Thunderline Corporation, Wayne, Michigan or approved equal. Seals shall be modular mechanical type, consisting of interlocking synthetic rubber links shaped to fill annular space between pipe and wall opening and shall provide watertight seal between pipe and wall opening.

2.17 Wall Pipes: Wall pipes shall be cast or ductile iron for sizes and connections of pipe types as indicated on the drawings. Wall pipes shall include center flanged waterstop, cast integral with the pipe barrel, at the mid-point. Waterstops continuously welded to the pipe barrel will not be allowed. Unless specifically indicated otherwise, each end of the wall pipe shall protrude a sufficient distance from face of the finished concrete to allow adequate clearance for tools, bolts, and nuts required to complete the type of pipe connection indicated. Wall pipes shall be rated for a working pressure of 250 psi.

2.18 Piping Insulation Systems

2.18.1 Provide insulation systems suitable for outdoor conditions for all exposed above grade piping to a depth of three feet below grade and as required to prevent freezing. Piping insulation systems shall consist of heat tracing, fiberglass insulation, and aluminum jacket.

2.18.2 Heat Tracing

2.18.2.1 Provide 120-volt AC electric heat tracing, thermostats and continuity lights and junction boxes to maintain pipe contents at 40ºF in a 0ºF ambient temperature. Heat trace shall be self-regulating rapid trace, 5 watts/foot Type SRL as manufactured by Chromalox or approved equal. The activation setpoint for all wastewater piping applications shall be 40ºF.

2.18.2.2 Composition: Tracing shall be composed of two copper conductors sized for the rating indicated, separated by a conductive matrix such that a constant heat output is produced per foot at any temperature in the range specified, degraded by the allowable voltage drop for specified running length. The active (conductive) element shall be covered with a minimum plastic coating 5 mils thick. The plastic coating shall be chemically inert in the temperature range of

operation and installation ambient temperature, and shall not attack or be attacked by any metal or plastic piping nor any normal surface finish or piping, nor any normal insulating material installed over the tracing. The tracing shall not be affected by direct sunlight, ambient temperature, operating temperature, rain, or salt laden atmosphere. Heat trace shall be capable of being overlapped without burnout.

2.18.2.3 Thermostats/controls shall be Chromalox Model RT, DL Series, single point on-off temperature controller with NEMA 4X enclosure constructed of high strength polymer or approved equal. Control thermostat shall include corrosion resistant wiring, control enclosure terminal block ¾-inch conduit opening, and MP-1 mounting plate. Switch rating shall conform to the requirements specified on the drawings. Provide all required connection, end seal kits, and accessories as required for complete, operable installation. Mount unit in a position that prevents condensation from draining into the enclosure from the connecting conduit.

2.18.3 Fiberglass Insulation: ASTM C 547 fibrous glass insulation, minimum density 3 pounds per cubic foot, provided with a factory applied vapor barrier jacket. Minimum thickness 1-inch.

2.18.4 Aluminum Jacket: Corrugated type, not less than 0.016-inch thick. Jackets shall be secured with stainless steel or aluminum bands not less than ⅜-inch wide with stainless steel or aluminum screws at 8 inches on center. Seams shall be lapped not less than 2 inches. Provide neat finish at valves, fittings, hangers and appurtenances.

3 EXECUTION

3.1 Inspection and Preparation: Prior to all piping work, carefully inspect the installed work or excavation by other trades and verify that all such work is complete to the point where the piping may be installed in accordance with these documents. Follow the drawings in laying out work and check drawings of other trades to verify sufficient space to install piping. Undimensioned drawings are intended to indicate the general arrangement of piping systems and are not intended to convey precise locational information. Coordinate with other trades to permit all phases of the work to be installed. Offsets, fittings, and extra pipe, necessary to avoid interference or provide maximum headroom and space shall be furnished and installed without additional expense to the Owner. If the piping is installed without coordinating with other phases of the work and so as to cause interference, the necessary changes shall be made at no additional cost to the Owner.

3.2 Installation: Run piping concealed in finished areas unless otherwise indicated. Run piping exposed in equipment rooms, service areas, or areas with no means or need for concealment. Excessive cutting and similar operations likely to weaken a building structure to facilitate the piping installation will not be permitted.

Implement suitable measures throughout the construction period to prevent trash and dirt from entering pipes, before, during, and after installation. Unless otherwise indicated, run piping parallel to the walls of the building. Erect vertical piping straight and plumb, with risers centered in pipe sleeves. Offsets shall conform to offsets in the building construction. Coordinate the work to insure that sleeves and inserts are positioned accurately along with other built-in items, before concrete pouring takes place, and before walls, partitions, and ceilings or roofs are erected so as to reduce to an absolute minimum the necessity for cutting or patching at a later stage.

3.3 Pipe Laying

3.3.1 Take all precautions necessary to insure that pipe, valves, fittings, and related items are not damaged in unloading, handling, and placing in trench. Examine each piece of material just prior to installation to determine that no damage has occurred. Remove any damaged material from the site and replace with undamaged material.

3.3.2 Keep pipe clean. Exercise care to keep foreign material and dirt form entering pipe during storage, handling, and placing. Close ends of in-place pipe at the end of any work period to prevent entry of animals and foreign material.

3.3.3 Bed pipe in accordance with Section 02200 – Earthwork and as detailed on the drawings.

3.3.4 Do not lay pipe when weather or trench conditions are unsuitable.

3.4 Lay gravity sewers so as to maintain a true alignment and grade as indicated on drawings. After completion, the pipe shall exhibit a full circle of light when lighted at one manhole and viewed from the next.

3.4.1 Commence laying gravity sewers at the lowest point on a section of line and lay pipe with the bell ends uphill.

3.4.2 Pipe Joint: Preparatory to making pipe joints on gravity sewer lines, clean and dry all surfaces of joint pipe and jointing material. Use lubricants, primers, adhesives, and similar materials as recommended by the manufacturers. Place, fit, join, and adjust the jointing materials or factory fabricated joints as recommended by manufacturer to obtain the degree of watertightness required. As soon as possible after the joint is made, place sufficient backfill material, as specified in Section 02200 – Earthwork, along each side of pipe to resist forces that might tend to move pipe off line and grade.

3.4.3 Backfill as specified in Section 02200 - Earthwork. Place backfill over the pipe immediately after the pipe has been laid.

3.5 Lay pressure piping with bell ends facing the direction of laying. Where grade is 10 percent or greater, pipe shall be laid uphill with bell ends upgrade. Lay pressure piping with a minimum cover of 36 inches unless otherwise indicated.

3.6 Join mechanical joint pipe as follows:

3.6.1 Thoroughly clean inside of the bell and 8 inches of the outside of the spigot end of the joining pipe to remove oil, grit, excess coating, and other foreign matter from the joint. Paint the bell and the spigot with soap solution. Slip cast-iron gland on spigot end with lip extension of gland toward end of pipe. Paint rubber gasket with or dip into soap solution and place on spigot end with thick edge toward gland.

3.6.2 Push the spigot end forward to seat in the bell. Then carefully press the gasket into the bell so that it is located evenly around the joint. Move the gland into position, insert bolts, and screw nuts up finger tight. Then tighten all nuts to torque listed below.

Bolts Size – Inches	Torque Feet – Pounds
⅝	40-60
¾	60-90
1	70-100
1¼	90-120

3.6.3 Tighten nuts on alternate sides of the gland until pressure on the gland is equally distributed.

3.6.4 Permissible deflection of mechanical joint pipe shall not be greater than listed in AWWA C600.

3.7 Join push-on joint pipe as follows:

3.7.1 Thoroughly clean inside of the bell and 8 inches of the outside of the spigot end of the joining pipe to remove oil, grit, excess coating, and other foreign matter. Flex rubber gasket and insert in the gasket recess of the bell socket. Apply a thin film of gasket lubricant supplied by pipe manufacturer to either the gasket or the spigot end of the joining pipe.

3.7.2 Start spigot end of pipe into socket with care. The joint shall then be completed by forcing the plain end to the bottom of the socket with a forked tool or jack type device. Field cut pipe shall have the end filed to match the manufactured spigot end.

3.7.3 Join restrained push-on joints as recommended in writing by the manufacturer.

3.7.4 Permissible deflection of push-on joint pipe shall not be greater than listed in AWWA C600.

3.7.5 Permissible deflection in restrained push-on joint pipe shall be as recommended in writing by the manufacturer.

3.8 Join restrained push-on joint ductile iron pipe as recommended in writing by the manufacturer. Permissible deflection in restrained joint pipe shall be as recommended in writing by the manufacturer.

3.9 Join and assemble solvent welded PVC pipe joints in accordance with requirements of ASTM D 2855.

3.10 Join pipe of different materials by using Fernco couplings in accordance with the manufacturer's written recommendations.

3.11 Cleanout installation

3.11.1 Install cleanouts in accordance with the manufacturer's written recommendations and as indicated on the drawings.

3.11.2 For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

3.11.3 For cleanouts located in concealed piping, install cleanout wall access covers of types indicated with frame and cover flush with finished wall.

3.12 Set Valves and Valve Boxes as follows:

3.12.1 Set vertically installed valves with stems in the vertical plane through the pipe axis and perpendicular to the pipe in the plane 90º to the pipe axis. Locate valves where indicated on drawings. Thoroughly clean valves before installation. Check valves for satisfactory operation.

3.12.2 Equip all underground valve operators with valve boxes. Set box in alignment with valve stem centered on valve nut. Set valve box to prevent transmitting shock or stress to the valve. Set box cover flush with the finished ground surface or pavement.

3.13 Install combination air valves at locations indicated on the drawings and at all high points on pressure piping in accordance with the manufacturer's written recommendations. Install ball valve between piping and air valve. Use tap, tapping saddle, tee, or other fittings as required for complete and operable installation.

3.14 Install all mechanical items and piping insulation systems in accordance with the manufacturer's written recommendations.

3.15 Construct manholes and wetwells using precast reinforced concrete manhole sections except as otherwise noted. Install manhole frames and covers and manhole steps using materials specified under products.

3.16 Construct manhole channel with smooth semicircular bottoms matching inside diameters of the connecting sewers. Change directions of flow with a smooth curve of as large a radius as the manhole size will permit. Change size and grade of channels gradually and evenly. Channels may be formed directly in the concrete manhole bottom, made of channel pipe, laid in concrete, or constructed by laying full section sewer pipe through the manhole and breaking out the top half when the surrounding concrete has hardened. Manhole floors outside the channels shall be smooth and shall have slope between 2 and 4 inches per foot toward the channels.

3.17 Install precast concrete valve vaults and tanks in accordance with the manufacturer's written recommendations.

3.18 Construct concrete cap or cradle in accordance with the latest edition of the VDOT Road and Bridge Standards at locations where the vertical separation between the new sanitary sewer and adjacent utilities is less than 6 inches.

3.19 Use wall pipes or sleeves where pipes, valves, stem extensions, or equipment parts pass through concrete or masonry walls or slabs. Sleeves shall be or sufficient size to allow sealing around pipes and clearance for valve stem or equipment. Extend vertical sleeves through slabs 1-inch above top surface.

3.19.1 Use cast iron or steel sleeves with intermediate collars to anchor and provide water stops on sleeves that pass through exterior walls below grade. Seal around pipes using grouting compound or "Link-Seal" pipe to wall closures manufactured by Thunderline Corporation, Wayne, Michigan. Seals shall be modular mechanical type, consisting of interlocking synthetic rubber links shaped to fill annular space between pipe and wall opening and shall provide watertight seal between pipe and wall opening. Grouting compound shall be mixed and placed in accordance with the recommendations of the manufacturer. Mechanical pipe to wall seal shall be installed in accordance with the written recommendations of the manufacturer.

3.20 For buried pressure and plant flow piping, provide retainer gland type devices, restraining devices, or restrained joint type pipe at all changes in direction of pressure piping, at dead ends, and as shown on the drawings.

3.20.1 Restrain all joints with retainer glands/devices in accordance with the written recommendations of the retainer gland/device manufacturer. All pipe joints shall be restrained with retainer glands/devices a minimum of 60 feet each side of a fitting or valve.

3.20.2 Where retainer glands/devices are used, extreme care shall be taken so that each set screw is tightened as recommended by the manufacturer before the pipe is backfilled and tested.

3.21 Install detectable tape in trench above all pipe per the manufacturer's written recommendations. Install continuous copper wire in trench above all pipe as indicated on the drawings.

3.22 Pressure pipe tests shall be as follows:

3.22.1 Supply the pumps, potable water, calibrated gages and meters, and all the necessary apparatus.

3.22.2 Hydrostatic Pressure Test: After the line has been backfilled, a hydrostatic pressure test shall be performed using potable water. Carefully fill the system with potable water at a velocity of approximately 1 foot per second while necessary measures are taken to eliminate all air. After the system has been filled, raise the pressure by pump to 100 psi. Measure pressure at lowest point in the system with gauge compensated for elevation. Maintain this pressure for at least 2 hours. If pressure cannot be maintained, determine the cause, repair, and repeat the test until successful.

3.22.3 Following the hydrostatic pressure test, subject the system to a leakage test. Use calibrated meter to determine leakage. Leakage shall be defined as the quantity of potable water that must be supplied into the pipe to maintain working pressure, after all air in the pipe line has been expelled and the pipe has been filled with potable water. Duration of leakage test shall be 2 hours. Zero leakage in the tested pipe section shall be defined as a successful test. Find and repair all leaks and repeat the test until successful.

3.22.4 Repairs: If piping or valves fail to meet test requirements, or if any leaks, crooked pipe, or other defects are visible by inspection, the Contractor shall repair or rebuild at his expense those portions of pressure piping which are faulty. The tests and repairs shall be continued until the pressure piping is deemed acceptable.

3.23 Testing Gravity Sewer Lines

3.23.1 Low pressure air testing in accordance with UNI-B-6 may be used on polyvinyl chloride (PVC) sanitary sewer lines. Low pressure air testing in accordance with ASTM C 924 may be used on all other sanitary sewer lines 24 inches or less in diameter. All manholes shall be tested using the infiltration method, exfiltration method, or vacuum testing. Tests shall be conducted on short sections of sewer line; i.e., between manholes, or at the end of each day's work. Installation of sewers will not be permitted at a point more than 2,000 feet ahead of any section of sewer or any manhole which has not been given the final test and accepted. The Contractor shall provide all labor, materials, tools, and equipment necessary to make the tests. All monitoring gauges shall be subject to calibration, if deemed necessary.

3.23.2 Low Pressure Air Test

3.23.2.1 Summary of Method: After the backfill has been placed and compacted to a minimum depth of 1 foot over the pipe, plug the section of the sewer line to be tested. Introduce low-pressure air into the plugged line.

3.23.2.2 Preparation of the Sewer Line: Flush and clean the sewer line prior to testing, thus serving to wet the pipe surface as well as clean out any debris. A wetted interior pipe surface will produce more consistent results. Plug all pipe outlets using approved pneumatic plugs with a sealing length equal to or greater than the diameter of the line being tested. Give special attention to laterals

3.23.2.3 Groundwater Determination: Install a ½-inch capped galvanized pipe nipple, approximately 12 inches long, through the manhole. Immediately prior to the line test, the groundwater elevation shall be determined by removing the pipe cap and blowing air through the pipe nipple into the ground so as to clear it, and then connecting a clear plastic hose to the pipe nipple. The hose shall be held vertically and a measurement of the height in feet of water over the invert of the pipe shall be taken after the water has stopped rising in the plastic hose.

3.23.2.4 Procedures

3.23.2.4.1 Determine the test duration for the section under test by computation from the applicable formulas shown in ASTM C 924, or from the following "Air Test Table." The pressure-holding time is based on an average holding pressure of 3 psi (21 kPa) gauge or a drop from 3.5 psi (24 kPa) to 2.5 psi (17 kPa) gauge. The tests shall be conducted between two consecutive manholes or as directed.

3.23.2.4.2 The test section of the sewer line shall be plugged at each end. One of the plugs used at the manhole shall be tapped and equipped for the air inlet connection for filling the line from the air compressor.

3.23.2.4.3 All service laterals, stubs, and fittings into the sewer test section shall be properly plugged and carefully braced against the internal pressure to prevent air leakage by slippage and blowouts.

3.23.2.4.4 Connect air hose to tapped plug selected for the air inlet. Then connect the other end of the air hose to the portable air control equipment which consists of valves and pressure gages used to control the air entry rate to the sewer test section and the air pressure in the pipe line.

3.23.2.4.5 More specifically, the air control equipment shall include a shutoff valve, pressure regulating valve, pressure reduction valve, and a monitoring pressure

gauge having a pressure range from 0 to 10 psi. The gauge shall have minimum divisions of 0.10 psi and an accuracy of plus or minus 0.04 psi.

3.23.2.4.6 Connect another air hose between the air compressor (or other source of compressed air) and the air control equipment. This completes the test equipment setup. Test operations may commence.

3.23.2.4.7 Supply air to the test section slowly, filling the pipe line until a constant pressure of 4.0 psig is maintained. The air pressure shall be regulated to prevent the pressure inside the pipe from exceeding 10.0 psig.

3.23.2.4.8 When constant pressure of 4.0 psig is reached, throttle the air supply to maintain the internal pressure above 3.5 psig for at least 5 minutes. This time permits the temperature of the entering air to equalize with the temperature of the pipe wall. During this stabilization period, check all plugged fittings with a soap solution to detect any leakage at these connections. If leakage is detected at any plug, release the pressure in the line and tighten all leaky plugs. Then start the test operation again by supplying air. When it is necessary to bleed off the air to tighten or repair a faulty plug, a new 5-minute interval shall be allowed after the pipe line has been refilled.

3.23.2.4.9 After the stabilization period, shut off or disconnect the air supply. Before starting the test, the pressure may be allowed to drop to 3.5 psig. Record the drop in pressure for the test period. If the pressure has dropped more than 1.0 psi (7 kPa) gauge during the test period, the line shall be presumed to have failed. The test may be discontinued when the prescribed test time has been completed even though the 1.0 psig drop has not occurred.

3.23.2.4.10 If the pipe to be tested is submerged in groundwater, the test pressure shall be increased 1.0 psi for every 2.31 feet the groundwater level is above the invert of the sewer.

3.23.2.4.11 Example: If the vertical height of water from the sewer invert to the top of the water column measures 4.62 feet, the additional air pressure required would be 4.62 divided by 2.31 equals 2 psi.

3.23.2.4.12 Therefore, the starting pressure of the test would be 3.5 plus 2 or 5.5 psig, and the 1.0 psig drop would be to 4.5 psig. There is no change in the allowable drop (1.0 psig) or in the time requirements established for the basic air test.

3.23.2.5 Safety: The air test may be dangerous if, because of lack of understanding or carelessness, a line is improperly prepared.

3.23.2.5.1 It is extremely important that the various plugs be installed and braced in such a way as to prevent blowouts. A force of 250 pounds is exerted on an 8-inch (203 mm) plug by an internal pipe pressure of 5 psi (34 kPa), it should be realized that sudden expulsion of a poorly installed plug or of a plug that is partially deflated before the pipe pressure is released can be dangerous.

3.23.2.5.2 As a safety precaution, pressurizing equipment shall include a regulator or relief valve set at 10 psi (69 kPa) to avoid over-pressurizing and damaging an otherwise acceptable line. No one shall be allowed in the manholes during testing.

3.23.2.6 Table: The air test table at the end of this section has been prepared utilizing applicable formulas from ASTM C 924.

3.24 Manhole Testing

3.24.1 All manholes shall be tested using the infiltration method, exfiltration method, or vacuum testing.

3.24.2 Infiltration or Exfiltration Method: All pipes leading to and from a manhole shall be plugged. Plugs shall be inserted into the pipes a distance greater than the length of the plugs used to test each respective section of sewer line to insure the manhole and sewer line tests overlap. Plugs shall be secured to the manhole structure. The manhole shall be filled with potable water to the top of frame and allowed to soak for a minimum of 2 hours and a maximum of 12 hours to permit the manhole to absorb water. The cover shall be on the manhole during the soaking period. At the end of the soaking period, potable water shall be added until the manhole overflows. After 30 minutes, check difference in level and convert to gallons. Manhole leakage shall not exceed ¼-gallon per hour. Upon completion of the test, the water shall be removed from the manhole.

3.24.3 Vacuum Testing: The vacuum test shall be made using an inflatable compression band, vacuum pump, and appurtenances specifically designed for vacuum testing manholes. Test procedures shall be in accordance with ASTM C 1244, except the more restrictive requirements specified herein.

Equipment shall be manufactured by Peter A. Glazier, Inc., P.O. Box 1002, Worcester, Massachusetts 01613, Telephone: (508) 755-3849, Toll-Free: (800) 822-6488.

3.24.3.1 Manholes may be tested by vacuum test immediately after assembly of the manhole, frames, and connecting pipes and before any backfill is placed around the manholes. However, the final test and acceptance shall be based only upon a test after the manhole is backfilled and the cover frame castings are set in place.

3.24.3.2 All lift holes shall be plugged with nonshrink grout and all pipes shall be plugged, taking care to securely brace the plugs and pipe.

3.24.3.3 After the testing equipment is in place, a vacuum of 10 inches of mercury shall be drawn on the manhole. The manhole will be considered to have passed the test if the vacuum does not drop more than 1-inch of mercury within 60 seconds for manholes 7 feet in depth or less and 90 seconds for manholes over 7 feet deep.

3.24.3.4 If the manhole fails the initial test, the Contractor shall locate the leakage and make proper repairs, and retest until a satisfactory test result is obtained.

3.24.3.5 After the manholes have been backfilled and the cover frame casting sealed in place, and prior to final acceptance of the project, any signs of leaks or weeping visible from the inside of the manhole shall be repaired, and the manhole made watertight and tested.

3.25 Test for leakage of gravity sewers including manholes, using either the infiltration or exfiltration method. Maximum allowable leakage shall be limited to 2,400 gallons per day per mile or 100 gallons per day per inch diameter per mile, whichever is less.

3.25.1 Use infiltration test when groundwater is at least 4 feet above top of the pipe for the entire length of line to be tested. Plug the pipe at the upper manhole. Install suitable measuring device at the next lowest manhole. Measure the amount of water flowing through the measuring device over a 30-minute period. Sewer lines crossing under streams shall exhibit zero infiltration.

3.25.2 Use exfiltration test when groundwater is less than 4 feet above top of pipe. Plug the pipe at the lower manhole. Fill the line and manhole with potable water to 4 feet above top of pipe, or top of manhole whichever is less. Let the water stand until pipe has reached maximum absorption and until all trapped air has escaped, 12-hour minimum. After maximum absorption is reached, refill manhole to original level. After 30 minutes, record difference in level and convert to gallons.

3.25.3 Groundwater Determination: Use same procedure as "Low Pressure Air Test" above.

3.26 Repairs: If sewer lines or manholes fail to meet test requirements or if any leaks, crooked pipe, or other defects are visible by inspection, the Contractor shall repair or rebuild at his expense those portions of sewer lines which are faulty. The tests and repairs shall be continued until the sewer line is deemed acceptable.

Air Test Table
Based on Formulas from ASTM C 924

Minimum Test Time in Minutes: Seconds
For Pressure Drop From 3.5 to 2.5 psig

Line Length in Feet

Pipe Size Inches	10	50	100	150	200	250	300	350	400	450	500
4	0:02	0:09	0:18	0:27	0:36	0:45	0:54	1:03	1:12	1:21	1:30
6	0:04	0:21	0:42	1:03	1:24	1:45	2:06	2:27	2:48	3:09	3:30
8	0:07	0:36	1:12	1:48	2:24	3:00	3:36	4:12	4:48	5:24	6:00
10	0:09	0:45	1:30	2:15	3:00	3:45	4:30	5:15	6:00	6:45	7:30
12	0:11	0:54	1:48	2:42	3:36	4:30	5:24	6:18	7:12	8:06	9:00
18	0:14	1:12	2:24	3:36	4:48	6:00	7:12	8:24	9:36	10:48	12:00
24	0:22	1:48	3:36	5:24	7:12	9:00	10:48	12:36	14:24	16:12	18:00

End of Section

Section 02735
Pipe Supports and Anchors

1 GENERAL

1.1 Reference specifications are referred to by abbreviation as follows:

1.1.1 American National Standards Institute..... ANSI

1.1.2 American Society for Testing and Materials..... ASTM

1.1.3 Manufacturers Standardization Society of the Valve and Fittings Industry..... MSS

1.2 Piping systems shall be supported in accordance with ANSI B31.1 “Power Piping” so as to maintain required pitch of lines, prevent vibration, and provide for expansion and contraction movement. Provide hangers in accordance with MSS SP-58 and MSS SP-69.

1.3 Acceptable Manufacturer: Anvil, Elcen Metal Products, F&S Central, or Michigan Hanger Company. Anvil figure numbers establish the quality standard.

2 PRODUCTS

2.1 Hangers and Rigid Supports

2.1.1 Adjustable swivel split ring hanger shall be fabricated of black malleable iron and be approved by Factory Mutual and be UL listed. Hanger shall be Anvil Figure 104.

2.1.2 Adjustable clevis type hanger shall be black carbon steel and be approved by Factory Mutual and be UL listed. Hanger shall be Anvil Figure 260.

2.1.3 Pipe roll hangers shall consist of a cast iron roll and steel roll rod. Hanger shall be Anvil Figure 171.

2.1.4 Brackets shall be heavy welded carbon steel, of dimensions required to adequately support piping. Brackets shall be hot dipped galvanized after fabrication in accordance with ASTM A 123. Brackets shall be Anvil Figure 199.

2.1.5 U-bolts shall be standard weight, hot dipped galvanized carbon steel, furnished with four finished hex nuts. U-bolts shall be Anvil Figure 137.

2.1.6 Short strap shall be carbon steel, Anvil Figure 262. One-hole clamp shall be black finished malleable iron, Anvil Figure 126.

2.1.7 Adjustable pipe saddle support shall be cast iron saddle, locknut nipple, and cast iron reducer, factory assembled. Stantion type support shall allow

vertical adjustment by turning locknut nipple. Adjustable pipe saddle support shall be Anvil Figure 264. Adjustable pipe saddle support shall include pipe stand with base flange of suitable size to carry load. Provide expansion anchors for connecting base flange to finished floor, minimum four anchors required.

2.2 Hanger rods shall be ASTM A 575 or A 576 hot rolled carbon steel and meet mechanical property requirements of ASTM A 663.

2.3 Beam clamps shall be fabricated specifically for the structure to which the hanger rod is attached.

3 EXECUTION

3.1 Install rigid pipe hangers as follows:

3.1.1 Uninsulated pipe 2 inches and smaller – Anvil Figure 104.

3.1.2 All piping 2½ inches and larger – Anvil Figure 260.

3.2 Where necessary due to space limitations, provide pipe roll hanger equal to Anvil Figure 171 for piping 2½ inches and larger.

3.3 Space supports or hangers for horizontal piping as follows unless otherwise indicated on the drawings. Provide additional supports for concentrated loads at valves or specialties.

Nominal Pipe Size, Inches	Maximum Span in Feet Steel or Iron Pipe	Plastic Pipe
½-inch	4	2
¾-inch through 1½-inch	6	3
2-inch and 2½-inch	10	4
3-inch	12	5
4-inch and 5-inch	14	6
6-inch	16	6
8-inch and 10-inch	18	7
12-inch and 14-inch	22	8
16-inch and 18-inch	27	-
20-inch	30	-
24-inch	32	-

3.3.1 Provide pipe hanger or support within 18 inches or every change in direction for piping 1½ inches and below and within 3 feet of every change in

direction for piping 2 inches and larger. Horizontal "No-Hub" piping shall be supported at each joint.

3.3.2 Vertical Piping: Support metal piping at each floor, but at not more than 10-foot intervals. Support plastic at each floor and at midpoint between floors, but not at more than 5-foot intervals.

3.4 Support hangers for pipe by using malleable iron or galvanized steel concrete inserts, concrete anchor bolts, beam clamps with lock nuts or retaining straps, or other special fastening devices, as required, for the support of hangers. As an option where direct attachment to frame members is not possible, auxiliary frame members may be provided which shall span at least two structural frame members.

3.4.1 Where pipe cannot be suspended from overhead supports, use substantial cast iron or welded steel wall brackets to support the hangers, pipe seats, or roll stands, as conditions demand.

3.5 Use hot rolled steel hanger rods sized as follows:

3.5.1 For 2-inch pipe and smaller – ⅜-inch diameter.

3.5.2 For 2½-inch through 3½-inch pipe – ½-inch diameter.

3.5.3 For 4-inch and 5-inch pipe – ⅝-inch diameter.

3.5.4 For 6-inch pipe – ¾-inch diameter.

3.5.5 For 8-inch and larger – ⅞-inch diameter.

End of Section

Section 02936
Seeding

1 GENERAL

1.1 Related Requirements: The following sections contain requirements that relate to this section.

1.1.1 Section 01400 – General Requirements

1.1.2 Section 02200 – Earthwork

1.2 Submittals: Provide the following items in accordance with the approved submittals schedule as specified in Section 01400 – General Requirements:

1.2.1 Seed Test Report

1.2.2 Fertilizer Analysis

1.3 Reference specifications are referred to by abbreviation as follows:

1.3.1 American Society of Testing and Materials ..... ASTM

1.3.2 Virginia Department of Transportation ..... VDOT

2 PRODUCTS

2.1 Topsoil: Topsoil shall be the top 6 inches of original soil from the site. Topsoil obtained off-site shall be fertile, friable loam, containing not less than 2% by weight of finely divided, decomposed vegetation. Topsoil shall be free of subsoil, clay lumps, brush, weeds, roots larger than 1½-inch in diameter, stones larger than 1½-inch in diameter, and other material toxic or harmful to growth.

2.2 Fertilizer: Fertilizer shall meet requirements of Federal Specification O-F-241. Provide fertilizer that is complete, inorganic, uniform in composition, and suitable for application with approved equipment. Proportions of fertilizer nutrients shall be the following:

2.2.1 Permanent Seeding

2.2.1.1 5% total nitrogen

2.2.1.2 10% available phosphoric acid

2.2.1.3 5% soluble potash

2.2.2 Temporary Seeding

2.2.2.1 10% total nitrogen

2.2.2.2 20% available phosphoric acid

2.2.2.3 10% soluble potash

2.3 Grass Seed: Grass seed, tested within 6 months of sowing, shall have the following characteristics:

2.3.1 Permanent Seeding (for Residential Lawn Areas)

Species	%Weight	%Purity	%Germination
Kentucky 31 tall fescue	95-100	98	90
Perennial ryegrass	0-5	98	90
Kentucky bluegrass	0-5	98	90

2.3.2 Temporary Seeding

Seeding Date	Species	%Wgt.	%Purity	%Germ.	Seed Rate (lb/acre)
Sep. 1-Feb. 15	Rye/Oats	100	98	85	50-100
Feb. 16-Apr. 30	Rye	100	96	85	60-100
May. 1-Aug. 31	Millet	100	98	80	50

2.4 Lime: Lime shall be ground agriculture grade limestone containing not less than 85% calcium and magnesium carbonates. Fineness shall be such that 100% will pass a No. 20 sieve, and not less than 50% will pass a No. 100 sieve. Burnt lime or hydrated lime may be substituted in equivalent carbonates, if requested.

2.5 Mulch: Type II mulch composed of threshed straw of cereal grain, pine needles or wood fiber which shall be free of objectionable weed seeds or other harmful material.

2.6 Asphalt Adhesive: Asphalt adhesive for use with Type II mulch shall be emulsified asphalt meeting requirements of ASTM D 977, Grade SS-1.

2.7 Mulch Binder: Synthetic mulch binder for use with Type II mulch shall be Curasol, DCA-70 Petroset, or Terra Tack.

2.8 Jute Mesh (VDOT EC-2 Soil Stabilization Blanket): Jute mesh shall be as defined in the VDOT Road and Bridge Specifications, Section 244, "Roadside Development Materials." Installation locations shall be as specified herein.

2.9 VDOT EC-3 Soil Stabilization Matting: C 125 Erosion Control Blanket manufactured by North American Green, 14649 Highway 41 North, Evansville,

Indiana 47711, Telephone: (800) 772-2040, or Curlex III High Velocity Blanket manufactured by American Excelsior Company, 850 Avenue H East, Arlington, Texas, 76011, Telephone: (800) 777-7645. Installation locations shall be as specified herein.

3 EXECUTION

3.1 General

3.1.1 Before seeding, 4 inches of topsoil shall be spread in areas to be seeded. In general, the topsoil shall come from the stockpiles created during the initial clearing of the site. If there is insufficient topsoil in the stockpiles, the Contractor shall provide topsoil from an offsite source at no additional cost to the Owner.

3.1.2 Material shall be delivered in unbroken containers, clearly marked by the manufacturer as to their contents. Seed, limestone, and fertilizer shall be labeled as to proportions, analysis, and quality. Store all materials in a manner affording protection from damage by weather or vandalism.

3.1.3 Seed only when the wind velocity is less than 15 miles per hour.

3.1.4 All areas disturbed by excavation, grading, or other construction operations, except areas to be paved or otherwise permanently stabilized, shall be seeded as specified for permanent seeding. Temporary seeding shall be provided when required at no additional cost to the Owner.

3.1.5 Remove all soiling or staining off finished structures or pavements resulting from seeding work. Maintain paved areas in clean condition.

3.2 Temporary Seeding

3.2.1 Use in areas when final grading has not been completed, when permanent seeding cannot be performed due to the specified permanent seeding dates, or when required for erosion control.

3.2.2 Apply fertilizer at a rate of 10 pounds per 1,000 square feet (450 pounds per acre) or equivalent. Apply lime at a rate of 90 pounds per 1,000 square feet.

3.2.3 For loose soil, work lime and fertilizer into soil and then seed. For packed or hard soil, loosen top layer while working lime and fertilizer into soil and then seed at the rate specified for the temporary seeding species.

3.2.4 Seed only between application dates mentioned above and in “Table 3.31-B: Temporary Seeding Specifications” as shown on design drawing C-8.

3.3 Permanent Seeding

3.3.1 For all areas to receive permanent seeding, apply fertilizer at the rate of 50 pounds per 1,000 square feet and apply lime at the rate of 100 pounds. per 1,000 square feet.

3.3.2 Apply fertilizer and lime uniformly and mix well into the top 4 inches of the seedbed.

3.3.3 Prepare soil for permanent seeding by tillage of topsoil in place to loosen thoroughly and break up all clods to a depth of 6 inches. Remove all stumps and roots, coarse vegetation, stones larger than 1½ inches, and all construction debris. Soil shall be worked by suitable agricultural equipment to a depth of not less than 4 inches. Surface shall be uniform, smooth, and drainable. A firm and compact seedbed is required.

3.3.4 Sow permanent grass seed between dates of March 1 and April 15 or September 1 and November 15.

3.3.5 Sow seed by mechanical seeder as follows:

3.3.5.1 Mix seed thoroughly with clean dry sawdust and broadcast at rate of 6 pounds of seed per 1,000 square feet for permanent seeding or as specified elsewhere for temporary seeding.

3.3.5.2 Apply Type II mulch uniformly to depth of approximately 1¼ inches.

3.3.5.3 Anchor Type II mulch by the following methods:

3.3.5.3.1 Apply light tack coat of asphalt emulsion or synthetic mulch binder.

3.3.5.3.2 On slopes steeper than 4(H):1(V), anchor with VDOT EC-2 jute mesh fastened to wooden stakes.

3.3.5.3.3 On slopes steeper than 2(H):1(V), anchor with VDOT EC-3 soil stabilization matting fastened in accordance with the manufacturer’s written recommendations.

3.3.6 Sow seed by hydraulic seeder as follows:

3.3.6.1 Prepare homogeneous slurry equal to the seed mixture used for mechanical seeding as specified in this section.

3.3.6.2 Distribute slurry uniformly at rate equal to the rate specified for mechanical seeding.

3.3.6.3 Apply mulch, jute mesh, and soil stabilization blankets as specified for sowing by mechanical seeder.

3.3.7 Coordinate permanent seeding with the requirements presented in "Table 3.32-D: Site Specific Seeding Mixtures for Piedmont Area" as shown on design drawing C-8.

3.4 Maintenance of Seeded Areas

3.4.1 The Contractor is advised that final payment for the project will not be received until a uniform stand of grass acceptable to the Engineer has been established.

3.4.2 Reseed and mulch spots larger than one square foot without uniform stand of grass. In areas where jute mesh or soil stabilization blankets have been applied, the mesh or blanket shall be removed prior to reseeding, and reapplied after reseeding activities are complete. Reseeding shall include application of fertilizer, lime, and seed in accordance with the agronomic loading rates specified herein. Reseeding shall be performed multiple times during the course of a planting season and over the course of multiple planting seasons until a uniform stand of grass is established.

3.4.3 Maintain all seeded areas until uniform stand of grass is acceptable to the Engineer.

3.4.4 In the event that growth is not established by the final project inspection, continue the specified attention until the stand is accepted by the Engineer.

3.4.5 Correct or repair all undue settling for a period of one year after final inspection.

3.4.6 Water as necessary.

3.4.7 Mowing: Maintain grass height between 2 and 4 inches.

End of Section

Section 03300
Cast-in-Place Concrete

1 GENERAL

1.1 Reference publications are referred to by abbreviations as follows:

1.1.1 American Concrete Institute.....ACI

1.1.2 American Society for Testing and Materials..... ASTM

1.1.3 Concrete Reinforcing Steel Institute .....CRSI

1.1.4 National Institute of Standards and Technology .....NIST

1.2 Quality Assurance

1.2.1 Provide the services of an independent inspection agency to perform inspection as specified in this section. The inspection agency shall be approved by WW Associates.

1.2.2 The independent testing agency, including branch office used, referred to in this Section and Section 1 of ACI 301 shall meet the requirements of ASTM E 329 and shall have been inspected within the past 3 years by the cement and concrete reference laboratory of the NIST and shall have corrected any deficiencies noted. Project sponsor as defined in ASTM E 329 shall be the Contractor.

1.3 Submittals: Provide the following in a timely manner.

1.3.1 Shop drawings of reinforcing steel in accordance with ACI 301. All construction joints shall be indicated on the shop drawings.

1.3.2 Complete concrete mix designs and documentation in accordance with ACI 301 Section 4.2.3 indicating compliance with one of the paths allowed in the flow chart. Include the following documentation:

1.3.2.1 Specific mix designs proposed.

1.3.2.2 Quantity and types of admixtures.

1.3.2.3 Strength test results used to establish standard deviation, and calculated standard deviation in accordance with ACI 301, paragraph 4.2.3.2, if that procedure is followed.

1.3.2.4 Calculated required average compressive strength.

1.3.2.5 Strength test records used to verify that required average compressive strength is met in accordance with ACI 301, paragraph 4.2.3.3, if that procedure is followed.

1.3.2.6 Trial mixtures, strength test thereof, water-cement ratio curve, and selected water-cement ratio to meet the required average compressive strength in accordance with ACI 301, paragraph 4.2.3.4.b, if that procedure is followed.

1.3.3 List of materials and work requiring inspection; inspections to be performed; and a list of the individuals, approved agencies, and firms intended to be retained for conducting such inspections. These lists shall be submitted to WW Associates for approval and to the building official.

1.3.4 Inspection reports.

1.3.5 Manufacturer's literature for the following:

1.3.5.1 Waterstops

1.3.5.2 Floor Type Hydrostatic Pressure Relief Valves

1.3.5.2.1 Trumbull Ductile Iron Type 3167-1572, or approved equal.

2 PRODUCTS

2.1 Concrete work shall meet applicable requirements of ACI 301-05 "Specifications for Structural Concrete," 4,000 psi minimum, except as modified by the supplemental requirements specified in this section. For numbers in parentheses, refer to ACI 301 paragraphs.

2.1.1 (1.6.4) All of the testing services of Sections 1.6.4.1, 1.6.4.2, and 1.6.4.3 shall be paid for by the Contractor. If the concrete is placed by pumping, the strength test shall be taken at the truck discharge and at the point of placement.

2.1.1.1 The testing representative shall sample concrete in accordance with the following schedule for each design mixture placed in any one day:

Strength Tests	1 Set of 3 Cylinders per 50 CY or fraction thereof
Slump Test	1 Test per 50 CY or fraction thereof or if consistency varies
Temperature	1 Test per 50 CY or fraction thereof
Air Entrainment	1 Test per 50 CY or as necessary for control

2.1.2 (2.2.1.4) Expansion joint material shall be self-expanding cork and shall meet the requirements of ASTM D1752.

2.1.3 (2.2.1.4) Isolation joint material shall be the thickness shown and shall meet requirements of ASTM D 1751.

2.1.4 (2.2.1.5) Waterstops shall be PVC ribbed with center bulb profile, style 705 by Sika/Greenstreak or approved equal. Waterstops at concrete joints shall be Hydrotite expandable waterstop, profile CJ-0725-3K, by Greenstreak Group, or approved equal. Waterstops at pipe penetrations shall be Hydrotite expandable waterstop, profile DSS-0320, by Greenstreak Group, or approved equal. Install in accordance with manufacturer's written instructions.

2.1.5 (3.1) Reinforcement General

2.1.5.1 Details of reinforcing

2.1.5.1.1 Verify the location of all sleeves, embedments, attachments, openings, and structural supports for the equipment provided.

2.1.5.1.2 All reinforcing shall be as follows unless otherwise noted on the drawings.

2.1.5.1.3 Reinforcing shall be detailed, fabricated, and placed in accordance with ACI 315-99, with the exception of development lengths and splice lengths.

2.1.5.1.4 Splice lengths at locations not shown on the drawings shall be detailed on the shop drawings to conform to ACI 315-99. Use the splice category appropriate for the actual bar spacing and concrete cover.

2.1.5.1.5 Unless otherwise detailed, dowels in walls shall match size and spacing of main reinforcing bars.

2.1.6 (3.2.1.1) Reinforcing steel shall meet requirements of ASTM A 615 Grade 60 and shall be deformed.

2.1.7 (3.2.2.2) Welding of bar reinforcement will not be permitted.

2.1.8 (3.3.2.3) Cover requirements for concrete exposed to weather shall be used at all surfaces of liquid retention structures, except where concrete is deposited against earth.

2.1.9 (3.3.2.4) Where concrete will be exposed to view in the finished structure, the portions of all bar supports within ½-inch of the concrete surface shall be noncorrosive or protected against corrosion.

2.1.10 (4.2.1.1) Cement shall be as follows:

2.1.10.1 Portland cement for all concrete shall be ASTM C150, Type II.

2.1.10.2 ASTM C989 Ground iron blast furnace slag may be mixed with ASTM C150 Portland cement to produce the equivalent of ASTM C595 Type IS (MS) blended cement, except that the blast furnace slag content shall not exceed 50 percent by weight of the total cementitious material.

2.1.10.3 ASTM C618 fly ash or pozzolan may be mixed with ASTM C150 Portland cement to produce the equivalent of ASTM C595 Type IP (MS) blended cement, except that the total fly ash and pozzolan content shall not exceed 25 percent by weight of the total cementitious material. Loss on ignition of fly ash or pozzolan shall not exceed 3 percent.

2.1.10.4 (4.2.1.2) Aggregates for slabs on grade shall conform to the following:

2.1.10.4.1 The nominal maximum size aggregate shall not be larger than the requirements of 4.2.2.3 – size of coarse aggregate. The combined aggregates shall be well graded from the coarsest to the finest with not more than 18 percent nor less than 8 percent, unless otherwise permitted, of the combined aggregate retained on any individual sieve with the exceptions that the No. 50 may have less than 8 percent retained, sieves finer than No. 50 shall have less than 9 percent retained, and the coarsest sieve may have less than 8 percent retained.

2.1.10.4.2 Aggregates used in concrete shall have a combined aggregate distribution similar to the aggregates used in the concrete represented by field test data or used in trial mixtures. Reports of individual aggregates shall include sieve sizes 1½ inches, 1-inch, ¾-inch, ½- inch, 3/8 inch, No. 4, No. 8, No. 16, No. 30, and No. 50 in accordance with ASTM E11.

2.1.10.5 (4.2.1.2) Coarse aggregate shall be a calcareous aggregate such as limestone or dolomite.

2.1.10.6 (4.2.2.4) Concrete shall be air entrained, except for interior slabs, which shall be non-air entrained.

2.1.10.7 (4.2.2.5) Air entraining or water reducing admixtures or both will be permitted. Other admixtures shall be submitted for approval

before submitting the mix designs and shall not be used without written approval.

2.1.10.8 (4.2.2.6) Calcium chloride shall not be used as an admixture, nor as an ingredient in any admixture. Chloride ions in admixtures shall not exceed 0.1 percent by weight of cement content.

2.1.10.9 (4.2.2.9) The 28-day compressive strength of all concrete shall be 4,000 pounds per square inch.

2.1.10.10 (4.2.2.9) Concrete for liquid retention structures shall have a water-cementitious material ratio of not more than 0.45.

2.1.10.11 (5.3.1) Foundation concrete shall not be placed until the soil subgrade for foundation bearing has been examined by the Geotechnical Engineer and found satisfactory for the design bearing capacity.

2.2 Moisture barrier beneath slabs on grade shall be minimum 6-mil polyethylene, with reinforced backing, with joints lapped not less than 6 inches.

2.3 Nonshrink grout for setting base plates, leveling plates, and bearing plates for columns and machine bases shall be premixed and noncorrosive and shall meet the requirements of ASTM C1107. Water for mixing grout shall be potable.

2.4 Joint sealant shall be Sikaflex 2C NS/SL by Sika Chemical Corporation, Eucolastic by Euclid Chemical Company or Stonflex MN6/MP6 by Stonhard, Inc.

2.5 Provide anchor rods as required to suit the equipment provided. Anchor rods shall be ASTM A36 or ASTM F1554, Grade 36 unless otherwise noted.

2.6 Adhesive anchors shall be HVA Adhesive Anchors by Hilti Fastening Systems, Chem-stud by the Rawlplug Company, ET Epoxy-Tie Adhesive anchors by the Simpson Strong-Tie Co. The anchor shall consist of a polyester resin adhesive capsule and a chisel-pointed threaded steel rod. Steel shall be zinc plated ASTM A 307. This type of adhesive anchor shall not be used in masonry. Allowable working (service) loads for 4,000 psi concrete shall be specified by manufacturer for given field conditions.

2.7 Floor Type Hydrostatic Pressure Relief Valves

2.7.1 Floor type hydrostatic pressure relief valves shall be designed for installation in the bottom of concrete tanks. Valves shall be Trumbull Ductile Iron Type 1367-1558, or approved equal. Valves shall be sized as indicated on the contract drawings.

2.7.2 The valve assembly shall consist of three parts: cover, body, and grate. All three parts shall be constructed of ASTM A 126, Class B cast iron. The assembly shall be designed so neither the cover nor the grate can become

separated from the valve body due to groundwater pressure around the tank. When necessary, both the cover and the grate can be easily removed by turning them to the right or left to free them from locking lugs cast integrally on the inside of the valve body.

2.7.3 The valve seats shall be constructed of BUNA-N rubber, bonded to the cover, mating with a machined bronze seat in the valve body.

2.7.4 The valves shall start to open at a head of approximately 9 inches of water.

2.7.5 The valves shall be designed with an internal strainer to prevent accumulation of debris on the seating surfaces and leakage from the tank.

2.7.6 The valve length may be extended by using manufacturer's recommendations.

2.7.7 Manufacturer recommendations shall be followed for maintenance of the valves to provide reliable protection over a long service life.

2.8 Special inspection of materials

2.8.1 Provide the following special inspections:

2.8.1.1 Review documentation for materials furnished to verify conformance to quality standards for materials specified herein.

2.8.1.2 Review mix design for conformance to Chapter 4 of ACI 301.

2.8.1.3 Inspect concrete mixing techniques for compliance with Section 4.3 of ACI 301.

2.8.2 Special inspection of materials will not be required for the following elements:

2.8.2.1 Other concrete items of a minor nature, such as duct banks and thrust blocks.

3 EXECUTION

3.1 Refer to applicable sections of ACI 301-05, except as modified by the supplemental requirements specified in this section. For numbers in parentheses, refer to ACI 301 paragraphs.

3.1.1 (5.3.2.1) Comply with ACI 306.1 for cold weather concreting and with the recommendations of ACI 305 R for hot weather concreting.

3.1.2 (5.3.3) All formed concrete which will be exposed to public view shall receive a smooth form finish.

3.2 Backfilling adjacent to foundation walls shall not occur until structural elements designed to brace walls have been placed and such concrete has reached 70 percent of its 28-day design compressive strength. Backfilling adjacent to cantilever retaining walls shall not occur until wall concrete has reached its 28-day design compressive strength.

3.3 Chamfer all exposed edges of concrete 1-inch.

3.4 Special Inspection of Field Work

3.4.1 Provide the following special inspections:

3.4.1.1 Inspect installation of reinforcing steel to verify compliance with contract drawings and Sections 3.3 of ACI 301.

3.4.1.2 Inspect formwork for compliance with Section 2.3 of ACI 301. Inspect form removal for compliance with Section 2.3.2 of ACI 318.

3.4.1.3 Test concrete strength, air content, and slump in accordance with Section 1.6.4.2 of ACI 301.

3.4.1.4 Inspect concrete placement for compliance with Section 5.3.2 of ACI 301.

3.4.1.5 Inspect curing for compliance with Section 5.3.6.1 of ACI 301.

3.4.2 Special inspection of field work will not be required for the following elements, except that concrete strength, air content, and slump shall be tested in accordance with Section 1.6.4.2 of ACI 301.

3.4.2.1 Other concrete items of a minor nature such as duct banks and thrust blocks.

End of Section

Section 05120
Structural Steel Framing

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural steel.

1.2 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Structural-steel materials.
2. High-strength, bolt-nut-washer assemblies.
3. Anchor rods.
4. Shop primer.

B. Shop Drawings: Show fabrication of structural-steel components.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Mill test reports for structural-steel materials, including chemical and physical properties.

C. Source quality-control reports.

D. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is

accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).

B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.

C. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with applicable provisions of the following specifications and documents:

1. ANSI/AISC 303.
2. ANSI/AISC 360.
3. RCSC's "Specification for Structural Joints Using High-Strength Bolts."

B. Connection Design Information:

1. Option 1: Connection designs have been completed and connections indicated on the Drawings.

2.2 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A992, Grade 50.

B. Channels, Angles, S-Shapes: ASTM A36.

C. Plate and Bar: ASTM A36.

D. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS AND CONNECTORS

A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.

2.4 PRIMER

A. Steel Primer:

1. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

2.5 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.

2.6 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.7 SHOP PRIMING

A. Shop prime steel surfaces.

B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:

1. SSPC-SP 2.
2. SSPC-SP 3.

C. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.

3.3 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify weld materials and inspect welds.
3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

1. Bolted Connections: Inspect and test bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.

a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

1) Liquid Penetrant Inspection: ASTM E165/E165M.

2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
3) Ultrasonic Inspection: ASTM E164.
4) Radiographic Inspection: ASTM E94/E94M.

End Of Section

Section 05500
Metal Fabrications

1 GENERAL

1.1 Related Documents

1.1.1 The General Conditions of the Contract and General Requirements are a part of this section.

1.2 Standards

1.2.1 Where specific standards, tests or criteria of following organizations are referred to in these specifications, it is intended that the specification refers to the latest standard, test or criteria adopted by that organization unless a specific date of adoption is included as part of the reference herein.

1.2.1.1 American Institute of Steel Construction (AISC).

1.2.1.2 American Iron and Steel Institute (AISI).

1.2.1.3 American National Standards Institute (ANSI).

1.2.1.4 American Society for Testing and Materials (ASTM).

1.2.1.5 American Welding Society (AWS).

1.2.1.6 AISC "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings," and "Code of Standard Practice for Steel Buildings and Bridges."

1.2.1.7 AWS "Structural Welding Code."

1.2.1.8 ASTM A6 "General Requirements for rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use."

1.2.1.9 Steel Structures Painting Council (SSPC).

1.3 Submittals

1.3.1 Submit shop drawings for fabrication and erection of miscellaneous metal assemblies. Include plans and elevations at not less than 1 in. to 1 ft.-0 in. scale, and include details of sections and connections at not less than 3 in. to 1 ft.-0 in. scale. Indicate anchorage and accessory items.

1.3.2 Submit, copies of manufacturer's specifications, anchor details and installation instructions for products to be used in the fabrication of miscellaneous metal work, including paint products.

1.3.3 Design Review: The Contractor shall submit construction drawings for each set

of access stairs/platforms/roofs, ladders, construction drawings for the footers/foundations supporting each set of access stairs/platforms, and all supporting design data and calculations, including all live loads and dead loads to be supported, and their points of application, to the Engineer for review. Live loads shall include equipment loads, wind, seismic, and snow loads. All drawings and structural calculations shall be stamped by a professional engineer licensed in the Commonwealth of Virginia. If anchor bolts are required, the Contractor shall furnish the anchor bolts together with a location plan and templates for such installation. Construction of the access stairs/platforms/roofs and the associated footers/foundations will not be permitted until the above-mentioned items are reviewed by the Engineer.

1.4 Quality Assurance

1.4.1 Take field measurements prior to preparation of shop drawings and fabrication, where possible. Do not delay job progress: Allow for trimming and fitting wherever taking field measurements before fabrication might delay work.

1.4.2 Preassemble 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.

2 PRODUCTS

2.1 Metals

2.1.1 Steel

2.1.1.1 Steel shall conform to ASTM A992 (Fy = 50 KSI) for Wide Flange Shapes, ASTM A500, Grade B (Fy = 46 KSI) for Rectangular HSS Shapes, and to ASTM A36 (Fy = 36 KSI) for Angles, Channels, and Plates. Miscellaneous steel not otherwise indicated or specified shall be mild steel.

2.1.1.2 Steel Pipe: ASTM A 53, standard weight (Schedule 40), unless another weight is indicated.

2.1.1.3 Cold Finished Steel Bars: ASTM A108.

2.1.1.4 Galvanized Carbon Steel Sheet: ASTM A526 with zinc coating.

2.1.1.5 Steel grating shall be galvanized 1¼-inch rectangular bar type grating with 1¼-inch deep by 3/16-inch thick bearing bars at 1-3/16 inches center to center unless noted otherwise.

2.1.2 Aluminum

2.1.2.1 Aluminum Extrusions shall be Alloy 6061-T6 and shall be fabricated in accordance with specifications for aluminum structures by the

aluminum association and ASTM B 221/B 221M.

2.1.2.2 Aluminum plate shall be ¼-inch diamond tread, Type 6061-T6.

2.1.2.3 Aluminum grating shall be 1-1/4 inches aluminum "I" bar grating (Type 6061) with 1-1/4 inches deep by ¼-inch thick bearing bars at 1-3/16 inches center to center and cross bars at 4 inches center-to-center unless noted otherwise.

2.2 Fasteners

2.2.1 Provide zinc-coated fasteners for exterior use or where built into exterior walls. Select fasteners for the type, grade, size and class required.

2.2.1.1 Bolts and Nuts: Regular hexagon head type, ASTM A307, Grade A.

2.2.1.2 Lag Bolts: Square head type.

2.2.1.3 Machine Screws: Cadmium plated steel.

2.2.1.4 Wood Screws: Flat head carbon steel.

2.2.1.5 Plain Washers: Round, carbon steel.

2.2.1.6 Masonry Anchorage Devices: Expansion shields.

2.2.1.7 Toggle Bolts: Tumble-wing type, class and style as required.

2.2.1.8 Lock Washers: Helical spring type carbon steel.

2.2.1.9 Stainless steel bolts Type 302, No. 4 or 180 grit finish.

2.3 Manufactured Products

2.3.1 Loose Bearing Plates

2.3.1.1 Provide loose bearing plates for steel and aluminum items bearing on masonry or concrete construction, made flat, free from warps or twists, and of required thickness and bearing area. Drill plates to receive anchor bolts and for grouting as required. Galvanize steel after fabrication.

2.3.2 Abrasive Stair Nosing

2.4.3.1 Provide cast or extruded aluminum nosings.

2.3.2.1.1 Cast Aluminum Nosing: Cross-hatched units, 4 inches wide with ¼-inch lip, for casting into concrete steps.

2.3.2.1.2 Extruded Aluminum Nosing: Ribbed units with abrasive

filler strips projecting 1/16-inch above aluminum extrusion, 3 inches wide, for casting into concrete steps.

2.3.2.2 Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.

2.3.2.3 Apply bituminous paint to concealed bottoms sides, and edges of cast units set into concrete.

2.3.2.4 Apply clear lacquer to concealed bottoms, sides, and edges of extruded units set into concrete.

2.4 Miscellaneous Framing and Supports

2.4.1 General: Provide aluminum framing and supports that are not a part of aluminum framework as necessary to complete the Work.

2.4.2 Fabricate units from aluminum shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.

2.5 Access Stairs, Ladders, and Platforms

2.5.1 The Contractor shall provide mill finish aluminum access stairs, ladders, and platforms as shown on the contract drawings.

2.5.2 Access stairs shall be supported from finished grade with reinforced concrete footers/foundation in accordance with NAAMM requirements. Access platform and stairs shall be manufactured by a shop fabricator, designed and sealed by a professional engineer, and submitted to WW Associates for review.

2.5.3 Minimum design criteria for access stairs and platforms shall be the following:

2.5.3.1 Stair treads and access platform shall be capable of withstanding a uniform load of 100 lbf/square feet, or a concentrated load of 300 lbf on an area of 4 square inches, whichever produces the greater stress.

2.5.3.2 Stair framing shall be capable of withstanding stresses resulting from loads specified above, in addition to stresses resulting from railing system loads.

2.5.3.3 Limit deflection of treads, platform, and framing members to L/360 or ¼-inch, whichever is less.

2.5.3.4 Footers/Foundation

2.5.3.4.1 Footers/foundation for access stairs and platforms shall be designed and constructed as part of this contract.

2.5.3.4.2 Footers/foundations shall be designed by the metal fabricator to safely sustain the access stair and platform structure and its live loads.

2.5.3.4.3 Footer/foundation design shall be based on the recommendations presented in the geotechnical report. The geotechnical report is presented in Appendix A of this project manual.

2.5.3.4.4 Provide reinforced concrete for footer/foundation construction in accordance with Section 03300 – Cast-in-Place Concrete.

2.5.4 Access platform and stairs shall be fabricated in accordance with the following sections of this project manual:

2.5.4.1 Section 05521 – Pipe Guard Railing

2.5.4.2 Section 05530 – Aluminum Gratings

2.5.5 Design of aluminum supports designated "delegated design" on contract drawings shall have minimum section sizes shown on contract drawings and as follows for stairs, landings, and associated stair platforms, unless otherwise noted:

2.5.5.1 Stair stringers: 10-inch minimum depth (channel or I beam)

2.5.5.2 Stair landing main support beams: 8-inch minimum depth (channel or I beam)

2.5.5.3 Stair support posts: 6-inch tube minimum

2.5.6 Design of aluminum supports designated "delegated design" shall be designed in accordance with the provisions of the Aluminum Design Manual, 2015.

2.5.7 All new fixed ladders and cages shall comply with the requirements of OSHA Standard 1910.27 Fixed Ladders and the following requirements:

2.5.7.1 Ladders and cages shall be all aluminum construction (Alloy 6061-T6).

2.5.7.2 Ladder pitch as defined in OSHA 1910.27(e)(1) shall be 90 degrees.

2.5.7.3 In addition to cages required by OSHA 1910.27(d)(1), provide cages where indicated on drawings.

2.5.7.4 Provide a self-closing safety gate at the top of all new ladders as manufactured by Fabenco, Inc. of Houston, TX (www.safetygate.com), or approved equal.

2.6 Workmanship

2.6.1 Preassemble items in the shop to the greatest extent possible, so as to minimize field splicing and assembly of units at the project site. Disassemble units only to the extent necessary for shipping and handling limitations. Clearly mark units for re-assembly and coordinated installation.

2.6.2 Use materials of size and thicknesses indicated, or if not indicated, of adequate strength and durability in finished product for intended use. Work to dimensions indicated using proven details of fabrication and support.

2.6.3 For the fabrication of work which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names and roughness. Remove such blemishes by grinding, or by welding and grinding, prior to cleaning, treating and application of surface finishes including zinc coatings.

2.6.4 Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of approximately 1/32-inch unless otherwise indicated. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

2.6.5 Weld corners and seams continuously and in accordance with recommendations of AWS. Grind exposed welds smooth and flush, to match and blend with adjoining surfaces.

2.6.6 Form exposed connections with hairline joints which are flush and smooth, using concealed fasteners wherever possible, use exposed fasteners of type indicated, or if not indicated, use Phillips Flathead (countersunk) screws or bolts.

2.6.7 Provide for anchorage of type required, coordinated with supporting structure. Fabricate and space anchoring devices as required to provide adequate support for intended use.

2.6.8 Cut, reinforce, drill and tap miscellaneous metal work as may be required to receive other items of work.

2.6.9 Fabricate miscellaneous units to sizes, shapes and profiles indicated or, if not indicated, of required dimensions to receive adjacent grating, plates, doors or other work to be retained by framing. Unless shown otherwise, fabricate from structural steel shapes and plates and steel bars, of welded construction using mitered corners, welded brackets and splice plates and a minimum number of joints for field connections. Equip items with integrally welded anchor strips for casting into poured concrete. Furnish inserts if items must be installed after

concrete is poured. Except as otherwise indicated, space anchors 2 ft.-0 in. on center.

2.6.10 Aluminum shall be isolated from dissimilar materials by a 1/16-inch butyl rubber or Teflon sheet.

2.7 Shop Painting

2.7.1 Aluminum items for access stairs and platforms shall be provided with a factory mill finish. Do not field paint these aluminum items.

2.7.2 Galvanizing: Hot-dip galvanize items indicated to comply with applicable standard listed below:

2.7.2.1 ASTM A 123, for galvanizing steel products.

2.7.2.2 ASTM A 153/A 153M, for galvanizing steel hardware.

3 EXECUTION

3.1 Field Conditions

3.1.1 Verify measurements in field for work fabricated to fit job conditions.

3.1.2 Examine adjoining work on which miscellaneous metal work is dependent before starting work.

3.1.3 Provide anchorage devices and fasteners where necessary for securing miscellaneous metal items to in-place construction including, threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors as required.

3.1.3.1 Furnish inserts and anchoring devices which must be set in concrete or built into masonry for installation of miscellaneous metal work. Provide setting drawings, templates, instructions and directions for installation of anchorage devices. Coordinate delivery with other work to avoid delay.

3.1.4 Perform cutting, drilling and fitting required for installation of miscellaneous metal items. Set work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels.

3.1.5 Fit exposed connections accurately together to form tight hairline joints. Weld connections which are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind joints smooth and touch-up shop paint coat. Do not weld, cut or abrade surfaces of exterior units which have been hot dip galvanized after fabrication, and are intended for bolted or screwed field connections.

3.2 Field Welding

3.2.1 Comply with AWS code for procedures of manual shielded metalarc welding, appearance and quality of welds made, and methods used in correcting welding work.

3.3 Setting Bearing Plates

3.3.1 Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

3.3.2 Set bearing plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor rods. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.

3.4 Installing Stair Nosing

3.4.1 Install with manufacturer’s anchoring system.

3.4.2 Center nosings on tread widths.

3.4.3 Align nosings flush with riser faces and level with tread surfaces.

3.5 Installation of Manufactured Items

3.5.1 Install manufactured items in accordance with manufacturer's written installation instructions.

End of Section

Section 05521
Pipe Guard Railing

1 GENERAL

1.1 Related Documents

1.1.1 Drawings and general provisions of the contract, including general and supplementary conditions and Division 1 Specification sections, apply to this section.

1.2 Summary

1.2.1 This section includes the following:

1.2.1.1 Aluminum pipe guard railing.

1.3 Reference specifications are referred to by abbreviation as follows:

1.3.1 Architectural Aluminum Manufacturers Association ..... AAMA

1.3.2 American Society of Testing and Materials ..... ASTM

1.3.3 National Association of Architectural Metal Manufacturers .....NAAMM

1.3.4 The Society for Protective Coatings..... SSPC

1.4 Performance Requirements

1.4.1 Thermal movements: Provide guard railing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1.4.1.1 Temperature change (range): 120°F (67°C), ambient; 180°F (100°C), material surfaces.

1.4.2 Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from district contact with incompatible materials.

1.5 Quality Assurance

1.5.1 Source Limitations: Obtain guard railing through one source from a single manufacturer.

1.6 Storage

1.6.1 Store guard railing in a dry, well-ventilated, weathertight place.

1.7 Project Conditions

1.7.1 Field Measurements: Verify guard railing dimensions by field measurements before fabrication and indicate measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the work.

1.7.1.1 Established Dimensions: Where field measurements cannot be made without delaying the work, establish dimensions and proceed with fabrication guard railing without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 Coordination

1.8.1 Coordinate installation of anchorages for guard railing. 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. Deliver such items to project site in time for installation.

1.9 Scheduling

1.9.1 Schedule installation so guard railing is mounted only on completed walls. Do not support temporarily by any means that does not satisfy structural performance requirements.

2 PRODUCTS

2.1 Metals

2.1.1 General: Provide metal free from pitting, seam marks, roller marks, stains, discolorations, and other imperfections where exposed to view on finished units. All guardrail and handrail shall be anodized aluminum.

2.1.2 Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.

2.1.2.1 Extruded structural pipe: ASTM B 429, Aloy 6063-T6.

2.1.2.2 Plate and sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.

2.1.2.3 Die and hand forgings: ASTM B 247 (ASTM B 247M), Alloy 6061-T6.

2.1.2.4 Castings: ASTM B 26/B 26M, Alloy A356-T6

2.1.3 Brackets, flanges, and anchors: Cast or formed metal of same type of material and finish as supported rails, unless otherwise indicated.

2.2 Welding Materials, Fasteners, and Anchors

2.2.1 Welding electrodes and filler metal: Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

2.2.2 Fasteners for anchoring guard railing to other construction:

2.2.2.1 For aluminum guard railing, use fasteners fabricated from Type 304 or Type 316 stainless steel.

2.2.3 Fasteners for interconnecting guard railing components: Use fasteners fabricated from same basic metal as fastened metal, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined.

2.2.3.1 Provide concealed fasteners for interconnecting guard railing components and for attaching them to other work, unless exposed fasteners fare unavoidable or are the standard fastening method for guard railing indicated.

2.2.3.2 Provide Phillips flat-head machine screws for exposed fasteners, unless otherwise indicated.

2.2.4 Cast-In-Place and post-installed anchors: Anchors of type indicated below, fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

2.2.4.1 Cast-In-Place and Chemical anchors: See Section 03300 – Cast-in-Place Concrete.

2.3 Paint

2.3.1 Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-paint 12, except containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D 1187.

2.4 Grout and Anchoring Cement

2.4.1 Nonshrink, nonmetallic grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.4.2 Erosion-resistant anchoring cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at project site to create pourable anchoring patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.5 Fabrication

2.5.1 General: Fabricate guard railing to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage.

2.5.2 Assemble guard railing in the 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. Use connections that maintain structural value of joined pieces.

2.5.3 Form changes in direction of railing members as follows:

2.5.3.1 By bending.

2.5.3.2 By flush radius bends.

2.5.3.3 By mitering at elbow bends.

2.5.3.4 By inserting prefabricated flush-elbow fittings.

2.5.3.5 By any method indicated above, applicable to change in direction involved.

2.5.4 Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.

2.5.5 Welded Connections: Fabricate guard railing for connecting members by welding. Cope components at perpendicular and skew connections to provide close fit, or use fittings designed for this purpose. Weld connections continuously to comply with the following:

2.5.5.1 Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2.5.5.2 Obtain fusion without undercut or overlap.

2.5.5.3 Remove flux immediately.

2.5.5.4 At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

2.5.6 Welded connections for aluminum pipe: Fabricate pipe guard railing to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.

2.5.7 Brackets, flanges, fittings, and anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect guard railing members to other work, unless otherwise indicated.

2.5.8 Provide inserts and other anchorage devices for connecting guard railing to concrete. Fabricate anchorage devices capable of withstanding loads imposed by guard railing. Coordinate anchorage devices with supporting structure.

2.5.9 For railing posts set in concrete, provide preset sleeves not less than 6 inches (150 mm) long with inside dimensions not less than ½-inch (12 mm) greater than outside dimensions of post, and plate forming bottom closure.

2.5.10 For removable railing post, fabricate slip-fit sockets from pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height. Provide socket covers designed and fabricated to resist being dislodged.

2.5.10.1 Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.

2.5.11 Shear and punch metals cleanly and accurately. Remove burrs from exposed cut edges.

2.5.12 Ease exposed edges to a radius of approximately 1/32-inch (1 mm), unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the work.

2.5.13 Cut, reinforce, drill, and tap components, as indicated, to receive finish hardware, screws, and similar items.

2.5.14 Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members that are exposed to exterior or to moisture from condensation or other sources.

2.5.15 Fabricate joints that will be exposed to weather in a watertight manner.

2.5.16 Close exposed ends of guard railing members with prefabricated end fittings.

2.5.17 Toe boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.6 Finishes, General

2.6.1 Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2.6.2 Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.6.3 Appearance of finished work: Variations in appearance of abutting or adjacent pieces are acceptable if they are assembled or installed to minimize contrast.

2.6.4 Provide exposed fasteners with finish matching appearance, including color and texture, or guard railing.

2.7 Aluminum Finishes

2.7.1 Finish designations prefixed by AA comply with system established by the Aluminum Association for designating aluminum finishes.

2.7.2 Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; chemical finish: Etched, medium matte; anodic coating: architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 607.1.

3 EXECUTION

3.1 Installation, General

3.1.1 Fit exposed connections together to form tight, hairline joints.

3.1.2 Perform cutting, drilling, and fitting required to install guard railing. Set guard railing accurately in location, alignment, and elevation; measured from established lines and levels and free from rack.

3.1.2.1 Do not weld, cut, or abrade surfaces of guard railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.

3.1.2.2 Set posts plumb within a tolerance of 1/16-inch in 3 feet (2 mm in 1 meter).

3.1.2.3 Align rails so variations from level for horizontal members and from parallel with rake of steps and ramps for sloping members do not exceed ¼-inch in 12 feet (5 mm in 3 meters).

3.1.3 Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, or dissimilar metals with a heavy coat of bituminous paint.

3.1.4 Adjust guard railing before anchoring to ensure matching alignment at abutting joints. Space posts at interval indicated, but not let than that required by structural loads.

3.1.5 Fastening to in-place construction: Use anchorage devices and fasteners where necessary for securing guard railing and for properly transferring loads to in-place construction.

3.2 Railing Connections

3.2.1 Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of guard railing.

3.2.2 Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "fabrication" article whether welding is performed in the shop or in the field.

3.2.3 Expansion Joints: Install expansion joints as required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches (50 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches (150 mm) of post.

3.3 Anchoring Posts

3.3.1 Use pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with the following anchoring material, mixed and placed to comply with anchoring material manufacturer's written instructions:

3.3.1.1 Non-shrink, nonmetallic grout or anchoring cement.

3.3.2 Leave anchorage joint exposed; wipe off surplus anchoring material; and leave 1/8-inch (3 mm) build-up, sloped away from post.

3.3.3 Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

3.3.3.1 For aluminum pipe railings, attach posts as indicated using fittings designed and engineered for this purpose.

3.3.4 Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.4 Cleaning

3.4.1 Clean aluminum by washing thoroughly with clean water and soap and rinsing with clean water.

3.5 Protection

3.5.1 Protect finishes of guard railing from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at the time of substantial completion.

3.5.2 Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

End of Section

Section 05530
Aluminum Gratings

1 GENERAL

1.1 Related Documents

1.1.1 Drawings and general provisions of the contract, including general and supplementary conditions and Division 1 Specification sections, apply to this section.

1.2 Summary

1.2.1 This section includes the following:

1.2.1.1 Metal bar gratings.

1.2.1.2 Metal frames and supports for gratings.

1.3 Submittals: Provide the following in a timely manner in accordance with the approved submittals schedule as specified in Section 01400 – General Requirements.

1.3.1 Product data for the following:

1.3.1.1 Swage-locked I-bar grating.

1.3.1.2 Clips and anchorage devices for gratings.

1.3.1.3 Paint products.

1.3.2 Shop drawings: Show fabrication and installation details for gratings. Include plans, elevations, sections, and details of connections. Show anchorage and accessory items. Provide templates for anchors and bolts specified for installation under other sections.

1.4 Reference specifications are referred to by abbreviation as follows:

1.4.1 American Society of Testing and Materials ..... ASTM

1.4.2 American Welding Society.....AWS

1.4.3 National Association of Architectural Metal Manufacturers .....NAAMM

1.5 Project Conditions

1.5.1 Field measurements: Where gratings are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the work.

1.5.1.1 Established dimensions: Where field measurements cannot be made without delaying the work, establish dimensions and proceed with fabricating gratings without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions. Allow for trimming and fitting.

1.6 Coordination

1.6.1 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 item with integral anchors, that are to be embedded in concrete. Deliver such items to project site in time for installation.

2 PRODUCTS

2.1 Aluminum

2.1.1 Extruded bars and shapes: ASTM B 221 (ASTM B 221M), alloys as follows:

6061-T6 or 6063-T6, for bearing bars of gratings and shapes.

6061-T1, for grating crossbars.

2.1.2 Aluminum rivets: ASTM B 316/B 316M, Alloy 6053-T4 or 6061-T6

2.1.3 Aluminum sheet: ASTM B 209 (ASTM B 209M), Alloy 5052-H32

2.1.4 Structural profiles: ASTM B 308/B 308M, Alloy 6061-T6

2.1.5 Aluminum plate: ASTM B 209, Alloy 6061-T6

2.2 Paint

2.2.1 Bituminous paint: Cold-applied asphalt mastic complying with SSPC-paint 12, except containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D 1187.

2.3 Fasteners

2.3.1 General: Provide Type 304 or 316 stainless-steel fasteners for exterior use. Select fasteners for type, grade, and class required.

2.3.2 Fasteners for aluminum gratings: Provide fasteners of aluminum, nonmagnetic stainless steel, zinc-plated steel, or other material warranted by the manufacturer to be compatible with aluminum gratings and other components.

2.4 Fabrication

2.4.1 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 coordinate installation.

2.4.2 Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.

2.4.3 Shear and punch metals cleanly and accurately. Remove burrs.

2.4.4 Ease exposed edges to a radius of approximately 1/32-inch (1 mm), unless otherwise indicated.

2.4.5 Fit exposed connections accurately together to form hairline joints.

2.4.6 Welding: Comply with AWS recommendations and the following:

2.4.6.1 Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2.4.6.2 Obtain fusion without undercut or overlap.

2.4.6.3 Remove welding flux immediately.

2.4.7 Coordinate with supporting structure. Fabricate and space anchoring devices to secure gratings, frames, and supports rigidly in place.

2.5 Metal Bar Gratings

2.5.1 Fabricate pressure-locked, I-bar aluminum gratings as follows:

2.5.1.1 Grating mark P-19-4 (1-1/4 I-bar) aluminum: 1-1/4-inch (32 mm) I-bar bearing bars at 1-3/16 inches (30 mm) O.C., and crossbars at 4 inches (102 mm) O.C.

2.5.2 Aluminum Finish: As follows:

2.5.2.1 Class I, clear, anodized finish.

2.5.3 Fabricate removable grating sections 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.

2.5.3.1 Provide not less 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.

2.5.3.2 Furnish self-drilling fasteners with washers for securing grating to supports.

2.5.4 Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.

2.5.4.1 Edge-band openings in grating that interrupt four or more bearing bars with bars of the same size and material as bearing bars.

2.5.5 Do not notch bearing bars at supports to maintain elevation.

2.6 Grating Frames and Supports

2.6.1 Aluminum frames: Fabricate frames for aluminum gratings from extruded-aluminum shapes to sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections. Cut, drill, and tap units to receive hardware and similar items.

2.6.2 Equip units with integrally welded anchors for casting into concrete.

2.6.2.1 Unless otherwise indicated, space anchors 24 inches (600 mm) O.C. and provide minimum anchor units in the form of aluminum straps 1-1/4 inches (32 mm) wide by 1/8-inch (3 mm) thick by 4 inches (100 mm) long.

2.7 Finishes

2.7.1 Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2.7.2 Finish gratings, frames, and supports after assembly.

3 EXECUTION

3.1 Installation, General

3.1.1 Fastening to in-place construction: provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete inserts, through-bolts, lag bolts, and other connectors.

3.1.2 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 from rack.

3.1.3 Provide temporary bracing or anchors in formwork for items that are to be built into concrete.

3.1.4 Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.

3.1.5 Field welding: Comply with the following requirements:

3.1.5.1 Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

3.1.5.2 Obtain fusion without undercut or overlap. Remove welding flux immediately.

3.1.6 Corrosion protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, or dissimilar metals with a heavy coat of bituminous paint.

3.2 Installing Metal Bar Gratings

3.2.1 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.

3.2.2 Attach removable units to supporting members with type and size of clips and fasteners as recommended by grating manufacturer for type of installation conditions shown.

3.2.3 Attach nonremovable units to supporting members by welding where both materials are the same; otherwise, fasten by bolting as indicated above.

End of Section

Section 07531
EPDM Single Ply Membrane Roofing

1 GENERAL

1.1 Description: This section specifies EPDM single-ply membrane roofing systems including the following:

1.1.1 Adhered sheet roofing.

1.2 Definitions

1.2.1 Roofing terminology: Refer to ASTM D 1079 for definition of terms related to roofing work not otherwise defined in this section.

1.3 Performance requirements: Install sheet membrane roofing and base flashing that are watertight; will not permit the passage of liquid water; and will withstand wind loads, thermally induced movement, and exposure to weather without failure.

1.3.1 Material compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing system manufacturer based on testing and field experience.

1.3.2 Roofing system design: Provide a roofing system that complies with roofing system manufacturer's written design instructions and with the following:

1.3.2.1 SPRI's wind design guide for adhered roofing systems.

1.4 Quality Assurance

1.4.1 Installer qualifications: Roofing installer shall have specialized in installing roofing similar to that required for this project and shall be approved, authorized, or licensed by the roofing system manufacturer to install manufacturer's product. Roofing installer shall provide evidence that the firm has been certified by the roofing material manufacturer and has installed at least 5 similar projects within the past 5 years, including references, to be considered qualified to provide these services.

1.4.2 Fire-test-response characteristics: Provide roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method indicated below by UL, FM, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

1.4.2.1 Exterior fire-test exposure: ASTM E 108 Class A for application and slopes indicated.

1.4.3 Preliminary roofing conference: Before starting roof deck construction, conduct conference at project site. Meet with the same participants and review the same items listed for the preinstallation conference. In addition, review status of submittals and coordination of work related to roof construction. Notify participants at least 5 working days before conference.

1.4.4 Preinstallation conference: Before installing roofing system, conduct conference at project site. Notify participants at least 5 working days before conference.

1.4.4.1 Meet with Owner; WW Associates; testing and inspecting agency representative; roofing installer; roofing system manufacturer's representative; and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.

1.4.4.2 Review methods and procedures related to roofing installation and repair, including manufacturer's written instructions.

1.4.4.3 Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.

1.4.4.4 Review loading limitations of deck during and after roofing.

1.4.4.5 Review flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing.

1.4.4.6 Review governing regulations and requirements for insurance, certificates, and inspection and testing, if applicable.

1.4.4.7 Review temporary protection requirements for roofing system during and after installation.

1.4.4.8 Review roof observation and repair procedures after roofing installation.

1.4.4.9 Document proceedings, including corrective measures or actions required, and furnish copy of record to each participant.

1.5 Delivery, Storage, and Handling

1.5.1 Deliver roofing materials to project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.

1.5.2 Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1.5.2.1 Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

1.5.3 Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.6 Reference specifications and standards are referred to by abbreviation as follows:

1.6.1 American Society for Testing and Materials ..... ASTM

1.6.2 Factory Mutual Research Organization .....FM

1.6.3 Single Ply Roofing Institute ..... SPRI

1.6.4 Underwriters Laboratories ..... UL

1.7 Submittals: Provide the following in a timely manner in accordance with the approved submittals schedule as specified in Section 01400 - General Requirements.

1.7.1 Roofing Product Data – Product data for each type of roofing product specified. Include data substantiating that materials comply with requirements.

1.7.2 Roofing Product Data – Product data and tapering plan demonstrating positive drainage to roof drains.

1.7.3 Shop Drawings – Include plans, sections, and details of the following:

1.7.3.1 Base flashings and membrane terminations.

1.7.4 Samples for Verification – 12-by-12-inch (300-by-300-millimeters) square of sheet roofing, of color specified, including t-shaped side and end lap seam.

1.7.5 Installer Certificates – Signed by roofing system manufacturer certifying that installer is approved, authorized, or licensed by manufacturer to install specified roofing system.

1.7.6 Manufacturers Certificates – Signed by roofing manufacturer certifying that the roofing system complies with requirements specified in the performance requirements article. Upon request, submit evidence of meeting requirements.

1.7.7 Qualification Data – For firms and persons specified in the quality assurance article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.7.8 Product Test Reports – Based on evaluation of tests performed by manufacturer and witnessed by a qualified independent testing agency,

indicate compliance of components of roofing system with requirements based on comprehensive testing of current product compositions.

1.7.9 Research/Evaluation Reports – Evidence of roofing system's compliance with building code in effect for project, from an international building code acceptable to authorities having jurisdiction.

1.7.10 Maintenance Data – For roofing system to include in the maintenance manuals.

1.7.11 Warranties – Sample copy of standard roofing system manufacturer's warranty stating obligations, remedies, limitations, and exclusions of warranty.

1.7.12 Inspection Report – Copy of roofing system manufacturer's inspection report of completed roofing installation.

1.8 Project Conditions

1.8.1 Weather limitations: Proceed with roofing work only when existing and forecasted weather conditions permit work to be installed in accordance with manufacturers' written instructions and warranty requirements.

1.9 Warranty

1.9.1 Roofing and related base flashing shall be designs as described in the manufacturer's latest manual to be compatible and eligible for manufacturer's maximum guarantee period, appropriate for the slope and substrate shown.

1.9.1.1 Furnish the owner with manufacturer's service agreement or standard warranty for the particular roofing and flashings, effective as of the date of acceptance. Include provision for renewal at end of initial warranty where such option is offered by the manufacturer.

1.9.1.2 Furnish the owner with a service affidavit, signed by the Contractor, worded as follows:

The undersigned agree, for a period of 2 years following the expiration of the initial 1-year warranty to inspect and make immediate, emergency, temporary repair as required to stop leaks or correct other defects in the roofing within 24 hours notice by the owner, and to make permanent repair within 60 days, all without reference to cause or nature of such defects in the roofing work.

Work required in this period will be at no cost to the owner with the following exception. All work required because of acts of

God, abuse, alterations, or failure of substrate or supporting structure will be paid for promptly by the owner after permanent repair (as indicated by the co-signing of this affidavit by the owner).

The undersigned also agrees to inspect the roofing and flashing semi-annually in the presence of the owner's authorized representative; to report in writing any sign of damage, deterioration, unusual wear, or weathering effects; and to recommend maintenance work.

1.9.2 General warranty: The warranties specified in this article shall not deprive the owner of other rights the owner may have under other provisions of the contract documents and shall be in addition to, and run concurrent with, other warranties made by the contractor under requirements of the contract documents.

1.9.3 Standard roofing manufacturer's warranty: Submit a written warranty, without monetary limitation, signed by roofing system manufacturer agreeing to promptly repair leaks resulting from defects in materials or workmanship for a warranty period of 20 years to WW Associates.

2 PRODUCTS

2.1 Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to the following:

2.1.1 EPDM sheet: Carlisle Syntec Systems; Carlisle Corp.

2.2 EPDM sheet: Uniform, flexible sheet formed from a terpolymer of ethylene-propylene-diene, complying with ASTM D 4637, type 1, of the following grade, class, thickness, backing, and exposed face color:

2.2.1 Grade and Class: Grade 1 or 2 and Class SR, scrim or fabric internal reinforced.

2.2.2 Thickness: 60 mils (1.5 millimeters) nominal.

2.2.3 Backing: Manufacturer's recommended standard.

2.2.4 Exposed face color: Black.

2.3 Auxiliary materials

2.3.1 General: Furnish auxiliary materials recommended by roofing system manufacturer for intended use and compatible with EPDM membrane roofing.

2.3.1.1 Furnish liquid-type auxiliary materials that meet voc limits of authorities having jurisdiction.

2.3.2 Sheet flashing: 60-mil (1.5-millimeter) thick EPDM, uncured or cured, according to application.

2.3.3 Bonding adhesive: Manufacturer's standard bonding adhesive.

2.3.4 Splice adhesive and cleaner: Single-component butyl splicing adhesive and solvent-based splice cleaner.

2.3.5 Splice primer and tape: Manufacturer's standard synthetic rubber polymer primer and 3-inch (75-millimeter) wide minimum, butyl splice tape with release film.

2.3.6 Lap sealant: Manufacturer's standard single-component sealant.

2.3.7 Water cutoff mastic: Manufacturer's standard butyl mastic sealant.

2.3.8 Metal termination bars: Manufacturer's standard aluminum bars, approximately 1-inch (25-millimeters) wide, roll formed and prepunched.

2.3.9 Metal battens: Manufacturer's standard aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1-inch (25-millimeters) wide by 0.05-inch (1.3-millimeters) thick, prepunched.

2.3.10 Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions of FM 4470, designed for fastening sheet to substrate, and acceptable to roofing system manufacturer.

2.3.11 Miscellaneous accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, t-joint covers, in-seam sealants, termination reglets, and other accessories recommended by roofing system manufacturer for intended use.

2.3.12 Roof Insulation

2.3.12.1 General: Provide preformed roof insulation boards that comply with requirements and referenced standards, selected from manufacturer’s standard sizes and of thicknesses indicated.

2.3.12.2 Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 3 (25PSI), fiber-reinforced felt facer on both major surfaces.

2.3.12.3 Tapered Insulation: All roofs shall be sloped to drain. Provide factory-tapered insulation boards fabricated to slope of ⅛-inch per 12 inches.

2.3.12.4 Tapered Insulation Roofing Design: The Contractor shall submit a detailed tapered insulation roofing design to demonstrate how this will be accomplished per roof section.

3 EXECUTION

3.1 Examination

3.1.1 Contractor shall protect building, structures, mechanical equipment, pavement and other facilities during construction.

3.1.2 Protect facilities from water damage during construction. Provide tarps and covers for building roofs to prevent water damage.

3.1.3 Examine substrates, areas, and conditions under which roofing will be applied, with installer present, for compliance with requirements.

3.1.4 Verify that roof openings and penetrations are in place and set and braced and that roof drains are properly clamped into position.

3.1.5 Verify that wood nailers are in place and secured and match thicknesses of insulation required.

3.1.6 Do not proceed with installation until unsatisfactory conditions have been corrected.

3.1.7 Verify areas to be repaired on Clearwell #3, including holes, scratches and seam failures.

3.1.8 Contractor shall install the tapered insulation and membrane in accordance with manufactured instructions. Insulation shall be installed with adhesive. Metal fabrication shall not be allowed.

3.2 Preparation

3.2.1 Clean substrate of dust, debris, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

3.2.2 Protect potable water and other equipment with tarps and other masking means that will keep contamination from entering water system.

3.2.3 Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of the roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing. Contractor is

responsible for ensuring the building and its contents are not damaged by inclement weather.

3.3 Adhered Sheet Installation

3.3.1 Install appropriate insulation and sheet over area to receive roofing according to roofing system manufacturer's written instructions. Unroll sheet and allow to relax as recommended by product manufacturer.

3.3.2 Start installation of sheet in presence of roofing system manufacturer's technical personnel.

3.3.3 Accurately align sheets and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

3.3.4 Apply bonding adhesive to completely cover substrate and underside of sheet at rate required by manufacturer and allow to partially dry. Do not apply bonding adhesive to splice area of sheet.

3.3.5 Mechanically and adhesively fasten sheet securely at terminations and perimeter of roofing.

3.3.6 Apply roofing sheet with side laps shingled with slope of roof deck where possible.

3.4 Seam Installation

3.4.1 Clean both faces of splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet terminations.

3.4.1.1 Apply a continuous bead of in-seam sealant before closing splice if required by roofing system manufacturer.

3.4.2 Clean and prime both faces of splice areas, apply splice tape, and firmly roll side and end laps of overlapping sheets according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet terminations.

3.4.3 Repair tears, voids, and lapped seams in roofing that does not meet requirements.

3.5 Flashing Installation

3.5.1 Install sheet flashings and preformed flashing accessories and adhere to substrates according to roofing system manufacturer's written instructions.

3.5.2 Apply bonding adhesive to substrate and underside of flashing sheet at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.

3.5.3 Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing as recommended by manufacturer.

3.5.4 Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.

3.5.5 Terminate and seal top of sheet flashings.

3.5.6 Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.6 Field Quality Control

3.6.1 Final roof inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to WW Associates.

3.6.1.1 Notify WW Associates or Owner 5 days in advance of the date and time of inspection.

3.7 Protecting and Cleaning

3.7.1 Protect sheet membrane roofing from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to WW Associates and owner.

3.7.2 Correct deficiencies in or remove roofing that does not comply with requirements, repair substrates, reinstall roofing, and repair sheet flashings to a condition free of damage and deterioration at the time of substantial completion and according to warranty requirements.

3.7.3 Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

End of Section

Section 07720
Roof Accessories

1 GENERAL

1.1 Description: This section specifies prefabricated pipe flashing.

1.2 Reference specifications and standards are referred to by abbreviation as follows:

1.2.1 American Society for Testing and Materials ..... ASTM

1.2.2 National Roofing Contractors Association ..... NRCA

1.3 Submittals: Provide the following in a timely manner in accordance with the approved submittals schedule as specified in Section 01400 – General Requirements.

1.3.1 Product data for each type of product specified, including manufacturer's detailed technical product data, installation instructions and recommendations, and details of construction relative to materials, dimensions of individual components, profiles, and finishes.

2 PRODUCTS

2.1 Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to the following:

2.1.1 Prefabricated pipe flashing:

2.1.1.1 The Pate Co.: Pipe Seal PPS-3.

2.1.1.2 Roof Products and Systems Corp.: Deckmate.

2.1.2 Prefabricated metal edge:

2.1.2.1 Carlisle metal edge system, .040 aluminum mill finish or equal.

2.1.3 Roof Expansion Joint Repair:

2.1.3.1 Sikadur Combiflex SG System.

2.2 Prefabricated Pipe flashing: Comply with loading and strength requirements as indicated where units support other work.

2.2.1 Fabricate base of aluminum and sealed watertight to an EPDM flashing riser.

2.2.2 Provide base profile to fit roof slope and configuration.

2.2.3 Secure top of EPDM riser to pipe with stainless steel adjustable, non-corrosive strap. Seal edge of EPDM at pipe with sealant as recommended by pipe flashing manufacturer.

2.3 Prefabricated Metal Edge: Comply with all manufacturer and code requirements to ensure that the total roofing system if fully warranted.

2.4 Roof Expansion Joint Repair: Provide all required materials to install per manufacturer's instructions and recommendations.

3 EXECUTION

3.1 Installation: Comply with manufacturer's instructions and recommendations. Coordinate with installation of roofing, as required, to ensure that each element of the work performs properly and that combined elements are waterproof and weathertight. Anchor units securely to supporting structural substrates, adequate to withstand lateral and thermal stresses, as well as inward and outward loading pressures.

3.1.1 Except as otherwise indicated, install roof accessory items according to construction details of NRCA Roofing and Waterproofing Manual.

3.1.2 Isolation: Where metal surfaces of units are to be installed in contact with incompatible metal or corrosive substrates, apply bituminous coating on concealed metal surfaces, or provide other permanent separation.

3.1.3 Flange seals: Unless otherwise indicated, set flanges of accessory units in a thick bed of roofing mastic or sealant to form a seal.

3.2 Cleaning and Protection: Clean exposed metal and plastic surfaces according to manufacturer's instructions. Touch up damaged metal coatings.

End of Section

Section 08110
Commercial Hollow Metal Doors and Frames

1 GENERAL

1.1 Summary

1.1.1 This section includes commercial hollow metal products, including doors, frames, and window assemblies as shown in the contract documents.

1.2 Products Provided Under This Section

1.2.1 Commercial hollow metal doors, swinging type, including fire rated doors as indicated.

1.2.2 Commercial hollow metal frames.

1.3 Related Sections

1.3.1 Section 01400 – General Requirements

1.3.2 Section 08710 – Finish Hardware

1.3.3 Section 09990 – Painting

1.4 References

1.4.1 The publications listed in this section form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.

1.4.1.1 ANSI/SDI A250.4-2018 Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Hardware Reinforcings

1.4.1.2 ANSI/SDI A250.10-2020, Standard Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames

1.4.1.3 ANSI/NAAMM HMMA 801-12, Glossary of Terms for Hollow Metal Doors and Frames

1.4.1.4 ANSI/NFPA 80, Fire Doors and Fire Windows

1.4.1.5 ANSI/NFPA 252, Standard Methods of Fire Tests of Door Assemblies

1.4.1.6 ANSI/UL 10C-16, Positive Pressure Fire Tests of Door Assemblies, with Revisions Through May 2021

1.4.1.7 ANSI/UL 1784-2015, Air Leakage Tests of Door Assemblies, 4th Edition

1.4.1.8 ASTM A 653/A 653/M-08, Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

1.4.1.9 ASTM A 1008/A 1108M-21A, Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High Strength Low-Alloy, High Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable

1.4.1.10 ASTM A 1011/A 1011M-09, Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High Strength Low-Alloy, and High Strength Low-Alloy with Improved Formability

1.4.1.11 ASTM C 143/A 143M-15A, Test Method for Slump of Hydraulic-Cement Concrete

1.4.1.12 NAAMM HMMA 802-07, Manufacturing of Hollow Metal Doors and Frames

1.4.1.13 NAAMM HMMA 803-08, Steel Tables

1.4.1.14 NAAMM HMMA 810-09, Hollow Metal Doors

1.4.1.15 NAAMM HMMA 810 TN01-03, Defining Undercuts

1.4.1.16 NAAMM HMMA 820-08 Hollow Metal Frames

1.4.1.17 NAAMM HMMA 820 TN01-03, Grouting Hollow Metal Frames

1.4.1.18 NAAMM HMMA 820 TN02-03, Continuously Welded Frames

1.4.1.19 NAAMM HMMA 830-02, Hardware Selection for Hollow Metal Doors and Frames

1.4.1.20 NAAMM HMMA 831-11, Recommended Hardware Locations for Hollow Metal Doors and Frames

1.4.1.21 NAAMM HMMA 840-99, Guide Specifications for Receipt, Storage, and Installation of Hollow Metal Doors and Frames

1.4.2 ANSI

American National Standards Institute, Inc.
25 W. 43rd Street, 4th Floor
New York, NY 10036
(212) 642-4900 www.ansi.org

1.4.3 ASTM

ASTM International
100 Barr Harbor Drive
West Conshohocken, PA 19428-2959
(610) 832-9585 www.astm.org

1.4.4 NAAMM

National Association of Architectural Metal Manufacturers
800 Roosevelt Road
Building C, Suite 312
Glen Ellyn, IL 60137
(630) 942-6591 www.naamm.org

1.4.5 NFPA

National Fire Protection Association
1 Battery Park
P.O. Box 9101
Quincy, MA 02269
(800) 344-3555 www.nfpa.org

1.4.6 UL

Underwriters Laboratories, Inc.
333 Pfingsten Road
Northbrook, IL 60062
(847) 272-8800 www.ul.com

1.5 Testing and Performance

1.5.1 Physical Endurance for Steel Doors and Hardware Reinforcings

1.5.1.1 The test specimen shall be a 3-foot x 7-foot (914 mm x 1-3/4-inch (44 mm) thick nominal size door, representative of the construction and material to be provided.

1.5.1.2 The specimen shall be tested in accordance with the ANSI A250.4, Cycle and Twist Test Procedure.

1.5.1.2.1 Cycle Test Acceptance Criteria: Doors specified with 0.053-inch (1.3 mm) and thicker face sheets shall be tested to 4,000,000 cycles. Doors specified with 0.0420-inch (1.0 mm) – 0.053-inch (1.3 mm) thick face sheets shall be tested to 1,000,000 cycles Level (A).

1.5.1.2.2 Twist Test Acceptance Criteria: Maximum deflection under 300 pound (136.1 kg) load.

1.5.1.2.2.1 4,000,000 cycle-tested doors shall not exceed 0.625-inch (15.8 mm) deflection and maximum permanent deflection shall not exceed 0.062 in. (1.5 mm).

1.5.1.2.2.2 1,000,000 cycle-tested doors shall not exceed 1.25-inch (31.7 mm) deflection and maximum permanent deflection shall not exceed 0.125 (3.1 mm).

1.5.1.3 Test Reports or Certificates of Compliance shall include a description of the test specimen, procedures used in testing, and indicate compliance with the contract document specified acceptance criteria.

1.5.2 Prime Paint Performance (ANSI A 250.10)

1.5.2.1 Sheet steel specimens, with the product manufacturer's production primer, replicating Finish 'as shipped', shall be tested in accordance with ANSI A250.10.

1.5.2.2 Performance shall meet the Acceptance Criteria described in ANSI A250.10.

1.5.2.3 Test Reports or Certificates of Compliance shall include a description of the test specimens, procedures used in testing, and indicate compliance with the contract document specified acceptance criteria.

1.5.3 Labeled Fire-Rated Doors and Frame Product

1.5.3.1 Doors and frames provided for openings requiring fire protection and temperature rise shall be listed and/or classified and bear the label of a testing agency having a factory inspection service. The product shall be tested in accordance with ANSI/NFPA 252 or ANSI/UL 10C and constructed as listed or classified for labeling. Fire and temperature rise ratings shall be as scheduled.

1.6 Quality Assurance

1.6.1 Manufacturer's Qualifications

1.6.1.1 Manufacturer shall provide evidence of having personnel and plant equipment capable of fabricating hollow metal door and frame product of the types specified.

1.6.1.2 Manufacturer shall provide evidence of having a written quality control system in place.

1.6.2 Quality Criteria

1.6.2.1 All doors and frame product shall meet the requirements of Section 1.5 of these specifications. Fabricate assemblies in strict accordance with the approved submittal drawings.

1.6.2.2 Fabrication methods and product quality shall meet standards set by the Hollow Metal Manufacturers Association, HMMA, a Division of the National Association of Architectural Metal Manufacturers, NAAMM, as set forth in the contract documents and NAAMM'S HMMA 800 through 850 Series documents.

1.7 Submittals

1.7.1 Submittal Drawings

1.7.1.1 Show dimensioned door and frame product elevations and sections.

1.7.1.2 Show listing of opening descriptions including locations, material thicknesses, and anchors.

1.7.1.3 Show location and details of openings.

1.7.2 The Contractor responsible for coordination and installation of products covered under this Section shall;

1.7.2.1 Verify and provide to the manufacturer, actual opening sizes and site conditions by field measurements before fabrication. Submittal drawings shall reflect measurements and conditions provided, and product manufactured accordingly. Coordinate field measurements with fabrication and construction schedules to avoid delay.

1.7.2.2 Verify that substrate conditions, whether existing or installed under other Sections, are as detailed in contract drawings, and are acceptable for product installation in accordance with the manufacturer's instructions.

1.7.3 Manufacturer shall not proceed with fabrication without receipt of approved submittal drawings and approved hardware schedules.

1.7.4 The Contractor responsible for the coordination of procuring products provided under this Section and Section 1.3 – Related Sections, shall comply with the hollow metal manufacturer's ordering instructions and lead time requirements to avoid delays.

2 PRODUCTS

2.1 Hollow Metal Doors

2.1.1 Materials

2.1.1.1 Steel

2.1.1.1.1 Doors: Face sheets shall be 0.053-inch (1.3 mm) minimum thickness zinc-coated steel conforming to ASTM A 653/A653M CS Type B, Coating Designation A60 (ZF180) or G60 (Z180).

2.1.2 Construction

2.1.2.1 Doors shall be the types, sizes, and construction, in accordance with the contract documents, and shall meet the performance requirements of Section 1.5. Prior to shipment mark each door with an identification number as shown on approved submittal drawings.

2.1.2.2 Door face sheets shall be joined at their vertical edges by a continuous weld extending the full height of the door, with no visible seams on their faces or vertical edges.

2.1.2.3 Minimum nominal door thickness shall be 1-3/4 in. (44 mm). Doors shall be neat in appearance and free from warpage or buckle. Edge bends shall be true and straight and of minimum radius for the thickness of metal used.

2.1.2.4 Doors shall be stiffened by continuous vertically formed steel sections which, upon assembly, shall span the full thickness of the interior space between door faces. These stiffeners shall be 0.026 in. (0.6 mm) minimum thickness, spaced so that the vertical interior webs shall be no more than 6 in. (152 mm) apart and securely fastened to both face sheets by spot welds spaced a maximum of 5 in. (127 mm) o. c. vertically. Spaces between stiffeners shall be filled with fiberglass or mineral rock wool batt-type material.

2.1.2.5 The top and bottom edges shall be closed with a continuous steel channel, not less than 0.053 in. (1.3 mm) thickness, welded to both face sheets.

2.1.2.6 Exterior doors shall be closed flush at the top edge. Where required for attachment for weather-stripping, a flush steel closure channel shall also be provided at the bottom edge. Openings shall be provided in the bottom closure channel of exterior doors to permit the escape of entrapped moisture.

2.1.2.7 Edge profiles shall be provided on both vertical edges of doors as follows, unless hardware dictates otherwise:

2.1.2.7.1 Single acting doors - beveled 1/8 in. (3.1 mm) in 2 in. (50.8 mm) profile.

2.1.2.8 Hardware Reinforcements and Preparations

2.1.2.8.1 Doors shall be mortised, reinforced, drilled and tapped at the factory for templated hardware only, in accordance with the approved hardware schedule and templates provided by the hardware supplier. Where surface mounted hardware, anchor hinges, thrust pivots, pivot reinforced hinges, or non-templated hardware apply, doors shall be reinforced, with drilling and tapping done in the field.

2.1.2.8.2 Minimum steel thickness for hardware reinforcements shall be as follows:

2.1.2.8.2.1 Full mortise hinges and pivots .....0.167 in. (4.2 mm)

2.1.2.8.2.2 Lock fronts, strikes, concealed holders, or surface mounted closers .....0.093 in. (2.3 mm)

2.1.2.8.2.3 Internal Reinforcements for other surface applied hardware ..... 0.67-inches (1.7 mm)

2.2 Hollow Metal Frames

2.2.1 Materials

2.2.1.1 Frame product shall be manufactured from cold rolled steel conforming to ASTM A1008/A 1008/M CS Type B, or hot-rolled, pickled and oiled (HRPO) steel conforming to ASTM A 1011/A 1011M CS Type B.

2.2.1.2 Exterior Frame Product: Frame product shall be manufactured from zinc coated steel conforming to ASTM A 653/A 653M CS Type B, Coating Designation A60 (ZF180) or G60 (Z180). Profiles shall be 0.053-inch (1.3 mm) minimum thickness in width.

2.2.2 Construction

2.2.2.1 Frame product shall have integral stops and be welded units of the sizes and types shown on approved submittal drawings. Frame product shall be constructed in accordance with the contract documents and meet the performance criteria specified in Section 1.5.1. Knock down frames are not acceptable. Frame product shall be constructed in accordance with NAAMM HMMA 820 with regard to joint designs and welding techniques. Prior to shipment

mark frame product with an identification number as shown on approved submittal drawings.

2.2.2.2 Finished work shall be neat in appearance, square, and free of defects, warps and buckles. Pressed steel members shall be straight and of uniform profile throughout their lengths.

2.2.2.3 Jamb, header, mullion and sill profiles shall be in accordance with the Contract Documents and as shown on the approved submittal drawings.

2.2.2.4 Corner joints shall have all contact edges closed tight with faces mitered and stops either butted or mitered.

2.2.2.4.1 Welding

2.2.2.4.1.1 Perimeter face joints (flush or indented) shall be continuously welded internally or externally. Flush face joints shall be finished smooth with seamless faces. Rabbets and soffits shall be continuously welded internally. The use of gussets or splice plates as a substitute for welding shall not be acceptable.

2.2.2.4.1.2 Internal flush face joints shall be continuously welded and finished smooth with seamless faces.

2.2.2.4.1.3 Members at internal indented intersections shall be securely welded to concealed reinforcements, and have hairline face seams.

2.2.2.4.1.4 All other intersection elements shall have hairline seams.

2.2.2.5 Minimum height of stops shall be 0.625 in. (15.8 mm).

2.2.2.6 Each door opening shall be prepared for single stud, resilient door silencers, three (3) per strike jamb for single door openings, except on gasketed or weather stripped frame product. Silencers shall be supplied.

2.2.2.7 Hardware Reinforcements and Preparations

2.2.2.7.1 Frame product shall be mortised, reinforced, drilled and tapped at the factory for templated hardware only, in accordance with the approved hardware schedule and templates provided by the hardware supplier. Where surface mounted hardware, anchor hinges, thrust pivots,

pivot reinforced hinges, or non-templated hardware apply, frame product shall be reinforced, with drilling and tapping done in the field.

2.2.2.7.2 Minimum steel thickness of hardware reinforcing shall be as follows:

2.2.2.7.2.1 Full mortised hinges and pivots ……0.167 in.x 1.25 in x 10 in. length (4.2 mm x 31.7 mm x 254 mm)

2.2.2.7.2.2 Strikes……...0.093 in. (2.3 mm) or 0.053 in. (1.3 mm) unitized reinforcement with extruded tapped holes that provide equivalent number of threads as 0.093 in. (2.3 mm)

2.2.2.7.2.3 Flush bolts, closers, hold open arms, and other surface applied hardware …….0.093 in. (2.3 mm)

2.2.2.8 Floor Anchors

2.2.2.8.1 For applications that do not permit the use of a floor anchor, an additional jamb anchor shall be substituted at a location not to exceed 8 in. (204 mm) from the base of the jamb.

2.2.2.9 Jamb Anchors

2.2.2.9.1 Frame product shall be provided with anchorage appropriate to frame and wall construction.

2.2.2.10 All door openings in frame product shall be provided with a temporary steel spreader welded to the feet of the jambs or mullions to serve as bracing during shipping and handling, and which shall not be used for installation.

2.3 Manufacturing Tolerances

2.3.1 Manufacturing tolerances shall be maintained within the following limits:

2.3.1.1 Frame Product for Single Doors

2.3.1.1.1 Width, measured between rabbets at the head: nominal opening width + 1/16 in. (+ 1.5 mm), - 1/32 in. (- 0.8 mm)

2.3.1.1.2 Height (total length of jamb rabbet): nominal opening height + 1/16 in. (1.5 mm), – 1/32 in. (0.8 mm)

2.3.1.1.3 Cross sectional profile dimensions (see Drawings):

2.3.1.1.3.1 Face ..... ± 1/32 in. (0.8 mm)

2.3.1.1.3.2 Stop ..... ± 1/32 in. (0.8 mm)

2.3.1.1.3.3 Rabbet ..... ± 1/32 in. (0.8 mm)

2.3.1.1.3.4 Depth ..... ± 1/16 in. (1.5 mm)

2.3.1.1.3.5 Throat ..... ± 3/32 in (2.3 mm)

2.3.1.2 Doors

2.3.1.2.1 Tolerances for actual hollow metal door size are as follows:

2.3.1.2.1.1 Width ..... ± 3/64 in. (1.2 mm)

2.3.1.2.1.2 Height ..... ± 3/64 in. (1.2 mm)

2.3.1.2.1.3 Thickness ..... ± 1/16 in. (1.5 mm)

2.3.1.2.1.4 Edge Flatness .....1/16 in. (1.5 mm) maximum

2.3.1.2.1.5 Surface Flatness .....1/8 in (3.1 mm) maximum

2.3.1.3 Hardware

2.3.1.3.1 Cutouts Template dimensions .....+0.015 in. (0.38 mm), - 0

2.3.1.3.2 Location..... ± 1/32 in. (0.8 mm)

2.3.1.3.3 Between hinge centerlines..... ± 1/64 in (0.4 mm)

2.4 Hardware Locations

2.4.1 The location of hardware on doors and frame product shall be as listed below. All dimensions, except the hinge locations, are referenced from the floor as defined in Section 3.3.2.

2.4.1.1 Hinges

2.4.1.1.1 Top….5 in. (127 mm) from underside of frame rabbet at door opening to top of hinge

2.4.1.1.2 Bottom……10 in. (254 mm) from floor to bottom of hinge

2.4.1.1.3 Intermediate……centered between top and bottom hinges

2.4.1.2 Locks and latches……38 in. (965 mm) to centerline of knob or lever shaft

2.5 Finish

2.5.1 After fabrication, all tool marks and surface imperfections shall be filled and sanded as required to make face sheets, vertical edges and weld joints free from irregularities and dressed smooth.

2.5.2 After appropriate metal preparation, exposed surfaces of doors and frames shall receive a factory applied rust inhibitive primer which meets or exceeds the performance requirements of Section 1.5.2.

2.5.3 Primer must be fully cured prior to shipment.

3 EXECUTION

3.1 Site Storage and Protection of Materials

3.1.1 Remove wraps or covers upon delivery at the building site and ensure that any scratches or disfigurement caused by shipping or handling are promptly cleaned and touched up with a rust inhibitive 'Direct to Metal' (DTM) primer.

3.1.2 Ensure that materials are properly stored on planks or dunnage in a dry location. Doors and frame product shall be stored in a vertical position, spaced by blocking. Materials shall be covered to protect them from damage but in such a manner as to permit air circulation.

3.2 Installation

3.2.1 The installer shall perform the following:

3.2.1.1 Prior to installation, the area of floor on which the frame product is to be installed, and within the path of the door swing, shall be checked for flatness.

3.2.1.2 Prior to installation, remove temporary spreaders. Doors and frame product shall be checked for correct size, swing, and opening number.

3.2.1.3 During the setting of frame product check and correct as necessary for opening width, opening height, squareness, alignment, twist and plumbness. Installation tolerances shall be maintained within the following limits.

3.2.1.3.1 Opening Width…...measured from rabbet to rabbet at top, middle and bottom of frame + 1/16 in (1.5 mm), - 1/32 in (0.8 mm)

3.2.1.3.2 Opening Height….measured vertically between frame head rabbet and top of floor or bottom of frame

minus jamb extensions at each jamb and across the head: + 1/16 in (1.5 mm), – 1/32 in (0.8 mm)

3.2.1.3.3 Squareness.....measured at rabbet on a line from jamb, perpendicular to frame head; not to exceed 1/16 in (1.5 mm)

3.2.1.3.4 Alignment…….measured at jambs on a horizontal line parallel to the plane of the face; not to exceed 1/16 in (1.5 mm)

3.2.1.3.5 Twist…….measured at opposite face corners of jambs on parallel lines perpendicular to the plane of the door rabbet; not to exceed 1/16 in (1.5 mm)

3.2.1.3.6 Plumbness…….measured at the jambs on a perpendicular line from the head to the floor; not to exceed 1/16 in (1.5 mm)

3.2.1.4 Frame products are not intended or designed to act as forms for grout or concrete. Grouting of hollow metal sections shall be done in "lifts" or precautions shall be otherwise taken by the contractor to ensure that frames are not deformed or damaged by the hydraulic forces that occur during this process.

3.2.1.5 Hollow metal surfaces shall be kept free of grout, tar and/or other bonding materials or sealers. Grout, tar, and/or bonding materials or sealers shall be promptly cleaned off frame product and doors.

3.2.1.6 The installer shall finish and touch-up marks caused by spreader removal.

3.2.1.7 Exposed hollow metal surfaces which have been scratched or otherwise marred during installation, cleaning, and/or field welding, shall promptly be finished smooth, cleaned, treated for maximum paint adhesion and touched up with a rust inhibitive primer comparable to and compatible with the shop applied primer and finish paint specified in Section 09990 – Painting. All touch-up primer and finish paint must be formulated for Direct to Metal (DTM) application.

3.2.1.8 Proper door edge clearances must be maintained in accordance with Section 3.3, except for special conditions otherwise noted. Where necessary, metal hinge shims are permitted to maintain clearances.

3.2.1.9 Hardware shall be applied in accordance with hardware manufacturer's templates and instructions.

3.2.1.10 Finish paint in accordance with Section 09990 – Painting.

3.2.1.11 Install door silencers.

3.2.1.12 Install door closers in accordance with manufacturer's instructions.

3.3 Clearances

3.3.1 Edge clearance for swinging hollow metal doors shall be a minimum of 1/32 in (0.8 mm) in order to provide for the functional operation of the assembly and shall not exceed the following:

3.3.1.1 Between doors and frame product at head and jambs .....3/16 in. (4.7 mm)

3.3.2 Floor clearance for swinging hollow metal doors shall not exceed the following:

3.3.2.1 At bottom of door where threshold in used..... 3/8 in. (9.5 mm) from bottom of door to top of threshold

3.4 Labeled fire doors and frame product shall be installed according with the terms of their listings or ANSI/NFPA 80.

End of Section

Section 08710
Finish Hardware

1 GENERAL

1.1 Related Documents: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 Summary

1.2.1 Furnish all labor, materials, equipment and appliances required for the complete execution of Work as shown on Drawings and specified herein.

1.3 Related Requirements: The following sections contain requirements that relate to this section.

1.3.1 Section 08110 – Commercial Hollow Metal Doors and Frames

1.4 Reference Specifications, Codes, and Standards

1.4.1 Without limiting the generality of these specifications, the Work shall conform to the applicable requirements of the following documents:

1.4.1.1 ANSI/BHMA 156

1.5 Submittals

1.5.1 In accordance with the procedures and requirements set forth in Section 01400 – General Requirements, submit the following:

1.5.1.1 Manufacturer’s data for each item of hardware. Include installation and maintenance instructions.

1.5.1.2 Furnish templates to fabricators of other work which is to receive hardware.

1.5.1.3 Hardware schedule organized into "hardware sets," indicating complete designation of every item required for each door or opening. Furnish initial draft of schedule at the earliest possible date, in order to facilitate the fabrication of other work (such as hollow metal frames) which may be critical in the project construction schedule. Furnish final draft of schedule after samples, manufacturer's data sheets, coordination with shop drawings for other work, delivery schedules and similar information has been completed and accepted.

1.5.1.4 Prepare a keying schedule in consultation with the Owner.

1.6 Quality Assurance

1.6.1 Provide materials, assemblies, equipment and services from a single source for each category except that locksets, latchsets and cylinders must originate from the same manufacturer.

1.6.2 Replace any item of finish hardware which cannot be installed or will not function properly.

1.6.3 Provide hardware complying with NFPA 80 and UL labeled for fire rated openings.

1.6.4 Furnish templates or information to door and frame manufacturer. Coordinate between the manufacturers where two or more articles of hardware are to be mounted on the same door. Verify all dimensions, new and existing.

1.6.5 Coordinate hardware with other work. Furnish hardware items of proper design for use on doors and frames of the thicknesses, profile, swing, security and similar requirements indicated, as necessary for proper installation and function.

1.7 Delivery, Storage and Handling

1.7.1 Handle, store, distribute, protect and install hardware in accordance with manufacturer's instructions or recommendations. Deliver packaged materials in original containers with seals unbroken and labels intact.

1.7.2 Properly mark or label, so each piece of hardware is readily identifiable with the approved hardware schedule. Tag each change key or otherwise identifying the door of which its cylinder is intended. Where double cylinder functions are used or where it is not obvious which is the key side of a door, appropriate instructions shall be included with the lock and hardware schedule.

1.7.3 Provide secure storage area for hardware.

2 PRODUCTS

2.1 Materials and Fabrication

2.1.1 Hand of Door

2.1.1.1 Drawings show swing or hand of each door leaf (left, right, reverse bevel, etc.). Furnish hardware for proper installation and operation of door.

2.1.2 Manufacturer's Name Plate

2.1.2.1 Do not use manufacturer's products which have name or trade name displayed in a visible location (omit removable nameplates), except in conjunction with required UL labels.

2.1.3 Base Metals

2.1.3.1 Produce hardware units of the basic metal and forming method indicated, using manufacturer's non-corrosive metal alloy, composition, temper and hardness but in no case of lesser quality material than specified.

2.1.4 Fasteners

2.1.4.1 Manufacture hardware to conform to published templates, generally prepared for machine screw installation. Do not provide hardware which has been prepared for self tapping sheet metal screws, except as specifically indicated.

2.1.4.2 Furnish stainless steel fasteners for installation with each hardware item. Exposed finish (under any condition) to match hardware finish or surfaces of adjacent work. Match the finish of adjacent work as closely as possible, including surfaces to receive painted finish.

2.1.4.3 Provide fasteners which are compatible with unit fastened and the substrate, and which will not cause corrosion of deterioration of finish hardware, base material or fastener.

2.1.5 Tools for Maintenance

2.1.5.1 Furnish a complete set of specialized tools as needed for Owner's continued adjustment, maintenance, removal and replacement of builder’s hardware.

2.1.6 Hardware Finishes

2.1.6.1 Stainless steel, US32D unless otherwise noted.

2.1.6.2 Closers shall have a USP finish unless otherwise noted.

2.1.7 Field Checks

2.1.7.1 Make periodic checks during installation of finish hardware to ascertain the correctness of the installation. After completion of the work, certify in writing, that all items of finish hardware have been installed, adjusted and are functioning in accordance with Specification requirements.

2.2 Description of Products

2.2.1 Hinges

2.2.1.1 Stainless steel full mortise concealed oil impregnated ball bearing type, five knuckle with non-rising pins for interior doors, and non-removable and non-rising pins for exterior doors. Tips shall be flat.

2.2.1.2 Sizes and weights of hinges:

2.2.1.2.1 Doors up to 36 inches – 4-1/2 inches regular weight.

2.2.1.2.2 Doors 36 inches to 40 inches – 5 inches regular weight.

2.2.1.2.3 Doors 40 inches to 48 inches – 5 inches heavy weight.

2.2.1.2.4 Fire Rated Doors up to 36 inches – 5 inches regular weight.

2.2.1.3 Provide three hinges per door leaf up to and including 90 inches and one additional hinge for each 30 inches of additional height.

2.2.1.4 Acceptable Manufacturers: Stanley Hardware, Hager Hardware, or approved equal.

2.2.2 Closers

2.2.2.1 Cast iron case with seamless one-piece forged steel spring tub.

2.2.2.2 Heavy duty forged steel arm.

2.2.2.3 Non-sized fully adjustable from size 1-6.

2.2.2.4 Backcheck intensity and location valves.

2.2.2.5 Delayed action closing.

2.2.2.6 Full metal cover.

2.2.2.7 Mechanical hold open device, except at fire rated doors.

2.2.2.8 ANSI 156.4, Grade 1.

2.2.2.9 Conforms to ADA 5 lbf maximum door opening force requirement for non-fire rated interior doors.

2.2.2.10 Provide mounting brackets, and fasteners required for proper attachment.

2.2.2.11 Provide closers at fire rated doors.

2.2.2.12 Acceptable manufacturers: Corbin/Russwin, LCN, Norton, or approved equal.

2.2.3 Flush Bolts

2.2.3.1 U.L. listed.

2.2.3.2 Forged brass construction, ½-inch diameter flattened bolt tip, 12-inch

long rod.

2.2.3.3 Fit standard ANSI door preparation.

2.2.3.4 Acceptable manufacturers: Glynn-Johnson, H.B. Ives, Hager Hardware, or approved equal.

2.2.4 Silencers

2.2.4.1 Rubber silencers: 3 for each single door and 2 for each double doors.

2.2.4.2 Acceptable manufacturers and products: (Hollow metal doors and frames): Glynn-Johnson Models 64 or 65, Hager Hardware Models 308D or 307D, H.B. Ives Models 20 or 21, or approved equal.

3 EXECUTION

3.1 General

3.1.1 Templates

3.1.1.1 After the hardware schedule is approved furnish to the various manufacturers, required blueprint templates for fabrication purposes. Templates shall be made available not more than ten (10) days after receipt of the approved hardware schedule.

3.1.2 Packaging and Marking

3.1.2.1 Ship hardware with proper non-corrosive fastenings for secure application. Each package of hardware shall be legibly marked indicating the part of the work for which it is intended. Markings shall correspond with the item numbers shown on the approved hardware schedule.

3.2 Installation

3.2.1 Install hardware in a manner which will eliminate cracks on surfaces.

3.2.2 Mount hardware units at heights recommended in "Recommended Locations for Builders Hardware" by BHMA, except as otherwise indicated or required to comply with governing regulations.

3.2.3 Install each hardware item in compliance with the manufacturer's instructions and recommendations. Do not install surface-mounted items until finishes have been completed on the substrate.

3.2.4 Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as is necessary for proper installation and operation.

3.2.5 Drill and countersink units which are not factory-prepared for anchorage

fasteners. Space fasteners and anchors in accordance with factory standards.

3.3 Adjust and Clean

3.3.1 Adjust and check each operating item of hardware and each door to ensure proper operation or function. Lubricate moving parts as recommended by manufacturer. Replace units which cannot be adjusted to operate freely and smoothly as intended for the application.

3.3.2 Final Adjustment

3.3.2.1 One week prior to acceptance or occupancy make a final check and adjustment of all hardware items. Clean and relubricate operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices and compensate for final operation of heating and ventilating equipment.

3.3.3 Instruct Owner personnel in proper adjustment and maintenance of hardware and hardware finishes, during the final adjustment of hardware.

3.4 Hardware Sets

3.4.1 The door hardware sets on the Drawings indicates functional and general requirements. Items shall be quality and finish as specified. Hardware set identification refers to set numbers indicated on the Drawings. Provide hardware required to meet Code requirements. Consult Drawings for set number required.

3.4.2 Hardware shall be as follows:

3.4.2.1 Hardware Sets

3.4.2.1.1 Applicable to interior single personnel doors:

Hinges

Passage

Door Closer with hold open

Silencers

End of Section

Section 09900
Painting

1 GENERAL

1.1. Related Documents

1.1.1. The General Conditions of the Construction Contract and Division 1, General Requirements are a part of this section.

1.2. Description of Work

1.2.1. The extent of painting work is as indicated on the drawings and schedules, and as herein specified.

1.2.2. The work includes the painting and finishing of all interior and exterior exposed items and surfaces throughout the project, as indicated.

1.2.3. Surface preparation, priming and coats of paint specified are in addition to shop priming and surface treatment specified under other sections of the work.

1.2.4. The work includes the field painting of concrete and masonry, exposed steel, and primed metal surfaces of doors and door frames.

1.2.5. The term "paint" as used herein means all coating systems materials, which includes primers, emulsions, enamels, stain, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats.

1.2.6. Paint all exposed surfaces whether or not colors are designated in any "schedule", except where the natural finish of the material is specifically noted a surface not to be painted. Where items or surfaces are not specifically mentioned, paint these the same as adjacent similar materials or areas. Colors will be selected by the Project Engineer from standard colors available for the materials systems specified.

1.3. Painting Not Included

1.3.1. The following categories of work are not included as part of the field-applied finish work, or are included in other sections of these specifications.

1.3.1.1. Shop Priming

1.3.1.1.1. Unless otherwise specified, shop priming of ferrous metal items is included under the various sections for structural steel, miscellaneous metal items, hollow metal work, and similar items. Also, for such fabricated components as shop-fabricated or factory-built mechanical and electrical equipment or accessories.

1.3.1.2. Pre-finished Items

1.3.1.2.1. Unless otherwise indicated, do not include painting when factory-finishing or installer-finishing is specified for such items as (but not limited to) toilet enclosures, pre-finished partition systems, acoustic materials, architectural woodwork and casework, finished mechanical and electrical equipment including light fixtures and distribution cabinets, and equipment.

1.3.1.3. Concealed Surfaces

1.3.1.3.1. Unless otherwise indicated, painting is not required on wall or ceiling surfaces in concealed areas and generally inaccessible areas, such as foundation spaces, furred areas, pipe spaces, and duct shafts as applicable to this project.

1.3.1.4. Finished Metal Surfaces

1.3.1.4.1. Metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze and similar finished materials will not require finish painting, unless otherwise indicated.

1.3.1.5. Operating Parts and Labels

1.3.1.5.1. Moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, linkages, sensing devices, and motor and fan shafts will not require finish painting unless otherwise indicated.

1.3.1.5.2. Do not paint over any code-required label, such as Underwriter's Laboratories and Factory Mutual, or any equipment identification, performance rating, name, or nomenclature plates.

1.4. Product Handling

1.4.1. Deliver all materials to the job site in original, new and unopened packages and containers bearing manufacturer's name and label.

1.4.2. Store materials in location approved by the Owner’s Representative.

1.4.3. Provide paint manufacturers printed label on each container with the following information:

1.4.3.1. Name or title of material.

1.4.3.2. CSI Spec. number, if applicable.

1.4.3.3. Manufacturer's stock number.

1.4.3.4. Manufacturer's name.

1.4.3.5. Analysis of major pigment and vehicle constituents.

1.4.3.6. Thinning instructions.

1.4.3.7. Application instructions.

1.4.3.8. Color name and number.

1.4.3.9. Manufacturer’s recommended wet and dry film thickness in mils.

1.5. Job Conditions

1.5.1. Do not apply paint when the temperature of surfaces to be painted and the surrounding air temperatures are below 50°F. or above 90°F., unless otherwise permitted by the paint manufacturer's printed instructions.

1.5.2. Do not apply paint in snow, rain, fog or mist; or when the relative humidity exceeds 85 percent; or to damp or wet surfaces. Painting may be continued during inclement weather only if the areas and surfaces to be painted are enclosed and heated within the temperature limits specified by the paint manufacturer during application and drying periods.

1.6. Submittals

1.6.1. Manufacturer's Data

1.6.1.1. For information only, submit copies of manufacturer's technical information, including paint label analysis and application instructions for each material proposed for use. Transmit a copy of each manufacturer's instructions to the paint applicator.

1.6.1.2. List each material and cross-reference to the specific paint and finish system and application. Identify by manufacturer's catalog number and general classifications.

1.6.2. Samples

1.6.2.1. Submit samples for Project Engineer's review of color and texture only. Compliance with all other requirements is the exclusive responsibility of the Contractor. Provide a listing of the material and application for each coat of each finish sample.

1.7. Color Selection

1.7.1. Prior to beginning work; the Contractor will furnish sample color chips to the Owner’s representative with a color schedule for surfaces requiring painting to allow color selections by the Owner.

1.7.2. Proprietary names used to designate colors or materials are not intended to imply that products of the manufacturers are required to the exclusion of equivalent products of other manufacturers.

1.8. Paint Coordination

1.8.1. Provide finish coats which are compatible with prime paints used. Review other Sections of the Specifications in which prime coats are specified to ensure compatibility of total coatings system. Upon request, furnish information on characteristics of specified finish materials, to ensure compatible prime coats are used. Provide barrier coats over incompatible primers or remove and reprime as required. Notify Project Engineer in writing of anticipated problems using specified coating systems with substrates specified to receive prime coats in other sections.

2 PRODUCTS

2.1. Materials

2.1.1. Provide the best quality grade of the scheduled types of coatings regularly manufactured by the acceptable paint manufacturers. Materials not displaying the manufacturer's identification as a standard, best grade product will not be acceptable.

2.1.2. Provide undercoat paint produced by the same manufacturer as the finish coats. Use only thinners approved by the paint manufacturer, and use only within recommended limits.

2.1.3. Provide paints of durable and washable quality. Use paint materials which will withstand normal washing as required to remove pencil marks, ink, ordinary soil, without showing discoloration, loss of gloss, staining, or other damage.

2.1.4. Products produced by the following manufacturers are acceptable alternates.

2.1.4.1. Pittsburgh Paints.

2.1.4.2. Carboline Company.

2.1.4.3. Sherwin-Williams Co.

2.1.4.4. Tnemec Company, Inc.

2.1.4.5. Porter Paints

2.1.4.6. Approved Equal.

3 EXECUTION

3.1. Inspection

3.1.1. Examine the areas and conditions under which painting work is to be performed. Notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.1.2. Starting of painting work will be construed as acceptance of the surfaces within any particular area.

3.1.3. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to the formation of a durable paint film.

3.2. Surface Preparation

3.2.1. General

3.2.1.1. Perform all preparation and cleaning procedures in strict accordance with the manufacturer's instructions and as herein specified, for each particular substrate condition.

3.2.1.2. Remove all hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be finish painted, or provide surface-applied protection prior to surface preparation and painting operations. Remove, if necessary, for the complete painting of the items and adjacent surfaces. Following completion of painting of each space or area, reinstall the removed items.

3.2.1.3. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Program the cleaning and painting so that dust and other contaminants from the cleaning process will not fall in wet, newly painted surfaces.

3.2.2. Previously-Painted Surfaces

3.2.2.1. Totally remove existing paint when: Surface is to be submerged in a severe environment, paint is less than 75% intact, brittle, eroded or has underfilm rusting.

3.2.2.2. Surfaces which are greater than 75% intact require removal of failed paints and then spot primed. Spot priming is in addition to coats specified.

3.2.2.3. Remove surface contamination such as oil, grease, loose paint, mill scale, dirt, foreign matter, rust, mold, mildew, mortar, efflorescence, and sealers.

3.2.2.4. Clean and dull glossy surfaces prior to painting in accordance with the manufacturer's recommendations.

3.2.2.5. Check existing paints for compatibility with new paint system. If incompatible, totally remove existing paint system or apply a barrier coat recommended by the paint manufacturer. Remove existing paints of undetermined origin. Prepare a test patch of approximately 3 square feet over existing paint. Allow test patch to dry thoroughly and test for adhesion. If proper adhesion is not achieved remove existing paint and repaint.

3.2.3. Cementitious Materials

3.2.3.1. Prepare cementitious surfaces of concrete to be painted by removing all efflorescence, chalk, dust, dirt, grease, oils, and by roughening as required remove glaze, concrete hardeners and form release compounds.

3.2.3.2. Determine the alkalinity and moisture content of the surfaces to be painted by performing appropriate tests. If the surfaces are found to be sufficiently alkaline to cause blistering and burning of the finish paint, correct this condition before application of paint. Do not paint over surfaces where the moisture content exceeds limits permitted by the manufacturer's printed directions.

3.2.4. Ferrous Metals

3.2.4.1. Clean non-galvanized, ferrous surfaces that have not been shop-coated of all oil, grease, dirt, loose mill scale and other foreign substances by solvent or mechanical cleaning, complying with SSPC recommendations.

3.2.4.2. Touch-up all shop-applied prime coats which have damaged, or bare areas, where required by other sections of the specifications. Wire brush, solvent clean, and touch-up with the same primer as the shop coat.

3.2.5. Oil and Grease

3.2.5.1. Remove by wiping clean with mineral spirits.

3.2.6. Mold or Mildew

3.2.6.1. Remove mold or mildew before painting. Scrub surface with stiff brush and a solution of one quart of household bleach to three quarts of water. Allow solution to remain on surface for 10 minutes then thoroughly rinse with clean water. Allow to dry for 2 days before painting.

3.2.7. Dirt and Other Foreign Matter

3.2.7.1. Remove with stiff bristle brush and blow clean with air pressure or steam clean.

3.3. Mechanical and Electrical Work

3.3.1. Painting of piping: Uninsulated pipe as indicated shall be painted as follows:

3.3.1.1. Paint shall be the same color as adjacent work or as specified herein.

3.3.2. Mechanical items to be painted include, but are not limited to, the following:

3.3.2.1. Piping, pipe hangers, and pipe support system.

3.3.2.2. Accessory items.

3.4. Materials Preparation

3.4.1. Mix and prepare painting materials in accordance with manufacturer's directions.

3.4.2. Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing and application of paint in a clean condition, free of foreign materials and residue.

3.4.3. Stir materials before application to produce a mixture of uniform density, and stir as required during the application of the materials. Do not stir surface film into the material. Remove the film and if necessary, strain the material before using.

3.5. Application

3.5.1. General

3.5.1.1. Apply paint by brush, roller or spray in accordance with the manufacturer's directions. Use brushes best suited for the type of material being applied. Use rollers of carpet, velvet back, or high pile sheep's wool as recommended by the paint manufacturer for material and texture required. Spray paint uniformly with suitable equipment.

3.5.1.2. Provide a non-slip skid resistant surface on all floors.

3.5.1.3. The number of coats and paint film thickness required is the same regardless of the application method. Do not apply succeeding coats until the previous coat has completely dried. Sand between coat applications with fine sandpaper, or rub surfaces with pumice stone where required to produce an even, smooth surface in accordance with the coating manufacturer's directions.

3.5.1.4. 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.

3.5.1.5. "Exposed surfaces" shall mean areas visible when permanent or built-in fixtures, convector covers, grilles, and other items are in place in areas scheduled to be painted.

3.5.1.6. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Paint surfaces behind permanently-fixed equipment or furniture with prime coat only.

3.5.1.7. Paint the back sides of access panels, removable, or hinged covers to match the exposed surfaces.

3.5.1.8. Finish doors on tops, bottoms, and side edges the same as the faces.

3.5.1.9. Sand lightly between each succeeding enamel or varnish coat.

3.5.1.10. Omit the first coat (primer) on metal surfaces which have been shop-primed and touch-up painted.

3.5.2. Minimum Coating Thickness

3.5.2.1. Apply each material at not less than the manufacturer's recommended spreading rate, to provide a total wet and dry film thickness of not less than that indicated on the manufacturer's printed label.

3.5.3. Scheduled Painting

3.5.3.1. Apply the first-coat material to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

3.5.3.2. Allow sufficient time between successive coatings to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and the application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

3.5.4. Prime Coats

3.5.4.1. Before application of finish coats, apply a prime coat to material which is required to be painted or finished, and which has not been prime coated.

3.5.4.2. Recoat primed and sealed walls 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.

3.5.5. Pigmented (Opaque) Finishes

3.5.5.1. Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage.

3.5.6. Brush Application

3.5.6.1. Brush-out and work all brush coats onto the surfaces in an even film. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable. Neatly draw all glass lines.

3.5.6.2. Brush apply all primer or first coats, unless use of mechanical applicators is permitted.

3.5.7. Mechanical Applications

3.5.7.1. Limit roller applications (generally) to interior wall finishes for second and third coats. Apply each roller coat to provide the equivalent hiding as brush-applied coats.

3.5.7.2. Confine spray application (generally) to metal framework, decking, wire mesh and similar surfaces where hand brush work would be inferior.

3.5.7.3. Wherever spray application is used, apply each coat to provide the equivalent hiding of brush-applied coats. Do not double back with spray equipment for the purpose of building up film thickness of 2 coats in one pass.

3.5.8. Completed Work

3.5.8.1. Match approved samples for color, texture and coverage. Remove, refinish, or repaint work not in compliance with specified requirements.

3.5.9. Protection

3.5.9.1. Protect work of other trades, whether to be painted or not, against damage by the painting and finishing work. Leave all such work undamaged. Correct any damaged by cleaning, repairing or replacing, and repainting, as acceptable to the Project Engineer.

3.5.9.2. Provide "Wet Paint" signs as required to protect newly painted finishes. Remove temporary protective wrappings provided by others for protection of their work after completion of painting operations.

3.5.10. Clean-up

3.5.10.1. During the progress of the work, remove from the site all discarded paint materials, rubbish, cans and rags at the end of each work day.

3.5.10.2. Upon completion of painting work, clean window glass and other paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.

3.5.10.3. At the completion of work of other trades, touch-up and restore all damaged or defaced painted surfaces.

3.6. Painting Schedule – Interior Surfaces

3.6.1. Ductile Iron Pipe

3.6.1.1. Surface Preparation: Perform in accordance with the coating system manufacturer's written recommendations.

3.6.1.2. Prime/Intermediate Coat: Tnemec Series N69 Hi-Build Epoxoline II (polyamidoamine epoxy) at 4.0 to 6.0 mils dry film thickness (DFT), or approved equal by a manufacturer specified herein.

3.6.1.3. Finish Coat: Tnemec Series N69 Hi-Build Epoxoline II (polyamidoamine epoxy) at 4.0 to 6.0 mils dry film thickness (DFT), or approved equal by a manufacturer specified herein.

3.6.1.4. Total Thickness of New Coating System: 8.0 to 12.0 mils dry film thickness (DFT).

3.6.2. Masonry and Concrete Walls

3.6.2.1. First Coat Apply one full coat Tnemec Series 130 EnviroFill at a rate of 75-85 square feet per gallon.

3.6.2.2. Second Coat: Apply one full coat Tnemec Series 113 H.B. Tneme-Tufcoat at a dry film thickness of 4.0 to 6.0 mils.

3.6.2.3. Third Coat: Apply one full coat Tnemec Series 113 H.B. Tneme-Tufcoat at a dry film thickness of 4.0 to 6.0 mils.

3.7. Painting Schedule - Exterior Surfaces

3.7.1. Ductile Iron Pipe

3.7.1.1. Surface Preparation: Perform in accordance with the coating system manufacturer's written recommendations.

3.7.1.2. Prime Coat: Tnemec Series N69 Hi-Build Epoxoline II (polyamidoamine epoxy) at 3.0 to 5.0 mils dry film thickness (DFT),

or approved equal by a manufacturer specified herein.

3.7.1.3. Intermediate Coat: Tnemec Series N69 Hi-Build Epoxoline II (polyamidoamine epoxy) at 4.0 to 6.0 mils dry film thickness (DFT), or approved equal by a manufacturer specified herein.

3.7.1.4. Finish Coat: Tnemec Series 73 Endura Shield (aliphatic acrylic polyurethane) at 2.5 to 3.5 mils dry film thickness (DFT), or approved equal by a manufacturer specified herein.

3.7.1.5. Total Thickness of New Coating System: 9.5 to 14.5 mils dry film thickness (DFT).

3.7.2. Metal

3.7.2.1. Structural steel, steel metal fabrications, and steel pipe

3.7.2.1.1. Gloss finish/alkyd base:

3.7.2.1.2. Shop coat: Metal primer.

3.7.2.1.3. 2 coats (field coat): Industrial enamel.

3.8. Painting – Submerged Surfaces

3.8.1. Ductile Iron Pipe

3.8.1.1. Surface Preparation: Perform in accordance with the coating system manufacturer's written recommendations.

3.8.1.2. Prime Coat: Tnemec Series N69 Hi-Build Epoxoline II (polyamidoamine epoxy) at 3.0 to 5.0 mils dry film thickness (DFT), or approved equal by a manufacturer specified herein.

3.8.1.3. Intermediate Coat: Tnemec Series 46H-413 Hi-Build Tneme-Tar (coal tar epoxy) at 7.0 to 10.0 mils dry film thickness (DFT), or approved equal by a manufacturer specified herein.

3.8.1.4. Finish Coat: Tnemec Series 46H-413 Hi-Build Tneme-Tar (coal tar epoxy) at 7.0 to 10.0 mils dry film thickness (DFT), or approved equal by a manufacturer specified herein.

3.8.1.5. Total Thickness of New Coating System: 17.0 to 25.0 mils dry film thickness (DFT).

3.8.2. Ferrous Metals

3.8.2.1. System No. 1 for continuously or intermittently submerged, potable or non-potable use.

3.8.2.1.1. Surface preparation: SSPC SP-10 – Near White Blast Cleaning.

3.8.2.1.2. Prime Coat: Macropoxy 646 PW, 3.0 mils DFT.

3.8.2.1.3. Finish Coat: Macropoxy 646 PW, 5.0 mils DFT.

3.8.2.2. System No. 2 for exterior, non-submerged exposure.

3.8.2.2.1. Surface Preparation, unprimed surfaces: SSPC SP-6 Commercial Blast Cleaning.

3.8.2.2.2. Surface Preparation: SSPC SP-10 – Near White Blast Cleaning.

3.8.2.2.3. Prime or Barrier Coat: Macropoxy 646 FC, 5.0 to 10 mils DFT.

3.8.2.2.4. Intermediate Coat: Macropoxy 646 FC, 5.0 to 10 mils DFT.

3.8.2.2.5. Finish Coat: High Solids Polyurethane, 3.0 to 5.0 mils DFT.

3.9. Shop Priming Systems – Ferrous Metals

3.9.1. Shop prime ferrous metal products specified in other sections of the specifications in accordance with the requirements set forth herein.

3.9.1.1. Normal exposure, submerged and non-submerged

3.9.1.1.1. Surface preparation: SSPC SP-10 new white blast cleaning

3.9.1.1.2. Shop prime: Macropoxy 646 FC, 5.0 to 10 mils DFT

3.10. Piping Color Code

3.10.1. Pipe colors shall be as selected by the Engineer. Exact shades shall be as selected from the paint manufacturer's standard colors. When main color differs from the following, color code the pipe, full length, as follows. Supplement color with color band, 1-inch wide, and placed on 18-inch centers, on pipe scheduled to have contrasting band. Bands may be self-adhesive plastic, manufactured for the purpose by Seton Nameplate Corporation, or approved equal.

3.10.2. Above grade piping 1-inch in diameter and larger shall be labeled. Provide labeling every 15 linear feet of pipe and spell out the pipe system. Labels shall be either black for light colored piping or white for dark colored piping.

3.10.3. Codes shall be lettered legend, giving the name of the pipe contents. Arrows shall be used to indicate direction of flow. Codes shall be applied close to valves and adjacent to changes in direction, branches, and where pipes pass through walls or floors, and at frequent intervals on straight pipe runs. The lettering and arrows shall be of such color, size, and location to be clearly visible and readable.

Description	Color	Code
Sanitary Sewer	Green	SAN
Force Main	Light Green	FM
Plant Flow/Bypass	Green	PF
Pump Suction	White	PS
Pump Discharge	White	PD
Sludge	Dark Brown	SL
Drain	Dark Brown	D
Supernatant/Decant	Dark Brown	SN/DC
Nonpotable Water	Purple	NPW
Potable Water	Dark Blue	PW

3.11. Field Quality Control

3.11.1. The Owner reserves the right to engage the services of an independent testing laboratory to sample the paint and material being used. Samples of the material on the project site shall be taken identified, sealed and certified in the presence of the Contractor.

3.11.2. The testing laboratory shall perform appropriate tests for a variety of characteristics as required by the Owner.

3.11.3. If the tests results show the material being used does not comply with the specifications requirements, the contractor shall be directed to stop painting, remove the non-complying material, pay for the testing, repaint the surfaces coated with the rejected material, and remove rejected material from the previously painted surfaces. An alternate, at the discretion of the Owner is to apply an additional coat of material on all surfaces.

End of Section

Section 11290
Sluice Gates and Weir Type Slide Gates

1 GENERAL

1.1 Quality Assurance: Sluice/slide gate equipment by RW Gate Company is specified as the quality standard. Weir type slide gate equipment by RW Gate is specified as a quality standard.

1.2 Submittals: Provide the following in a timely manner in accordance with the approved submittals schedule as specified in Section 01400 – General Requirements.

1.2.1 Shop drawings of the following:

1.2.1.1 Submittals shall include, at a minimum, detailed custom drawings of the gate assembly with dimensional and mounting information and a listing of the materials of construction. General arrangement drawings and cut sheets are not considered acceptable drawings.

1.2.1.2 Sluice/slide gates, operators, actuators, and wall thimbles. Calculations shall be provided to confirm compliance with the safety factors listed in AWWA C561 for all parts of the frame, anchorage and slide including the portion of the slide that engage the frame. A copy of the test results from the 25,000 cycle test confirming the durability of the seal system shall be provided.

1.2.1.3 Weir gates and operators

1.2.1.4 Staff gauges

1.2.1.5 Gate shop test reports

1.3 Project Conditions

1.3.1 Electrical Motors, Controllers, Starters, and Disconnects: Furnish motors, controllers, starters, and disconnects with their respective pieces of equipment. Motors, controllers, starters, and disconnects shall conform to and shall have electrical connections in accordance with the National Electrical Code. Controllers and starters shall have a maximum of 120-volt control circuits, and auxiliary contacts for use with the controls furnished.

2 PRODUCTS

2.1 Sluice/Slide Gates

2.1.1 Sluice gates and slide gates shall be as manufactured by RW Gate Company, Rodney Hunt, Waterman Industries, Inc., Washington Aluminum Company, or approved equal.

2.1.2 The gates shall be in compliance with the latest version of AWWA C561 as

modified herein.

2.1.3 Leakage for sluice gates and slide gates shall be restricted to 0.05 gpm/ft or less of the seal perimeter at the design seating head and the design unseating head.

2.1.4 The gate assemblies on sluice gates that are used to cover openings 60-inches wide or less shall be designed for a minimum of 20-feet of seating head and unseating head regardless of the design head. The operating mechanism shall be designed for the design head.

2.1.5 All gates shall be shop inspected for proper operation prior to shipment.

2.1.6 Welds shall be performed by welders with ASME Section IX or AWS D1.6 IX certification.

2.1.7 The gate manufacturer shall be ISO 9001 certified.

2.1.8 Materials of Construction

2.1.8.1 All stainless steel referenced in this specification shall be Type 304 unless otherwise indicated herein.

2.1.8.2 All welded stainless steel components shall be constructed of Type 304L stainless steel.

2.1.8.3 All structural stainless steel used in the construction of slides, frames and wall thimbles shall have a minimum material thickness of ¼-inch.

2.1.8.4 All non-welded stainless steel components, excluding anchor bolts and assembly bolts, shall be Type 304.

2.1.8.5 Anchor bolts and assembly bolts shall be Type 316 stainless steel.

2.1.9 Slide

2.1.9.1 The slide shall consist of a stainless steel plate that is reinforced with stiffeners to withstand the specified head conditions. The slide shall engage the frame a minimum of 1-inch on each side.

2.1.9.2 The slide shall be reinforced with plates or channel shaped members to restrict deflection to 1/16-inch or less at the design head.

2.1.9.3 The stiffeners shall be welded to the slide plate in the horizontal and vertical positions.

2.1.9.4 The portion of the slide that engages the frame shall have a minimum thickness of ½-inch.

2.1.9.5 A stem connector shall be welded to the slide as a means of connecting the operating stem. The bottom portion of the stem shall

be affixed to the stem connector with a minimum of two bolts.

2.1.10 Frame

2.1.10.1 The frame shall be constructed of stainless steel plate, with the guide section formed into "C" shaped channel to house the seal, and shall be reinforced to withstand the specified operating conditions.

2.1.10.2 The frame shall be a rigid, one-piece assembly with a flanged frame arrangement.

2.1.10.3 Flat frames shall only be provided on gates with frames that will be embedded in the concrete wall or mounted inside existing channels.

2.1.10.4 Flanged frame sections shall extend the length of the frame. The use of angles as extensions from the guides to the yoke is not acceptable. The portion of the frame where the anchor penetrates shall have a minimum thickness of ½-inch.

2.1.10.5 The frame shall have a minimum weight of 13 pounds per foot.

2.1.10.6 Lifting lugs shall be provided on all frame styles.

2.1.11 Seals

2.1.11.1 The seal system shall consist of self-adjusting UHMWPE seals with a rubber compression cord.

2.1.11.2 The UHMWPE seals shall be arranged to ensure that there is no metal-to-metal contact between the slide and frame.

2.1.11.3 The compression cord shall be contained by the UHMWPE seal so that it shall not be in contact with the slide.

2.1.11.4 Seal system shall be self-adjusting for the life of the gate. Adjustable wedging devices such as wedges, wedge bars and pressure pads are not acceptable.

2.1.11.5 Rubber seals such as J-bulb seals, P-seals and D-seals shall not be not acceptable in lieu of UHMWPE seals.

2.1.11.6 The invert seal on upward opening gates shall use a compressible EPDM rubber seal located on the bottom of the slide or in the invert of the frame.

2.1.11.7 The invert seal shall be of a flush bottom arrangement.

2.1.11.8 The invert seal shall be mechanically fastened with stainless steel bolts.

2.1.11.9 Invert seals attached solely by the use of adhesives shall not be not

acceptable.

2.1.11.10 All seats and seals shall be secured with assembly bolts. All seals shall be field removable and field replaceable without the need to remove the gate frame from the wall.

2.1.11.11 The seal system shall have been shop tested with a 25,000 cycle operating test in an abrasive environment to confirm the ability of the seals to withstand the abrasive condition with negligible deterioration and to confirm that the leakage restriction requirement is still possible.

2.1.11.12 The shop test shall have been performed on a stainless steel sluice gate and the test results shall have been certified by the manufacturer in writing.

2.1.11.13 A copy of the shop test report shall be provided to the Engineer.

2.1.12 Operating Stem

2.1.12.1 The operating stem shall be of stainless steel and shall be designed to transmit in compression at least 2 times the rated output of the manual operating mechanism with an 80 lbs effort.

2.1.12.2 The stem shall have a slenderness ratio (L/r) less than 200.

2.1.12.3 The threaded portion of the stem shall have a minimum diameter of 1-1/2 inches.

2.1.12.4 The threads shall have machine rolled, full depth ACME threads with a 16 Micro-inch finish or better.

2.1.12.5 Stub threads shall not be acceptable.

2.1.12.6 Stems provided in multiple pieces shall be provided with couplings.

2.1.12.7 Couplings shall be stainless steel and shall be internally threaded and keyed or bored and bolted.

2.1.12.8 Stem guides shall be constructed of stainless steel with UHMWPE bushings.

2.1.12.9 Gates shall be provided with a clear plastic stem cover.

2.1.12.10 The stem cover shall be lexan or butyrate and shall have a cap and condensation vents.

2.1.12.11 Clear mylar indicating tape shall be provided for field application after the gate has been installed and positioned.

2.1.12.12 Stop collars shall be provided to limit the downward travel on gates.

2.1.12.13 Stop collars shall be bronze and shall be internally threaded and provided with stainless steel set screws.

2.1.13 Operating Mechanism

2.1.13.1 Operating mechanisms shall be provided by the gate manufacturer.

2.1.13.2 Manual operators shall be yoke mounted on self-contained gates or floorstand mounted as shown on the Drawings.

2.1.13.3 Manual operators shall be of the bevel gear type suitable for operation with a portable operator.

2.1.13.4 Gear ratios shall be selected by the gate manufacturer to ensure that the maximum operating effort is 25 pounds at the design head.

2.1.13.5 Minimum gear ratio shall be 2:1.

2.1.13.6 Gearboxes shall have a cast iron or ductile iron housing, a bronze lift nut, steel gears and a stainless steel input shaft.

2.1.13.7 Ball or roller bearings shall support the lift nut and input shaft.

2.1.13.8 The housing shall be grease lubricated and permanently sealed.

2.1.13.9 Handwheel or cranks shall be provided.

2.1.13.10 Adaptor plats shall be utilized to attach the operating mechanism to the yoke. Adaptor plates shall be stainless steel and shall have a minimum thickness of ¾-inch.

2.1.14 Floorstands And Wall Brackets

2.1.14.1 Floorstands shall be mounted to the concrete, to a wall bracket, or on the yoke of a self-contained gate.

2.1.14.2 All floorstands and wall brackets shall be fabricated from stainless steel.

2.1.14.3 The base plate, adaptor plate and gussets shall be minimum ⅜-inch thick.

2.1.15 Wall Thimbles

2.1.15.1 Wall thimbles shall be constructed of minimum ¼-inch thick plate and shall be of the F-type configuration (unless otherwise recommended by the manufacturer) of the same depth as the thickness of the concrete wall unless otherwise indicated on the Contract Drawings.

2.1.15.2 Wall thimbles shall be of stainless steel construction and provided by

the same manufacturer as the sluice gates.

2.1.16 Anchorage

2.1.16.1 Anchor bolts and wall thimble studs shall be 316 stainless steel, fully threaded and shall have a minimum diameter of ½-inch.

2.1.16.2 Anchor bolts shall be of the epoxy type.

2.1.17 Finish

2.1.17.1 All heat tint and slag from the welding process shall be acid passivated or mechanically passivated through bead blasting in accordance with ASTM A380. Grinding or buffing is not acceptable in lieu of passivation.

2.1.17.2 All ferrous components shall be suitably prepared and then shop coated with manufacturer's standard primer and finish coat.

2.2 Self-Contained Weir Gate

2.2.1 Self-contained weir type slide gates shall be as manufactured by Rodney Hunt Company, RW Gate Company, Waterman Industries, Inc., Washington Aluminum Company, or approved equal. Gates shall be self-contained rising stem weir type with the disc arranged to lower to open and with the guides designed to either mount on the face of the concrete or be embedded in the concrete as indicated in the gate schedule and on the drawings. All attaching bolts and anchor bolts shall be stainless steel and shall be provided by the gate manufacturer.

2.2.2 The guides shall be of stainless steel dual slot design. The primary slot shall accept the plate of the disc and the secondary slot shall be sufficiently wide to accept the reinforcing ribs of the disc. The guides shall be designed for maximum rigidity, shall have a weight of not less than 3 pounds per foot, and shall be provided with holes for anchor bolts every 18 inches. They shall extend beneath the opening a sufficient amount to support the disc in the fully down or open position. An aluminum angle shall be welded to the guides across the invert of the opening and up both sides. A hollow bulb J-seal shall be attached to this angle with stainless steel strips and attaching bolts. The seal shall be arranged so that it shall deflect a minimum of 1/16-inch.

2.2.3 Where the guides extend above the operating floor, they shall be sufficiently strong so that no further reinforcing shall be required. The yoke to support the operating benchstand shall be formed by two angles welded at the top of the guides to provide a one-piece rigid frame. The arrangement of the yoke shall be such that the disc and stem can be removed without disconnecting the yoke.

2.2.4 The disc or sliding member shall be of aluminum plate reinforced with "U" shaped aluminum extrusions welded to the plate not more than 16 inches apart. The disc shall not deflect more than 1/360 of the span of the gate under the

design head. Reinforcing ribs shall extend into the guides so that they overlap the seating surface of the guides.

2.2.5 The operator shall be a handwheel operated benchstand type mounted on the yoke of the gate. The benchstand shall be fully enclosed, equipped with roller bearings above and below the operating nut and with a mechanical seal around the operating nut. A mechanical seal shall be provided around the pinton shaft where it extends from the hoist enclosure. The operating stem shall be Type 304 stainless steel.

2.2.6 The operator shall be marked to show opening direction. A clear, butyrate pipe cover shall be provided above the stem. Mylar markings shall be attached to the pipe cover and graduated in one-hundredths (0.01) of a foot to indicate weir gate position.

2.3 Staff Gauges (Provide staff gauges for all weir gates)

2.3.1 The Contractor shall furnish and install FRP staff gauges, as manufactured by Plasti-Fab, Inc., or approved equal.

2.3.2 FRP staff gauges shall be manufactured 6 inches wide. Gauge height shall be measured from the top of the weir wall to the top of the concrete channel, as indicated on the drawings. The material shall be fiberglass reinforced polyester laminate with type set or computer-generated lines and numbers printed on a resin compatible material and laminated into the gauge. Surface mounted or painted markings are not acceptable. Background shall be white with black numerals. The face of the gauge shall be a flat molded surface.

2.3.3 Numbers, lines, and lettering shall be in resin compatible, UV stabilization black ink. Numbers shall be ¾-inch high. The centerline and minor lines shall be readily discernible for 12 feet away.

2.3.4 Gauges shall display markings graduated in 0.1-foot increments. Set “0 foot” increment at the top of the weir wall at the locations indicated on the drawings. Weir wall elevations are indicated on the drawings.

2.4 Shipping identification tags shall be attached to all equipment items according to the tag number on the drawings.

3 EXECUTION

3.1 Install equipment as shown on the drawings and according to written instructions of the manufacturer. Check equipment for satisfactory operation.

3.2 Non-shrink grout or a resilient gasket shall be applied by the Contractor between the gate frame and the wall to ensure that there is no leakage around the gate.

3.3 Use sleeves where valve stem extensions or equipment parts pass through concrete or masonry walls or slabs. Sleeves shall be either cast iron or Schedule 40 steel of sufficient size to allow sealing around pipes and clearance for valve stems or

equipment.

3.4 Gate Schedule: The following schedule lists sluice/slide gates, weir gates, and hand lift stop plates included under this section.

GATE SCHEDULE											
Gate Tag Number	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10	S-11
Location	Equalization Splitter Box	Equalization Splitter Box	Mech. Screen Chamber	Mech. Screen Chamber	Mech. Screen Chamber	Mech. Screen Chamber	Headworks Facility	Primary Clarifier Splitter Box	Primary Clarifier Splitter Box	Primary Clarifier Splitter Box	Primary Clarifier Splitter Box
Type	Self-Contained Sluice Gate	Self-Contained Sluice Gate	Self-Contained Slide Gate	Self-Contained Slide Gate	Self-Contained Slide Gate	Self-Contained Slide Gate	Weir Gate	Weir Gate	Weir Gate	Self-Contained Sluice Gate	Self-Contained Sluice Gate
Material	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel
[1]Effective Gate Width	2’-0” Diameter	2’-0” Diameter	4’-0”	4’-0”	4’-0”	4’-0”	4’-0"	4’-0”	4’-0”	2’-0” Diameter	2’-0” Diameter
[2]Effective Gate Height	2’-0” Diameter	2’-0” Diameter	4’-0”	4’-0”	4’-0”	4’-0”	0'-6"	1’-4”	1’-4”	2’-0” Diameter	2’-0” Diameter
[3-4;7] Effective Guide Frame Height	9’-4”	9’-4”	7’-0”	7’-0”	7’-0”	7’-0”	7’-0”	12’-0”	12’-0”	12’-0”	12’-0”
Guide Frame Type	Mounted to Face Concrete Wall w/ Wall Thimble	Mounted to Face Concrete Wall w/ Wall Thimble	Embedded	Embedded	Embedded	Embedded	Mounted to Face Concrete Wall	Mounted to Face Concrete Wall	Mounted to Face Concrete Wall	Mounted to Face Concrete Wall	Mounted to Face Concrete Wall
Closure	Flush Bottom	Flush Bottom	Flush Bottom	Flush Bottom	Flush Bottom	Flush Bottom	Gate Stop Angle	Gate Stop Angle	Gate Stop Angle	Flush Bottom	Flush Bottom
Operator	Handwheel	Handwheel	Handwheel with Electric Actuator	Handwheel with Electric Actuator	Handwheel with Electric Actuator	Handwheel with Electric Actuator	Handwheel	Handwheel	Handwheel	Handwheel	Handwheel
Design Head	6’-4”	6’-4”	4’-0”	4’-0”	4’-0”	4’-0”	4’-0”	3’-4”	3’-4”	9’-0”	9’-0”
Additional Requirements	---	---	See Note 6	See Note 6	See Note 6	See Note 6	See Note 5	See Note 5	See Note 5	---	---

[1]Effective gate width shall be the width of the opening, not including that portion of the gate in the guide frame side members.

[2]Effective gate height shall be the height of the gate above the finished channel bottom or above the top of the weir wall, not including that portion of the gate in the guide frame bottom member.

[3]Effective guide frame height for sluice gate shall be the height of the guide from above the finished channel bottom to the bottom of the handwheel, not including that portion of the gate embedded in the channel bottom.

[4]Effective guide frame height for weir gates shall be the height of the guide from the bottom of the frame to the bottom of the handwheel, not including that portion of the gate embedded in the channel bottom.

[5]See operating range for weir gate indicated on the drawings.

[6]Existing self-contained slide and gate. Remove and replace electric motor actuator. Provide new mounting baseplate adapters, new slide gate stem, stem covers, and other appurtenances as required to create a functional unit.

[7]Centerline of top of handwheel for sluice/slide and weir gates shall be 3 feet above the top of the structure.

End of Section

Section 11300
Wastewater Pumping Equipment

1 GENERAL

1.1 System Description: Wastewater pumping equipment shall consist of, but not be limited to, all work associated with the following equipment:

1.1.1 Drain Pump Station

1.1.1.1 Self-priming, suction-lift wastewater pumps and constant-speed motors as shown on the Drawings.

1.2 Related Requirements: The following sections contain requirements that relate to this section.

1.2.1 Section 13709 – Sequence of Operation

1.2.2 Section 13300 – Flow, Level, and Pressure Instruments

1.3 Reference Specifications where applicable to work under this section are referred to by abbreviation as follows:

1.3.1 American National Standards Institute..... ANSI

1.3.2 American Society for Testing and Materials..... ASTM

1.3.3 National Electrical Code.....NEC

1.3.4 National Electrical Manufacturers Association.....NEMA

1.4 Quality Assurance

1.4.1 The wastewater pumping equipment shall be provided as a package system as specified, as indicated on the drawings, and as required to provide a complete and proper installation ready for operation. The wastewater pumping equipment shall be designed to pump raw domestic sanitary sewer wastewater as specified.

1.4.2 The wastewater pumping equipment specified in this section shall be furnished by one equipment supplier as an integrated design package. The supplier shall provide all equipment and appurtenances and be responsible for the complete and satisfactory operation of the entire integrated system. The equipment supplier shall be the wastewater pumping equipment manufacturer.

1.4.3 Each equipment supplier shall have unit responsibility for its equipment startup. Provide services of experienced manufacturer-trained technicians for one site visit for each set of pumps installed, consisting of a total of two 8-hour working days on the site, to demonstrate satisfactory pump operation

and to provide training and instruction of the Owner's personnel for equipment operation.

1.4.4 Wastewater pumps shall be manufactured by the Gorman-Rupp Company. Other manufacturer substitutions will not be allowed and will be considered a non-responsive bid. The contract drawings and design of these pumps are based on the Gorman-Rupp Company equipment as the design standard. Contact information for the Gorman-Rupp company representative shall be as follows:

1.4.4.1 The Gorman-Rupp Company600 S. Airport Road
Mansfield, OH 44901-1217
Telephone: (419) 755-1011
Internet: www.grpumps.com
Virginia Sales Representative: Tencarva Machinery Company
E-Mail Address: tthomas@tencarva.com

1.4.5 If wastewater pumping equipment other than the design standard is used, the Contractor shall provide a similar arrangement and revise the dimensional layout as necessary. Such revisions to the design must be certified by a professional engineer, approved by the Engineer in the shop drawing phase of construction, and shall be revised and constructed at no additional cost to the Owner. Equipment supplied other than the design standard shall conform to the paragraph entitled “Project Conditions” and all additional requirements specified in this section.

1.5 Submittals: Provide the following in a timely manner in accordance with the approved submittals schedule as specified in Section 01400 – General Requirements.

1.5.1 Certified pump curves

1.5.2 Catalog cuts, shop drawings, dimensional data, and wiring diagrams for equipment and accessories.

1.5.3 Pump operational test reports.

1.5.4 Instrumentation and controls data for the following:

1.5.4.1 Instrumentation and controls, including equipment, point-to-point wiring diagrams, point-to-point instrumentation diagrams, and sequence of operation.

1.5.4.2 Control panel

1.5.5 Spare Parts: Provide manufacturer’s recommended spare parts list. In addition, provide a guaranteed price list for all spare parts, which will be binding for 1-year following contract award on this project.

1.5.6 Operation and Maintenance Manual: Submit one (1) electronic PDF copy for review by the Engineer. Submit three (3) hard copies of the final approved manual to the Owner.

1.5.6.1 The manuals' identification shall be inscribed on the cover.

1.5.6.2 The manuals shall include the names, addresses, and telephone numbers of the local representatives for each item of equipment and each system.

1.5.6.3 The manuals shall have a table of contents and be assembled to conform to the project manual table of contents with the tab sheets placed before instructions covering the subject. Additionally, each manual shall contain a comprehensive index of all manuals submitted in accordance with this paragraph.

1.5.6.4 Manuals and specifications shall be furnished which provide full and complete coverage of the following subjects:

1.5.6.4.1 Operational Requirement: This document shall describe, in concise terms, all the functional and operational requirements for the system.

1.5.6.4.2 Maintenance: Documentation of all user performed maintenance on all system components, including inspection, and periodic replacement of defective units. This shall include calibration, maintenance, and repair of all equipment, instrumentation, and controls, plus diagnosis and repair or replacement of all system hardware.

1.6 Project Conditions

1.6.1 Equipment furnished in accordance with this section shall be installed at the location and in the space allocated on the contract drawings.

1.6.2 Pump manufacturers shall supply pumps as complete units, including motors, drives, belts, couplings, base plates, guards, and all other required accessories and appurtenances, to ensure compatibility and integrity of the individual components, and provide the specified warranty for all components. Assembly by the Contractor of pumps, motors, shafting, couplings, and the like supplied by various independent manufacturers will not be allowed.

1.6.3 Pump motors shall be sized such that the motor does not overload at any point on the operating curve. Pumps and motors shall be designed to perform with a reasonable service life when operated continuously or intermittently. Motors shall be designed with a minimum service factor of 1.15.

1.6.4 Electrical Motors, Controllers, Starters, and Disconnects: Furnish motors, controllers, starters, and disconnects with their respective pieces of equipment. Motors, controllers, starters, and disconnects shall conform to and shall have electrical connections in accordance with the National Electrical Code. Controllers and starters shall have a maximum of 120-volt control circuits, and auxiliary contacts for use with the controls furnished.

1.6.5 Any structural, piping, electrical requirements, wiring, instrumentation and controls, drawings, or other modifications required to accommodate equipment offered shall be done at no additional cost to the Owner.

1.7 Manufacturer's Warranty

1.7.1 The pump manufacturer shall warrant all equipment to be of quality construction, free of defects in material and workmanship. A written warranty shall include specific details described below.

1.7.2 All other equipment, apparatus, and parts furnished shall be warranted for sixty (60) months, excepting only those items that are normally consumed in service, such as oils, grease, packing, gaskets, o-rings, etc. The pump manufacturer shall be solely responsible for warranty of the pumping equipment and all components.

1.7.3 Components failing to perform as specified by the Engineer, or as represented by the manufacturer, or as proven defective in service during the warranty period, shall be replaced, repaired, or satisfactorily modified by the manufacturer.

2 PRODUCTS

2.1 Wastewater Pumps

2.1.1 System Description

2.1.1.1 Pumps shall be horizontal, self-priming sewage pumps, specifically designed for pumping raw, unscreened domestic sanitary sewage.

2.1.1.2 Pumps Nos. 1 and 3: The Contractor shall provide a new Gorman-Rupp T8 pump, motor, belts sheaves, and motor guard in the configuration and location indicated on the contract drawings to achieve the pump operating conditions specified herein.

2.1.1.3 Existing Pump No. 2: The existing Gorman-Rupp T6 pump and motor shall be removed and reinstalled in left hand configuration at the location indicated on the contract drawings. Provide new belt, sheaves, and motor guard as required to achieve the pump operating conditions specified herein. The Contractor shall verify the existing impeller diameter, belt and sheave size, motor horsepower, motor speed, and pump speed prior to removal.

2.1.2 Size: Pumps shall have suction and discharge connections as indicated. Discharge piping shall transition as indicated on the drawings.

2.1.3 Internal Passages: All openings, internal passages, and internal recirculation ports shall be large enough to permit the passage of a sphere 3 inches in diameter and any trash or stringy material which may pass through the average house collection system.

2.1.4 Pump Performance: Each pump in the Drain Pump Station shall have the necessary characteristics and be properly selected to perform under these operating conditions:

2.1.4.1 Pump Nos. 1 and 3

2.1.4.1.1 Model (8-inch suction/8-inch discharge): T8A3S-B

2.1.4.1.2 Impeller size (inches): 14.75

2.1.4.1.3 Pump capacity (GPM): 1,600

2.1.4.1.4 Pump speed (RPM): 1,050

2.1.4.1.5 Total dynamic head (feet): 42

2.1.4.1.6 Motor horsepower: 30 HP

2.1.4.2 Existing Pump No. 2

2.1.4.2.1 Model (6-inch suction/6-inch discharge): T6A3S-B

2.1.4.2.2 Impeller size (inches): 12.375

2.1.4.2.3 Pump capacity (GPM): 1,200

2.1.4.2.4 Pump speed (RPM): 1,150

2.1.4.2.5 Total dynamic head (feet): 38

2.1.4.2.6 Motor horsepower: 40 HP

2.1.4.3 Each pump shall be designed to retain adequate liquid in the pump casing to insure unattended automatic repriming while operating at its rated speed in a completely open system without suction check valves and with a dry suction leg.

2.1.5 Pump casing: Casing shall be Class 30 cast iron with integral volute scroll. Casing shall incorporate following features:

2.1.5.1 Mounting feet sized to prevent tipping or binding when pump is completely disassembled for maintenance.

2.1.5.2 Fill port coverplate, 3½-inches in diameter, shall be opened after loosening a hand nut/clamp bar assembly. In consideration for safety, hand nut threads must provide slow release of pressure, and the clamp bar shall be retained by detente lugs. A Teflon gasket shall prevent adhesion of the fill port cover to the casing.

2.1.5.3 Casing drain plug shall be at least 1¼-inches NPT to insure complete and rapid draining.

2.1.5.4 Liquid volume and recirculation port design shall be consistent with performance criteria specified herein.

2.1.6 Coverplate: Coverplate shall be Class 30 cast iron. Design must incorporate following maintenance features:

2.1.6.1 Retained by hand nuts for complete access to pump interior. Coverplate removal must provide ample clearance for removal of stoppages, and allow service to the impeller, seal, wearplate or check valve without removing suction or discharge piping.

2.1.6.2 A replaceable wearplate secured to the coverplate by weld studs and nuts shall be AISI 1015 HRS.

2.1.6.3 In consideration for safety, a pressure relief valve shall be supplied in the coverplate. Relief valve shall open at 75-200 psi.

2.1.6.4 Two o-rings of Buna-N material shall seal coverplate to pump casing.

2.1.6.5 Pusher bolt capability to assist in removal of coverplate. Pusher bolt threaded holes shall be sized to accept same retaining capscrews as used in rotating assembly.

2.1.6.6 Easy-grip handle shall be mounted to face of coverplate.

2.1.7 Rotating Assembly: A rotating assembly, which includes impeller, shaft, mechanical shaft seal, lip seals, bearings, sealplate and bearing housing, must be removable as a single unit without disturbing the pump casing or piping. Design shall incorporate following features:

2.1.7.1 Sealplate and bearing housing shall be Class 30 cast iron. Separate oil filled cavities, vented to atmosphere, shall be provided for shaft seal and bearings. Cavities must be cooled by the liquid pumped. Three lip seals will prevent leakage of oil.

2.1.7.1.1 The bearing cavity shall have an oil level sight gauge and fill plug check valve. The clear sight gauge shall provide easy monitoring of the bearing cavity oil level and condition of oil without removal of the fill plug

check valve. The check valve shall vent the cavity but prevent introduction of moist air to the bearings.

2.1.7.1.2 The seal cavity shall have an oil level sight gauge and fill/vent plug. The clear sight gauge shall provide easy monitoring of the seal cavity oil level and condition of oil without removal of the fill/vent plug.

2.1.7.1.3 Double lip seal shall provide an atmospheric path providing positive protection of bearings, with capability for external drainage monitoring.

2.1.7.2 Impeller shall be ductile iron, two-vane, semi-open, non-clog, with integral pump out vanes on the back shroud. Impeller shall thread onto the pump shaft and be secured with a lockscrew and conical washer.

2.1.7.3 Shaft shall be AISI 17-4 pH stainless steel.

2.1.7.4 Bearings shall be anti-friction ball type of proper size and design to withstand all radial and thrust loads expected during normal operation. Bearings shall be oil lubricated from a dedicated reservoir. Pump designs using the same oil to lubricate the bearings and shaft seal shall not be acceptable.

2.1.7.5 Shaft seal shall be oil lubricated mechanical type. The stationary and rotating seal faces shall be tungsten titanium carbide alloy. Each mating surface shall be lapped to within three light bands flatness (35 millionths of an inch), as measured by an optical flat under monochromatic light. The stationary seal seat shall be double floating by virtue of a dual o-ring design; an external o-ring secures the stationary seat to the sealplate, and an internal o-ring holds the faces in alignment during periods of mechanical or hydraulic shock (loads which cause shaft deflection, vibration, and axial/radial movement). Elastomers shall be Viton. Cage and spring to be stainless steel. Seal shall be oil lubricated from a dedicated reservoir. The same oil shall not lubricate both shaft seal and shaft bearings. Seal shall be warranted as specified herein.

2.1.7.6 Pusher bolt capability to assist in removal of rotating assembly. Pusher bolt threaded holes shall be sized to accept same capscrews as used for retaining rotating assembly.

2.1.8 Adjustment of the impeller face clearance (distance between impeller and wearplate) shall be accomplished by external means.

2.1.8.1 Clearances shall be maintained by a four point external shimless coverplate adjustment system, utilizing a four collar and four adjusting screw design allowing for incremental adjustment of clearances by hand as required. Each of the four points shall be

lockable to prevent inadvertent clearance increases or decreases due to equipment vibration or accidental operator contact. The four point system also allows for equal clearance gaps at all points between the impeller and wear plate. Requirement of realignment of belts, couplings, etc., shall not be acceptable. Coverplate shall be capable of being removed without disturbing clearance settings. Clearance adjustment systems that utilize less than four points will not be considered.

2.1.8.2 There shall be provisions for additional clearance adjustment in the event that adjustment tolerances have been depleted from the coverplate side of the pump. The removal of stainless steel shims from the rotating assembly side of the pump shall allow for further adjustment as described above

2.1.8.3 Clearance adjustment which requires movement of the shaft only, thereby adversely affecting seal working length or impeller back clearance, shall not be acceptable.

2.1.9 Suction check valve shall be molded Neoprene with integral steel and nylon reinforcement. A blow-out center shall protect pump casing from hydraulic shock or excessive pressure. Removal or installation of the check valve must be accomplished through the coverplate opening, without disturbing the suction piping. Sole function of check valve shall be to save energy by eliminating need to reprime after each pumping cycle. Pumps requiring a suction check valve to assist reprime will not be acceptable.

2.1.10 Spool flanges shall be one-piece Class 30 cast iron, fitted to suction and/or discharge ports. Each spool shall have one 1¼-inch NPT and one ¼-inch NPT tapped hole with pipe plugs for mounting gauges or other equipment.

2.1.11 Gauge kit: Each pump shall be equipped with a glycerin-filled compound gauge to monitor suction pressures, and a glycerin-filled pressure gauge to monitor discharge pressures. Gauges shall be a minimum of 4 inches in diameter and shall be graduated in feet water column. Rated accuracy shall be 1% of full scale reading. Compound gauges shall be graduated -30 to +30 feet water column minimum. Pressure gauges shall be graduated 0-140 feet water column minimum.

2.1.11.1 Gauges shall be mounted on a resilient panel and frame assembly which shall be firmly secured to pumps or piping. Gauge installations shall be complete with all hoses and fittings and shall include a shutoff valve installed in each gauge inlet at the point of connection to suction and discharge pipes.

2.1.12 Spare parts kit: Furnish each pump with the following minimum spare parts:

2.1.12.1 (1) Spare mechanical seal (complete) and all gaskets, seals, sleeves, o-rings, and packings required to be replaced during replacement of the seal.

2.1.12.2 (1) Set of impeller clearance adjustment shims.

2.1.12.3 (1) Cover plate o-ring.

2.1.12.4 (1) Quart of seal lubricant.

2.1.13 Air release valves: Each pump shall be equipped with one automatic air release valve, designed to permit the escape of air to the atmosphere during initial priming or unattended repriming cycles. Upon completion of the priming or repriming cycle, the valve shall close to prevent recirculation. Valves shall provide visual indication of valve closure and shall operate solely on discharge pressure. Valves that require connection to the suction line shall not be acceptable.

2.1.13.1 All valve parts exposed to sewage shall be constructed of cast iron, stainless steel, or similar corrosion resistant materials. Diaphragms, if used, shall be of fabric-reinforced neoprene or similar inert material.

2.1.13.2 A cleanout port, 3 inches in diameter, shall be provided for ease of inspection, cleanout, and service.

2.1.13.3 Valves shall be field adjustable for varying discharge heads.

2.1.13.4 Flanged to flexible connection devices shall be provided for each suction and discharge connection to relieve misalignment stresses.

2.2 Motors

2.2.1 The pump motors shall be horizontal, open drip proof (ODP), induction type, with normal starting torque and low starting current characteristics, suitable for operation with the existing 3 phase, 460 volt, 60 Hertz electrical service at the project site. The motors shall not be overloaded at the design condition or at any head on the characteristic pump operating curve as specified.

2.2.2 Each motor shall be in current NEMA design with cast iron frame and copper windings. Each motor shall have a 1.15 service factor with Class F insulation.

2.2.3 Motors shall be tested in accordance with provisions of ANSI/IEEE Standard 112.

2.3 Drive Transmission

2.3.1 Power shall be transmitted from motors to pumps by means of V-belt drive assemblies. The drive assemblies shall be selected to establish proper pump speed to meet the specified operating conditions.

2.3.2 Each drive assembly shall have minimum of two V-belts. A single belt drive will not be acceptable. Each V-belt drive assembly shall be selected on the basis that adequate power will be transmitted from driver to pump.

2.3.3 Drive systems with a safety factor of less than 1.5 to 1.0 shall not be considered sufficient for the service intended. Computation of safety factors shall be based on performance data published by the drive manufacturer.

2.3.4 Each pump station shall be equipped with horizontal V-belts in the configuration indicated on the drawings.

2.4 Belt Guards

2.4.1 Pump drive transmissions shall be enclosed on all sides in a guard constructed of any one or combination of materials consisting of expanded, perforated, of solid sheet metal, except that maximum perforated or expanded openings shall not exceed ½-inch.

2.4.2 Guards shall be manufactured to permit complete removal from the pump unit without interference with any unit component. Guards shall be securely fastened to the unit base and rigidly braced to some fixed part.

2.4.3 All metal shall be free from burrs and sharp edges. Structural joints shall be continuously welded. Panels may be riveted to frames with not more than 5-inch spacing. Tack welds shall not exceed 4-inch spacing.

2.4.4 The guard shall be primed with a minimum of 1.5 mils of zinc-based synthetic primer. A finish acrylic enamel coating with a minimum 1.5 mils shall be applied in accordance with Section 3, Color Definitions of ANSI 253.1; Safety Color Code for Marking Physical Hazards.

2.5 Painting: Pumps, piping, and exposed steel framework shall be cleaned prior to painting. Exposed surfaces to be coated with one coat gray W.R. non-lift primer and one coat white acrylic alkyd W.R. enamel. Paint shall be low VOC, alkyd based, high solids, semi-gloss white enamel for optimum illumination enhancement, incorporating rust inhibitive additives. The finish coat shall be 1.0 to 1.2 mil dry film thickness (minimum), resistant to oil mist exposure, solvent contact, and salt spray. The factory finish shall allow for over-coating and touch up after final installation.

2.6 Level Control System

2.6.1 Functional description: The level control system shall start and stop the pump motors in response to changes in the wet well level, as set forth in this section, and as indicated on the contract drawings. The level control system shall use the existing SCADA panel to control the pumps and transmit status alarms to the existing SCADA system.

2.6.2 Type: The level control system shall be an air bubbler type as specified in Section 13300 – Flow, Level, and Pressure Instruments.

2.6.3 Sequence of operation: The level instrument shall continuously monitor the wet well level, permitting the operator to read wet well level at any time. Upon operator selection of automatic operation, the level instrument shall start the motor for one pump when the liquid level in the wet well rises to the "Pump No. 1 On" level. When the liquid is lowered to the "Pumps Off" level, the level instrument shall stop this pump. These actions shall constitute one pumping cycle. Should the wet well level continue to rise, the level instrument shall start the second pump when the liquid level reaches the "Pump No. 2 On" level, and the third pump when the liquid level reaches the "Pump No. 3 On" level, so that all pumps are operating. These levels shall be adjustable as described below. Controls shall be set up to allow one pump to start at any one time.

2.6.4 Automatic pump alternation: The level control system shall utilize the alternator relays in the existing SCADA panel to select first one pump, then the second pump, and then the third pump, to run as lead pump for a pumping cycle. Alternation shall occur at the end of a pumping cycle.

2.7 Nameplates

2.7.1 Motor: List all data pertinent to proper installation of each motor and identification of motor for maintenance and replacement parts, including as a minimum:

2.7.1.1 Motor manufacturer's serial or model number; horsepower; speed; voltage; number of phases; hertz; service factor; time rating, and manufacturer's number of each bearing.

2.7.2 List all data pertinent to properly identify each pump for maintenance and replacement of parts. Including as a minimum:

2.7.2.1 Model number, serial number, design conditions, pump speed, manufacturer's name and address, and other necessary data.

2.7.3 Shipping identification tags shall be attached to all equipment according to the tag numbers shown on drawings.

3 EXECUTION

3.1 Factory tests shall be performed as specified below:

3.1.1 Motor: All motors shall receive a routine test including, but not limited to, the following parameters:

3.1.1.1 No load current and speed at normal voltage and frequency.

3.1.1.2 Locked rotor current measurement at rated frequency.

3.1.1.3 High potential test.

3.1.1.4 Bearing inspection.

3.2 Installation:

3.2.1 The Contractor shall install the equipment as specified herein, as shown on the drawings, and according to the written instructions of the manufacturer. Provide all necessary interconnections, services, and adjustments required for a complete operating system.

3.2.2 Suction pipe connections shall be vacuum tight. Fasteners at all pipe connections shall be tight. Install pipe with supports and thrust restraint to prevent strain and vibration on pump station piping. Install and secure all service lines (level control, air release valve or pump drain lines) as required in wet well.

3.2.3 Check motor and control data plates for compatibility to site voltage. Install and test the station ground prior to connecting line voltage to station control panel.

3.2.4 Prior to applying electrical power to any motors or control equipment, check all wiring for tight connection. Verify that protective devices (fuses and circuit breakers) conform to project design documents. Manually operate circuit breakers and switches to ensure operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence and ground before actual start-up.

3.3 Performance tests: The wastewater pump unit manufacturer's experienced engineers shall perform testing of the system as installed. During the tests, all manufacturer's integrated design equipment shall be tested under every condition of operation, and all controls shall be tested to demonstrate performance of the required function. All adjusting and balancing shall be completed to the satisfaction of the Engineer. Warranty on adjustment of controls shall extend 1 year after the system is put into operation. All defects in the work and equipment shall be corrected by the Contractor and the manufacturer, respectively, at their own expense, and the test repeated until proven satisfactory.

3.4 Startup: The pump startup shall be performed by the manufacturer's technical representative. The representative will inspect the completed installation. The representative will calibrate and adjust instrumentation, correct or supervise correction of defects or malfunctions, and instruct operating personnel in proper operation and maintenance procedures. Follow the manufacturer's recommended startup procedures and demonstrate to the Owner that the equipment is performing as specified in this section.

End of Section

Section 11301
Sludge Pumping Equipment

1 GENERAL

1.1 System Description: Sludge pumping equipment shall consist of, but not be limited to, all work associated with the following equipment:

1.1.1 Self-priming, positive displacement, progressive cavity sludge pumps and variable frequency drives as shown on the Drawings for the following applications:

1.1.1.1 Primary Clarifier Waste Sludge

1.1.1.2 Waste Septage

1.1.1.3 Centrifuge Feed

1.2 Related Requirements: The following sections contain requirements that relate to this section.

1.2.1 Section 13709 – Sequence of Operation

1.2.2 Section 13300 – Flow, Level, and Pressure Instruments

1.2.3 Section 264820 – Variable Frequency Drives

1.3 Reference Specifications where applicable to work under this section are referred to by abbreviation as follows:

1.3.1 American Gear Manufacturers Association ..... AGMA

1.3.2 American National Standards Institute..... ANSI

1.3.3 American Society for Testing and Materials..... ASTM

1.3.4 National Electrical Code.....NEC

1.3.5 National Electrical Manufacturers Association.....NEMA

1.4 Quality Assurance

1.4.1 The sludge pumping equipment shall be provided as a package system as specified, as indicated on the drawings, and as required to provide a complete and proper installation ready for operation. The sludge pumping equipment shall be designed to pump raw and aerobically digested primary and waste activated sludge and raw septage as specified.

1.4.2 The sludge pumping equipment specified in this section shall be furnished by one equipment supplier as an integrated design package. The supplier

shall provide all equipment and appurtenances and be responsible for the complete and satisfactory operation of the entire integrated system. The equipment supplier shall be the sludge pumping equipment manufacturer.

1.4.3 Each equipment supplier shall have unit responsibility for its equipment startup. Provide services of experienced manufacturer-trained technicians for one site visit for each set of pumps installed, consisting of a total of three 8-hour working days on the site, to demonstrate satisfactory pump operation and to provide training and instruction of the Owner's personnel for equipment operation.

1.4.4 Seepex shall be the design standard for the self-priming, positive displacement, progressive cavity sludge pump assemblies. The drawings and design of the pump assemblies are based on the design standard. Pump assemblies as manufactured by Moyno Pumps or Netzsch shall be considered approved equals.

1.4.5 If sludge pumping equipment other than the design standard is used, the Contractor shall provide a similar arrangement and revise the dimensional layout as necessary. Such revisions to the design must be certified by a professional engineer, approved by the Engineer in the shop drawing phase of construction, and shall be revised and constructed at no additional cost to the Owner. Equipment supplied other than the design standard shall conform to the paragraph entitled “Project Conditions” and all additional requirements specified in this section.

1.5 Submittals: Provide the following in a timely manner in accordance with the approved submittals schedule as specified in Section 01400 – General Requirements.

1.5.1 Certified pump curves

1.5.2 Catalog cuts, shop drawings, dimensional data, and wiring diagrams for equipment and accessories.

1.5.3 Pump operational test reports.

1.5.4 Instrumentation and controls data for the following:

1.5.4.1 Instrumentation and controls, including equipment, point-to-point wiring diagrams, point-to-point instrumentation diagrams, and sequence of operation.

1.5.5 Spare Parts: Provide manufacturer’s recommended spare parts list. In addition, provide a guaranteed price list for all spare parts, which will be binding for 1-year following contract award on this project.

1.5.6 Operation and Maintenance Manual: Submit one (1) electronic PDF copy for review by the Engineer. Submit three (3) hard copies of the final approved manual to the Owner.

1.5.6.1 The manuals' identification shall be inscribed on the cover.

1.5.6.2 The manuals shall include the names, addresses, and telephone numbers of the local representatives for each item of equipment and each system.

1.5.6.3 The manuals shall have a table of contents and be assembled to conform to the project manual table of contents with the tab sheets placed before instructions covering the subject. Additionally, each manual shall contain a comprehensive index of all manuals submitted in accordance with this paragraph.

1.5.6.4 Manuals and specifications shall be furnished which provide full and complete coverage of the following subjects:

1.5.6.4.1 Operational Requirement: This document shall describe, in concise terms, all the functional and operational requirements for the system.

1.5.6.4.2 Maintenance: Documentation of all user performed maintenance on all system components, including inspection, and periodic replacement of defective units. This shall include calibration, maintenance, and repair of all equipment, instrumentation, and controls, plus diagnosis and repair or replacement of all system hardware.

1.6 Project Conditions

1.6.1 Equipment furnished in accordance with this section shall be installed at the location and in the space allocated on the contract drawings.

1.6.2 Pump manufacturers shall supply pumps as complete units, including motors, drives, belts, couplings, base plates, guards, and all other required accessories and appurtenances, to ensure compatibility and integrity of the individual components, and provide the specified warranty for all components. Assembly by the Contractor of pumps, motors, shafting, couplings, and the like supplied by various independent manufacturers will not be allowed.

1.6.3 Pump motors shall be sized such that the motor does not overload at any point on the operating curve. Pumps and motors shall be designed to perform with a reasonable service life when operated continuously or intermittently. Motors shall be designed with a minimum service factor of 1.15.

1.6.4 Electrical Motors, Controllers, Starters, and Disconnects: Furnish motors, controllers, starters, and disconnects with their respective pieces of equipment. Motors, controllers, starters, and disconnects shall conform to and shall have electrical connections in accordance with the National Electrical Code. Controllers and starters shall have a maximum of 120-volt control circuits, and auxiliary contacts for use with the controls furnished.

1.6.5 Any structural, piping, electrical requirements, wiring, instrumentation and controls, drawings, or other modifications required to accommodate equipment offered shall be done at no additional cost to the Owner.

1.7 Manufacturer's Warranty

1.7.1 Each unit shall be warranted to be free from defects in materials and workmanship for a period of twelve months after substantial completion. The warranty shall cover all repairs for all systems furnished by the manufacturer. Manufacturer shall repair or replace, at its option, any such equipment found to be defective, provided written notice of the alleged defect is received within twelve months after substantial completion.

1.7.2 Components failing to perform as specified by the Engineer, or as represented by the manufacturer, or as proven defective in service during the warranty period, shall be replaced, repaired, or satisfactorily modified by the manufacturer.

2 PRODUCTS

2.1 Sludge Pumps

2.1.1 Description: Pumps shall be horizontal, self-priming, positive displacement, progressive cavity sludge pumps, specifically designed for pumping raw and aerobically digested primary and waste activated sludge with an estimated solids concentration of 2-5% and raw septage with an estimated solids concentration of 5-10%.

2.1.2 Size: Pumps shall have suction and discharge connections as indicated. Discharge piping shall transition as indicated on the drawings.

2.1.3 Pump Performance: Each pump shall have the necessary characteristics and be properly selected to perform under these operating conditions:

2.1.3.1 Primary Clarifier Waste Sludge Pumps

2.1.3.1.1 Pump Quantity: As indicated on the contract drawings.

2.1.3.1.2 Model: Seepex Model BN 35-6L/A1-C1-L8-F0-GA

2.1.3.1.3 Minimum Condition: 50 GPM at 21-psi discharge pressure and 112 RPM pump speed

2.1.3.1.4 Normal Design Condition: 88 GPM at 21-psi discharge pressure and 197 RPM pump speed

2.1.3.1.5 Maximum Condition: 120 GPM at 21-psi discharge pressure and 268 RPM pump speed

2.1.3.1.6 Maximum Motor Horsepower: 10 HP, non-overloading across entire pump performance curve

2.1.3.2 Waste Septage Pumps

2.1.3.2.1 Pump Quantity: As indicated on the contract drawings.

2.1.3.2.2 Model: Seepex Model BN 35-6L/A1-C1-L8-F0-GA

2.1.3.2.3 Minimum Condition: 60 GPM at 18-psi discharge pressure and 112 RPM pump speed

2.1.3.2.4 Normal Design Condition: 120 GPM at 18-psi discharge pressure and 223 RPM pump speed

2.1.3.2.5 Maximum Condition: 150 GPM at 18-psi discharge pressure and 268 RPM pump speed

2.1.3.2.6 Maximum Motor Horsepower: 15 HP, non-overloading across entire pump performance curve

2.1.3.3 Centrifuge Feed Pumps

2.1.3.3.1 Pump Quantity: As indicated on the contract drawings.

2.1.3.3.2 Model: Seepex Model BN 35-6L/A1-C1-L8-F0-GA

2.1.3.3.3 Minimum Condition: 44 GPM at 28-psi discharge pressure and 90 RPM pump speed

2.1.3.3.4 Normal Design Condition: 88 GPM at 28-psi discharge pressure and 146 RPM pump speed

2.1.3.3.5 Maximum Condition: 110 GPM at 28-psi discharge pressure and 224 RPM pump speed

2.1.3.3.6 Maximum Motor Horsepower: 10 HP, non-overloading across entire pump performance curve

2.1.4 Rotor and Stator

2.1.4.1 Each pump shall be a one-stage design employing a convoluted rotor operating in a similarly convoluted stator. The convolutions shall be configured to form a cavity between the rotor and stator,

which shall progress from the pump's inlet to discharge port with the operation of the rotor. The fit between the rotor and stator at the point of contact shall compress the stator material sufficiently to form a seal and to prevent leakage from the discharge back to the inlet end of the pumping chamber.

2.1.4.2 The stator shall be molded with a seal integral to the stator elastomer preventing the metal stator tube and the bonding agent from the elastomer from contacting the pumped liquid. Gaskets or "O" rings may not be used to form this seal. Stators for sludge pumps shall have Buna elastomer.

2.1.4.3 The sludge pump rotors shall be constructed of Alloy Steel (Type 316 stainless steel). The sludge pump rotors shall have a chromium nitride coating (Duktil) with a hardness of 1250 Vickers and a minimum thickness of 0.0108-inch. Hard chrome plating or ceramic coatings shall not be acceptable due to the ease at which this coating will crack and the lack of diffusion into the rotor base metal.

2.1.5 Rotor and Drive Train

2.1.5.1 Each pump rotor shall be driven through a positively sealed and lubricated pin joint. The pin joint shall have replaceable bushings, constructed of air-hardened tool steel of 57-60 HRc, in the rotor head and coupling rod. The pin shall be constructed of high-speed steel, air hardened to 60-65 HRc. The joint shall be grease lubricated with a high temperature (450°F), PTFE filled synthetic grease, covered with BUNA-N sleeve and positively sealed with hose clamps constructed of Type 304 stainless steel. A stainless-steel shell shall cover the rotor side universal joint assembly to protect the elastomer sleeve from being damaged by tramp metals or glass. The universal joints shall carry a separate warranty of 10,000 operating hours. This warranty shall be unconditional in regards to damage or wear.

2.1.6 Casing

2.1.6.1 An ANSI B16.5 150-pound flanged connection shall be provided at both the inlet and discharge ports. The suction and discharge casings shall each be provided with a ⅜-inch (or larger) tap to permit installation of pressure instruments.

2.1.7 Bearings

2.1.7.1 Each pump shall be provided with oil lubricated thrust and radial bearings, located in the gearmotor, designed for all loads imposed by the specified service.

2.1.8 Shaft Sealing

2.1.8.1 Shaft shall be sealed using a single internal mechanical seal. The shaft shall be solid through the sealing area, but of a two-part design which allows the rotating unit to be removed from the pump without disassembly of the gearmotor bearings. Seal materials shall be solid silicon carbide faces with Type 316 stainless steel metal parts and Viton (EPDM) elastomers.

2.1.9 Motor and Drive Unit

2.1.9.1 Gear motors or gear reducers shall be designed in accordance with AGMA 6019-E (Class II). Unless otherwise noted, motors shall be energy-efficient, inverter-duty, TEFC motors.

2.1.9.2 Sludge pumps shall require adjustable speed drives (ASDs) in accordance with Section 264820 – Variable Frequency Drives. For ASD-driven units, the pump supplier shall be responsible for the provision of the fixed reduction between the motor and pump. The reduction ratio shall be that required to operate the pump at its maximum operating speed when the motor is operating at its nominal rated full speed as specified herein. ASD-driven units may be operated at up to 90 Hertz at the maximum speed.

2.1.10 Accessories

2.1.10.1 Run Dry Protection

2.1.10.1.1 The stator shall be fitted with a sensor sleeve and thermistor sensor. A controller shall also be provided and shall be installed by the Contractor in the motor control center. The controller shall monitor the stator temperature and activate a shutdown and alarm sequence if the stator temperature reaches the adjustable limit on the controller. The controller shall include a manual local and remote reset function. Input to the controller shall be 115 VAC, 60 Hertz.

2.1.10.2 Over Pressure Protection

2.1.10.2.1 Each pump unit shall be supplied with a silicone-filled isolation ring with a dual mounted gauge and single point pressure switch. The pressure ranges for the switch and gauge shall be selected specifically for each specified service. The isolation ring shall be mounted between ANSI flanges, be sized according to the discharge pipe as shown on the contract drawings, and be constructed with a carbon steel body and fittings

with a BUNA-N sleeve. The switch shall be SPDT, NEMA 4.

2.1.11 Spare parts kit: Furnish one set of special tools to service the pumps, as well as the following minimum spare parts for each pump:

2.1.11.1 (1) Stator assembly with TSE sensor sleeve

2.1.11.2 (1) Rotor

2.1.11.3 (1) Set of universal joint assemblies

2.2 Painting: Pumps, piping, and exposed steel framework shall be cleaned prior to painting. Exposed surfaces to be coated with one coat gray W.R. non-lift primer and one coat white acrylic alkyd W.R. enamel. Paint shall be low VOC, alkyd based, high solids, semi-gloss white enamel for optimum illumination enhancement, incorporating rust inhibitive additives. The finish coat shall be 1.0 to 1.2 mil dry film thickness (minimum), resistant to oil mist exposure, solvent contact, and salt spray. The factory finish shall allow for over-coating and touch up after final installation.

2.3 Nameplates

2.3.1 Motor: List all data pertinent to proper installation of each motor and identification of motor for maintenance and replacement parts, including as a minimum:

2.3.1.1 Motor manufacturer's serial or model number; horsepower; speed; voltage; number of phases; hertz; service factor; time rating, and manufacturer's number of each bearing.

2.3.2 List all data pertinent to properly identify each pump for maintenance and replacement of parts. Including as a minimum:

2.3.2.1 Model number, serial number, design conditions, pump speed, manufacturer's name and address, and other necessary data.

2.3.3 Shipping identification tags shall be attached to all equipment according to the tag numbers shown on drawings.

3 EXECUTION

3.1 Factory tests shall be performed as specified below:

3.1.1 Motor: All motors shall receive a routine test including, but not limited to, the following parameters:

3.1.1.1 No load current and speed at normal voltage and frequency.

3.1.1.2 Locked rotor current measurement at rated frequency.

3.1.1.3 High potential test.

3.1.1.4 Bearing inspection.

3.2 Installation

3.2.1 The Contractor shall install the equipment as specified herein, as shown on the drawings, and according to the written instructions of the manufacturer. Provide all necessary interconnections, services, and adjustments required for a complete operating system.

3.2.2 Suction pipe connections shall be vacuum tight. Fasteners at all pipe connections shall be tight. Install pipe with supports and thrust restraint to prevent strain and vibration on pump piping.

3.2.3 Check motor and control data plates for compatibility to site voltage. Install and test the station ground prior to connecting line voltage to station control panel.

3.2.4 Prior to applying electrical power to any motors or control equipment, check all wiring for tight connection. Verify that protective devices (fuses and circuit breakers) conform to project design documents. Manually operate circuit breakers and switches to ensure operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence and ground before actual start-up.

3.3 Performance tests: The sludge pump unit manufacturer's experienced engineers shall perform testing of the system as installed. During the tests, all manufacturer's integrated design equipment shall be tested under every condition of operation, and all controls shall be tested to demonstrate performance of the required function. All adjusting and balancing shall be completed to the satisfaction of the Engineer. Warranty on adjustment of controls shall extend 1 year after the system is put into operation. All defects in the work and equipment shall be corrected by the Contractor and the manufacturer, respectively, at their own expense, and the test repeated until proven satisfactory.

3.4 Startup: The pump startup shall be performed by the manufacturer's technical representative. The representative will inspect the completed installation. The representative will calibrate and adjust instrumentation, correct or supervise correction of defects or malfunctions, and instruct operating personnel in proper operation and maintenance procedures. Follow the manufacturer's recommended startup procedures and demonstrate to the Owner that the equipment is performing as specified in this section.

End of Section

Section 11310
Self-Cleaning Mechanical Filter Screen

1 GENERAL

1.1 System Description: Provide self-cleaning mechanical filter screens with screenings washers/compactors and control panel and associated controls as specified, indicated on the drawings, and as needed to provide a complete and proper installation ready for operation. The mechanical filter screens and screenings washers/compactors shall be designed to remove screenings from the raw influent wastewater and discharge the screenings into a storage container.

1.2 Project Conditions

1.2.1 Equipment furnished in accordance with this section shall be installed at the location and in the space allocated on the contract drawings.

1.2.2 Motors shall be designed to perform with a reasonable service life when operated continuously or intermittently. Motors shall be designed with a minimum service factor of 1.15. Other motor requirements shall be as specified in this section and as specified in Division 26 – Electrical.

1.2.3 Electrical Motors, Controllers, Starters, and Disconnects: Furnish motors, controllers, starters, and disconnects with their respective pieces of equipment. Motors, controllers, starters, and disconnects shall conform to and shall have electrical connections in accordance with the National Electric Code. Controllers and starters shall have a maximum of 120-volt control circuits, and auxiliary contacts for use with the controls furnished.

1.2.4 Any structural, piping, electrical requirements, wiring, instrumentation and controls, drawings, or other modifications required to accommodate equipment offered other than that specified as the design standard and as shown on the drawings shall be done at no additional cost to the Owner.

1.3 Quality Assurance

1.3.1 The mechanical filter screen and screenings washer/compactor equipment specified in this section shall be an integrated system and as such shall be furnished by one equipment supplier as an integrated design package. Supplier shall provide all equipment and appurtenances and be responsible to the Contractor for the complete and satisfactory operation of the entire integrated system. The equipment supplier shall be the mechanical filter screen manufacturer.

1.3.2 Experience: The mechanical filter screen system manufacturer shall certify to not less than 5 years of experience in the application, design, and manufacture of mechanical screening systems for use in municipal wastewater treatment plants and shall submit a list of not less than 15 operating installations as evidence of meeting the experience requirement.

1.3.3 Provide Aqua Guard Ultraclean Model AG-UC-MN-A mechanical self-cleaning filter screens as manufactured by the Parkson Corporation or approved equal by Hydro-Dyne Engineering or Huber Technology, Inc. The drawing and design of the mechanical self-cleaning filter screen is based on Parkson Corporation as the design standard.

1.3.4 Provide Aqua Washpress Model AWP 8-2 screenings washers/compactors as manufactured by the Parkson Corporation or equivalent by Hydro-Dyne Engineering or Huber Technology, Inc. The drawing and design of the screenings washer/compactor is based on Parkson Corporation as the design standard.

1.3.5 The mechanical filter screen control panel shall be capable of sending a remote alarm for alarm status to the existing SCADA system. Additional information is presented in Section 13709 – Sequence of Operation.

1.3.6 If an alternate equipment system is used, the Contractor shall provide a similar arrangement, and revise the dimensional layout as necessary. Such revisions to the design must be certified by a professional engineer, approved by the Engineer in the shop drawing phase of construction, and shall be revised and constructed at no additional cost to the Owner. Equipment supplied by alternate manufacturers shall conform to paragraph entitled "Project Conditions" and all additional requirements specified in this section.

1.3.7 The mechanical filter screen equipment manufacturer shall have unit responsibility to the Contractor for supervision of the installation and startup of all equipment specified in this section.

1.3.8 The equipment shall include all necessary devices, such as machinery guards, emergency stops, warning labels, and similar items.

1.3.9 Provide the services of the equipment manufacturer's experienced mechanical serviceman for one site visit consisting of a total of two 8-hour working days before startup to assure integral operation, both mechanically and electrically, to demonstrate satisfactory operation.

1.3.10 Provide the services of the equipment manufacturer's experienced process engineer for one site visit consisting of a total of two 8-hour working days on site to provide performance testing, select and optimize operating variables, and to give initial instruction of owner's personnel in operation of the equipment.

1.4 Reference specifications are referred to by abbreviation as follows:

1.4.1 American Bearing Manufacturers Association .....ABMA

1.4.2 American Gear Manufacturers Association ..... AGMA

1.4.3 American Society of Mechanical Engineers ..... ASME

1.4.4 American Society for Testing and Materials..... ASTM

1.4.5 American National Standards Institute..... ANSI

1.4.6 National Electric Code .....NEC

1.4.7 National Electrical Manufacturers Association.....NEMA

1.5 Submittals: Provide the following in a timely manner in accordance with the approved submittals schedule as specified in Section 01400 – General Requirements.

1.5.1 Catalog cuts, shop drawings, and point to point wiring diagrams for equipment, accessories, drives and controllers.

1.5.2 Replaceable parts list: Accompanying the shop drawings, submit a complete nomenclature of all replaceable parts, their part numbers, current cost which will be considered binding for a period of 2 years, and name and address of nearest vendor of parts.

1.5.3 Instrumentation and controls data for the following:

1.5.3.1 Instrumentation and controls, including equipment, point to point wiring diagrams, point-to-point instrumentation diagrams, and sequence of operation.

1.5.3.2 Control panel

1.5.4 Operation and Maintenance Manual: Submit one (1) electronic PDF copy for review by the Engineer. Submit three (3) hard copies of the final approved manual to the Owner.

1.5.4.1 The manuals' identification shall be inscribed on the cover.

1.5.4.2 The manuals shall include the names, addresses, and telephone number of the local representatives for each item of equipment and each system.

1.5.4.3 The manuals shall have a table of contents and be assembled to conform to the project manual table of contents with the tab sheets placed before instructions covering the subject. Additionally, each manual shall contain a comprehensive index of all manuals submitted in accordance with this paragraph.

1.5.4.4 Manuals and specifications shall be furnished which provide full and complete coverage of the following subjects:

1.5.4.4.1 Operational requirement: This document shall describe, in concise terms, all the functional and operational requirements for the system.

1.5.4.4.2 Maintenance: Documentation of all user performed maintenance on all system components including

inspection and periodic replacement of defective units. This shall include calibration, maintenance, and repair of all equipment, instrumentation, and controls, plus diagnosis and repair or replacement of all system hardware.

1.5.5 Spare parts: Provide manufacturer's recommended spare parts list.

2 GENERAL

2.1 Self-Cleaning Mechanical Filter Screen

2.1.1 Performance Requirements

2.1.1.1 The automatic filter screen shall be designed to positively clean and remove debris up to 3 inches in diameter from the influent stream by means of high impact plastic filter elements designed to retain and elevate debris to the discharge point of the unit, where the UltraClean three step cleaning technology renews the filter belt.

2.1.1.2 The Parkson Aqua Guard Ultraclean Model AG-UC-MN-A heavy duty, fully automatic mechanical self-cleaning, filter screen shall be suitable for installation and operation in a flow channel measuring 4 feet wide by 4 feet deep, as measured from the base of the screen to the level at which it shall be supported. The angle of inclination shall be 75º from horizontal. The minimum width of the mechanical screen shall be 2.5 feet. The minimum width of the screen belt shall be 1.943 feet.

2.1.1.3 The point at which all collected material shall fall off the discharge chute shall be 4.71 feet above the top of the channel, representing the available clearance for the screenings washer/compactor to collect the debris. The total discharge height of the screen, as measured from its base to the screenings discharge point, shall be 9.5 feet.

2.1.1.4 Each screen shall be capable of passing a hydraulic peak flow of 9.0 MGD (18.0 MGD peak flow with both screens in operation) of raw influent wastewater with a downstream water depth of 1.33 feet in a channel 4 feet wide. The average design flow rate shall be 6.0 MGD. The loss of head at peak flow shall not exceed 6⅞ inches of water, and the screen shall be capable of presenting a clean filtration surface to the oncoming liquid stream at all times during continuous operation. The screen shall be capable of intermittent operation in order to form a mat for maximum trash and debris removal.

2.1.1.5 The unit shall be capable of handling 1.6 cubic yards per hour of screenings to ensure that the maximum amount captured by the screen can be transported out of the channel and into the waiting receptacle.

2.1.1.6 The screen shall be capable of presenting a clean filtration surface to the influent stream at all times during continuous operation utilizing UltraClean technology. It shall be capable of intermittent operation in order to form a mat of material to provide maximum trash removal. Additionally, in order to maximize the capture of paper, rags, and other flexible debris, which tends to drape over and adhere to the filtration surfaces, the screen shall have 0.63 square feet of contact surface area per square foot of wetted filtration belt frontal surface.

2.1.2 Frame Assembly

2.1.2.1 The frame of the unit, which is stationary, shall be constructed from Type 304 stainless steel with a thickness of 3/16 inch. It supports and locates all of the operating components. The unit shall rest at the bottom of the channel, and be anchored at the operating floor elevation. No mechanical mounting or fastening of the unit frame is required to the sidewalls or bottom of the channel.

2.1.2.2 The "A" frame unit shall be supported at the operating floor elevation by support legs constructed from Type 304 stainless steel. The legs shall be designed to allow the unit to pivot the screen out of the channel without dewatering (e.g., for bypass purposes). Routine service of the unit is possible with the screen in the channel.

2.1.2.3 Guide rails shall be mounted to each side on the inside surface of the frame to direct the filter belt during its ascension out of the channel. The guide rails shall be ½-inch thick and will be constructed from Type 304 stainless steel.

2.1.2.4 At the top of the screen, circular chain guides shall gently direct the filter belt from its ascending path out of the channel towards the drive sprockets. These circular guides shall be constructed from Type 304 stainless steel and shall be welded to a Type 304 stainless steel shaft. To reduce the wear on both the chain and chain guides, the shaft shall be secured to bearings on each side of the frame and free to rotate.

2.1.2.5 Chain guides shall also be provided to direct the filter belt from the drive sprockets to the descending path into the channel. These fixed rails shall be constructed of Type 304 stainless steel and shall be 5/8 inch thick.

2.1.2.6 Lower return guides shall be provided at the base of the screen to direct the filter belt during its 180-degree turn from the descending to ascending paths. The lower guide rails shall be constructed from 1/2-inch thick Type 304 stainless steel and shall be fixed in place as low as possible in the frame to optimize the submerged screen area. No submerged bearing or rotating guides are used that will require routine maintenance or that may become fouled by trash and debris.

2.1.2.7 Neoprene rubber seals with Type 304 stainless steel backing plates shall be mounted along the upstream edges of the frame to seal the outer edge of the frame against the channel wall, and the area between the frame and filter belt side plates.

2.1.2.8 The bottom of the unit shall be sealed with two rows of nylon brushes, which allow the elements to pass through, but prevents trash from passing beneath the filter elements, ensuring capture of all solids and trash by the filter belt.

2.1.2.9 All shaft bearings are mounted externally to the side frame for ease of access and maintenance.

2.1.2.10 Full covers that allow for maximum maintenance access and minimize dripping and misting will be provided. The covers shall be fabricated from 14 gauge Type 304. All enclosures shall be removable and lightweight.

2.1.2.11 Front covers shall consist of 3 components. Lower cover shall be a full width bolt on piece. The middle cover shall be a single hinged front door mounted above the lower cover. Screen widths greater than 3 feet shall have double hinged doors. The upper cover shall hinge upward for easy access to the chain, screen belt, spray system and rotating rails. The cover shall have gas assisted lifting mechanisms and positive locking arms.

2.1.3 Filter/Belt Screen Assembly

2.1.3.1 The screen shall provide dual filtration of all materials to minimize compaction of captured debris and minimize the head loss through the screen. This shall be accomplished by recessing the horizontal fine filtration opening in the face of the screen. The coarse horizontal openings formed by the upper or forward shank/arm of the elements shall be XX millimeters and shall be the first opening the flow stream contacts as it passes through the screen. The lower or recessed shank/arm of the elements shall create a two dimensional grid, which limits the maximum vertical opening to XX millimeters and the fine horizontal opening of 6 millimeters. The elements are arranged in a staggered fashion to form an endless belt and to create a range of motion that allows the recessed shank/arm of one row of elements to pass through the plane of the forward arm of the next row of elements it meshes with. Each filter element shall be a single molded component with a rake integral to its shape. The filter belt shall form a row of these rakes spaced every 4 inches, capable of lifting material of up to 3 inches in diameter out of the channel. The elements are secured to two separate filter shafts that pass through individual bosses in the elements.

2.1.3.2 The side plates (or end plates) are mounted next to the outermost elements of each filter row, and overlap to form a continuous moving sidewall for the filter belt. This moving wall prevents captured trash and debris from spilling over the sides of the filter belt. The side plates shall be constructed from a high strength phenolic resin.

2.1.3.3 The tension of the moving screen/filter belt assembly shall be completely supported by a stainless steel link chain. The chain must connect the filter shaft ends on both sides of the belt assembly so that the elements are free of tension, and support no weight of the assembly. The chain shall be of closed link design with 2 link sidebars, chain rollers and pins per link. The chain assembly shall have a minimum cross sectional area of 0.144 square inches at the weakest point of any individual link sidebar.

2.1.3.4 Chains shall be supplied with hollow pin construction that allows for the removal and replacement of the filter shafts, side plates and filter elements without releasing the chain tension. The unit is designed to allow this function to take place at the operating floor elevation with the screen in the channel. Chain rollers shall have a diameter of 1¾ inches.

2.1.3.5 All chain components shall be corrosion resistant stainless steel. Sidebars shall be Type 304 stainless steel. Pins, bushings and rollers shall be Type 304 stainless steel. 400 series components shall be heat treated to a minimum hardness of 39 on the Rockwell C Scale.

2.1.3.6 The filter shafts shall have a maximum diameter of ¾-inch and be spaced on 4-inch centers in the direction of travel of the filter belt. The shafts shall be constructed from Type 304 stainless steel.

2.1.4 Screen Belt Drive Assembly

2.1.4.1 The drive assembly consists of a gear reducer, motor, drive shaft, and bearing with eccentric locking collar. The drive mechanism shall be protected from the trash stream to ensure that the screen runs smoothly without jamming. The driving force is transmitted to clean, trash free components to avoid mis-tracking or binding, which could render the screen inoperable, requiring manual cleaning and realignment.

2.1.4.2 The gear reducer shall be hollow shaft design by Sumitomo, mounted directly to the unit external to the side frame and connected directly to the drive shaft with a keyless tapered bushing. The reducer shall be designed in accordance with AGMA recommendations for Class II service based on the required horsepower for operation of the machine.

2.1.4.3 The motor shall be a squirrel cage induction motor, ¾-HP, TEFC, 1,800 RPM, manufactured by Baldor, and suitable for 460 volt, 3

phase, 60 Hertz electrical service. Motor shall be acceptable for use in a Class 1, Division 2 environment in accordance with Paragraph 501-8(b) of the National Electric Code.

2.1.4.4 Overload protection shall be provided by an electrical overload device that senses motor current draw (SSAC Current Monitor or approved equal).

2.1.4.5 The filter belt drive shaft is located in the head of the unit and is supported at each end by the hollow shaft reducer and bearing with eccentric locking collar. The drive shaft sprockets that engage the filter belt chain rollers and transmit motion to the filter belt assembly are welded to the drive shaft. The drive shaft and sprockets shall be constructed from Type 304 stainless steel.

2.1.5 UltraClean Technology

2.1.5.1 In addition to the normal interaction of the filter elements, the UltraClean Technology cleans and renews the screen in 3 additional ways:

2.1.5.1.1 UltraWash Screen Belt Spray System

2.1.5.1.2 UltraClean Belt Geometry and repositioned brush

2.1.5.1.3 Quick Change UltraBrush Assembly

2.1.5.2 The UltraWash screen belt spray system consists of two (2) optimally positioned stainless steel spray bars with ¼ turn quick release spray nozzles. The ¼ turn makes unplugging nozzles quick and easy with access provided thru the covers. Water demand shall be 29 GPM at 60 psi.

2.1.5.3 Solenoid Valves: The UltraWash system shall be actuated by one 120 volt, single phase, 60 Hertz, normally closed solenoid valve. Valve shall consist of a brass body with a 1-inch NPT pipe connection. Electrical housing shall be rated NEMA 4X with a ¾-inch conduit connection.

2.1.5.4 The Contractor shall provide and locate manual shut off valves and pressure gauges for each spray bar after the solenoid valve

2.1.5.5 The UltraClean Belt Geometry increases the self-cleaning action of elements and positions the screen belt for optimal cleaning by the combination of the brush and spray wash system.

2.1.5.6 The UltraBrush assembly shall be of hybrid construction that limits stringy solids from wrapping around the brush shaft and extends its effective life. The bristles are longer and make full penetration of the

element shank for positive cleaning of the filter belt. The brush is driven by an independent drive system.

2.1.5.7 A side mounted door provides access for replacing the UltraBrush without reaching into the unit by more than 6 inches. Designs that require reaching into the machine beyond 6 inches to change the brush are prohibited. Changing of the brush is accomplished in under 10 minutes by sliding the solid core brush from the cantilevered drive shaft.

2.1.6 Brush Drive Assembly

2.1.6.1 The drive assembly consists of a gear reducer, motor, and brush shaft. The drive mechanism shall be protected from the trash stream to ensure that the brush runs smoothly.

2.1.6.2 The gear reducer shall be of hollow shaft design by Sumitomo, mounted directly to the unit external to the side frame and connected directly to the brush shaft with a keyless tapered bushing. The reducer shall be designed in accordance with AGMA recommendations for Class II service based on the required horsepower for operation.

2.1.6.3 The motor shall be a squirrel cage induction motor, 3 HP, TEFC, 1,800 RPM, manufactured by Baldor, and suitable for 460 volt, 3 phase, 60 Hertz electrical service. Motor shall be acceptable for use in a Class 1, Division 2 environment in accordance with Paragraph 501-8(b) of the National Electrical Code.

2.1.6.4 Overload protection shall be provided by an electrical overload device that senses motor current draw (SSAC Current Monitor or equal)

2.1.6.5 The brush drive shaft shall be of a cantilevered design. In the installed position, it shall be supported at each end by the hollow shaft reducer and eccentric bearing. The entire mechanism will be adjustable via jacking screws to achieve brush removal and replacement.

2.1.7 Discharge Chute

2.1.7.1 A discharge chute shall be provided integral to the machine, constructed from 14 gauge, Type 304 stainless steel and designed to direct the screenings to the collection equipment below.

2.1.7.2 The chute shall have a ¼-inch thick flange that shall allow it to be connected to ancillary washing, compacting, and collection equipment

2.1.8 Lubrication: Lubrication lines shall be extended from each bearing housing to a central point located on the respective side of the machine, accessible from the operating floor for ease of maintenance.

2.1.9 Fasteners: All fasteners shall be Type 316 stainless steel.

2.1.10 Surface Finish

2.1.10.1 Surface Treatment of Stainless Steel Components: All frame and structural members will be mechanically cleaned using DuPont Starblast. Sheet metal components, such as covers or the discharge chute, will be furnished with a 2B finish.

2.1.10.2 All other appurtenances including roller chain, brush sprockets, bearing housings, motor, reducer, etc. shall be supplied with the manufacturer's standard finish.

2.2 Screenings Washer/Compactor

2.2.1 Performance Requirements

2.2.1.1 Each screenings washer/compactor unit will be designed to receive and wash screenings, then reduce the volume and water content by means of a pressing action. Screenings to be washed will be gravity fed to the drainage trough and conveyed by the screw towards the washing section. Wash water is added, which back flows the screenings, while the spiral alternately stops and restarts to convey the screenings through the wash section. The wash water is then turned off and the screenings are discharged and dewatered by the backpressure generated in the discharge pipe.

2.2.1.2 Each screenings washer/compactor unit shall have an inlet capacity of 35 cubic feet per hour, handling wet screenings with an approximate dry weight of not less than 8% solids.

2.2.2 Main Body: The main body shall consist of a drainage trough and a washer barrel, enclosed by an outer housing and a support leg at each end. The main body will be constructed of T 304L stainless steel for all welded components; to minimize corrosion in the heat affected zones, and Type 304 stainless steel for all non-welded components.

2.2.2.1 Drainage Trough: The drainage trough shall be the perforated inlet area of the unit, which captures screenings and allows liquid to drain. The inlet area shall measure 11 inches wide by the length indicated on the contract drawings. The drainage trough shall be constructed from 12 gauge AWP 8 stainless steel with 0.19 inch diameter perforations.

2.2.2.2 Washer Barrel: The washer barrel shall provide a washing zone and a dewatering zone for the incoming screenings. The washer barrel shall be constructed of ¼-inch thick stainless steel, with three distinct perforated drainage zones having 0.19 inch diameter holes chamfered to 0.38 inch diameter on the outside. The inside of the washer barrel shall be provided with six (6) ¼-inch thick by 1½-inch wide

replaceable wear bars with 400 Brinnel hardness.

2.2.2.3 Outer Housing: The outer housing shall enclose the sides and bottom of the drainage trough and washer barrel. The outer housing shall collect drained liquid from the drainage trough and washer barrel and direct the liquid to a 4.0 inch drain tube. Access panels shall be provided on the outer housing in the washer barrel area to facilitate servicing of the washer barrel. The outer housing shall be constructed from 10 gauge (0.135 inch) thick stainless steel.

2.2.2.4 Support Legs: A support leg shall be provided at each end of the main body to support the main body, provide the means to mount the drive assembly (at the drive end), and provide the means to mount discharge piping (at the discharge end). Each support leg shall be designed to allow the screw to be removed from either end of the main body. Each support leg shall be provided with a footpad and anchor bolt holes, to secure the unit to the structure.

2.2.3 Screw: The shafted screw will be provided to convey screenings through the various stages of the unit. The screw will be constructed of carbon steel and finished with alkyd enamel paint. The spiral will be 8.00 inches outside diameter (OD) and have minimum 0.63 inch thick flights. A replaceable ¼-inch wide nylon brush with a stainless steel casing will be attached with bolted clips to the spiral OD throughout the inlet area to scour the perforated sheet. The brush OD will be 8.50 inches.

2.2.4 Wash Sprays: The wash zone will include a spray wash system to wash organic residue from screenings. The wash zone spray will consist of one (1) spray header, four (4) water injection points, one (1) ball valve and one (1) solenoid valve. The solenoid valve body will be of brass construction with Buna seals. The ball valve will be of brass construction with a stainless steel ball. The wash press spray system will have an output of 10 GPM at 60 psi. The spray connection will be ½ inch NPT.

2.2.5 Flush Sprays: The press will include a single point spray wash system to flush organic residue trapped in the outer trough. The flushing spray will consist of one (1) spray header, one (1) ball valve and one (1) solenoid valve. The solenoid valve body will be of brass construction with Buna seals. The ball valve will be of brass construction with a stainless steel ball. The trough flush spray system will have an output of 15 GPM at 60 psi. The spray connection will be ½ inch NPT.

2.2.6 Drive System: The unit drive system will consist of a gearmotor mounted on a sealed drive mounting bracket and a drive shaft that connects the gear reducer output to the shaft of the screw.

2.2.6.1 Gear Motor: The gearmotor will be a single speed, dual voltage SEW Eurodrive motor direct coupled to an SEW Eurodrive helical gear

reducer.

2.2.6.1.1 The electric motor will be 3 HP, TEFC for severe duty service with a 1.15 service factor, rated for use in a 40°C ambient temperature. The motor will be NEMA Design B with Class F insulation, 1,800 RPM output speed, and supplied by 460 volt, 3-phase, 60 Hertz electrical service. The motor conduit box will have one (1) ½-inch NPT and one (1) ¾-inch NPT conduit connection.

2.2.6.1.2 The gear reducer will be AGMA class II (1.6 service factor) with a minimum 94% efficiency, producing an output speed of 14 RPM and an output torque of 13,900 inch-pounds. Heavy duty tapered roller bearings in the gear reducer will provide a maximum thrust capacity of 6,740 pounds.

2.2.6.1.3 Gear reducers with service factors of less than 1.4 and efficiencies of less than 94% will not be allowed.

2.2.6.2 Drive Mounting Bracket

2.2.6.2.1 A drive mounting bracket will be provided to mount the gearmotor to the drive end support leg of the unit. The bracket will be made of Type 304L/316L stainless steel.

2.2.6.2.2 A compression type packing gland seal will be provided on the mounting bracket to seal the drive shaft. PTFE packing rings will be fitted into the seal housing, and held in place by a two-bolt stainless steel gland follower.

2.2.6.3 Drive Shaft: The drive shaft will be direct coupled to the spiral and constructed of carbon steel. The shaft will be painted, except in the area of the shaft that extends into the hollow bore of the reducer.

2.2.7 Inlet Hopper and Cover

2.2.7.1 A 12 gauge (0.105 inch) stainless steel inlet hopper will be supplied to direct screenings and liquid into the drainage trough. The chute will be flange bolted to the trough, with each side of the chute being a minimum 60 degrees from horizontal.

2.2.7.2 A 12 gauge (0.105 inch) stainless steel cover will be supplied to cover the remaining top of the main body.

2.2.7.3 A gasket will be provided to seal the feed hopper's inspection door cover.

2.2.8 Discharge Piping

2.2.8.1 A 14 gauge (0.075 inch) stainless steel discharge pipe will be fitted to the discharge end support leg to direct screenings into a customer provided receptacle. All discharge pipe flanges will be 304L stainless steel. Aluminum flanges will not be allowed.

2.2.8.2 Discharge Piping Heat Tracing: The discharge pipe will be fitted with 10 watt per foot, self-regulating heating cable, 1½- inch thick closed cell foam insulation, and a 0.08 inch thick polyethylene jacket. This option is for sites where a portion of the discharge pipe is exposed to below freezing ambient temperatures.

2.2.8.3 Thermostat: A NEMA 4X ambient sensing control thermostat mounted to the discharge pipe, will be preset for 40 °F, and will have a ¾-inch NPT conduit connection. Electrical power will be supplied from the main control panel.

2.2.9 Pipe Supports: Pipe supports will be supplied by the manufacturer if required.

2.2.10 Fasteners: All fasteners will be Type 316 stainless steel.

2.2.11 Fabrication: Weld size, type, and procedure will provide the necessary strength and facilitate the manufacturing of the specific component.

2.2.12 Surface Finish

2.2.12.1 All stainless steel components will have standard mill finish and will be mechanically cleaned to remove weld discoloration and fabrication markings.

2.2.12.2 The screw and drive shaft will be finished with an enamel coating.

2.2.12.3 The motor and gear reducer will have the standard manufacturer's finish.

2.2.13 Electrical Devices: Electrical device interconnecting conduit and wiring will be the responsibility of the Contractor. In addition to the drive motor, the following electrical devices will be furnished with the unit

2.2.13.1 Solenoid Valves: Two (2) 120 volt, single phase, 60 Hertz solenoid valves for the wash zone and flush spray washes housed in NEMA 4X enclosures will have 18-inch long integral leads and will have ½-inch NPT conduit connections.

2.2.13.2 Emergency Stop Local Pushbutton Station: A NEMA 4X polycarbonate emergency stop push button will be mounted to the end flange and will have a ½-inch NPT conduit connection

2.3 Control Panel

2.3.1 A NEMA 4X control panel shall be provided by the screen manufacturer including main breaker, disconnects, motor starters, step-down control transformer, fuses and fuse blocks, Hand-Off-Auto (HOA) selector switches for screen, brush, and washer/compactor drives and wash and flush water sprays, repeat cycle timer, reset buttons, running lights, motor current monitor, elapsed time meters, overload limit switches, emergency stop push buttons, contacts to allow continuous screen and washer/compactor operation on high liquid level, adjustable thermostat switch to operate the screens and washers/compactors on a timed or continuous basis, and programmable relay to monitor equipment mounted electrical devices and perform necessary logic functions. The control panel shall be suitable for installation at the location as indicated on the drawings and contain the logic devices required for full, proper operation of the entire screen package assembly (i.e., both screens and washers/compactors) under the design load conditions specified herein.

2.3.2 The equipment supplier shall provide all power wiring, control wiring, and conduit required to connect the equipment to the control panel and to connect the power supply to the control panel. Coordinate the installation of this wiring and conduit with the installation of the mechanical filter screen package assembly equipment.

2.3.3 A chemically resistant float switch assembly shall be provided for sensing high liquid level in front of the screen as indicated on the drawings. Float switch assembly shall be Model 9G direct acting float switch as manufactured by Consolidated Electric Company or approved equal.

2.3.4 The control panel shall have the appropriate contacts to transmit a status alarm to the existing SCADA system when the specified alarm conditions are activated.

2.3.5 Description of Operation – Mechanical Screens: Mechanical screen control shall be by automatic timer for intermittent operation, and mercury float switch and thermostat for continuous operation. Sequence of operation shall be as follows:

2.3.5.1 When the HOA selector switch is in the OFF position, the screen shall not run.

2.3.5.2 Placing the HOA selector switch in the HAND position shall cause the screen to run continuously.

2.3.5.3 Placing the selector switch in the AUTO position shall cause the screen to run and stop according to the program set in the repeat cycle timer.

2.3.5.4 Once the screen is powered, the limit switch on the screen shall monitor operation. When an overload occurs, the screen shall disengage, the limit switch shall be activated, the drive motor shall

stop, and a status alarm is transmitted to the SCADA system. After overload is corrected, the unit shall run after the button is pushed.

2.3.5.5 When in the AUTO position, high level in front of the screen shall be sensed by a liquid level switch. At high level, the switch shall close and energize the drive motor for continuous operation until the level drops to the normal operating range.

2.3.5.6 When the ambient temperature drops below a preset temperature, the thermostat switch shall close and energize the drive motor for continuous operation until the ambient temperature rises above the preset temperature.

2.3.5.7 When in the AUTO position, the spray wash system and brush shall also be activated whenever the screen is running

2.3.5.8 Emergency Stop: The unit can be deactivated at any time by pressing either the control panel mounted or unit mounted Emergency Stop push buttons.

2.3.5.9 The screenings washers/compactors shall be interlocked to operate simultaneously with their respective mechanical screens.

2.3.6 Description of Operation – Screenings Washers/Compactors

2.3.6.1 Hand Operation

2.3.6.1.1 When HAND mode is selected, the screw will run continuously. When either spray wash HAND mode is selected, the spray wash will run continuously.

2.3.6.2 Intermittent Automatic Operation: The control panel will be equipped to control the wash cycle, screw movement and flush cycle. Each wash or flush cycle and the screw movement will be controlled independently through the use of timers and counters. The drive motor and spray washes will be controlled automatically when the selector switches are placed in the AUTO position.

2.3.6.2.1 The press motor starts after an adjustable accumulated run time from the interlocked feeding equipment. The press motor will have a staging timer where it will run for an adjustable length of time, typically set at 0.3 seconds.

2.3.6.2.2 The press motor continues to run for an adjustable length of time (cycle on timer), typically set at 3-5 seconds. The press motor stops for an adjustable length of time (cycle off timer), typically set at 5 seconds. The wash solenoid valve opens and closes per the (wash cycle water duration timer) typically set at 8-10 seconds.

2.3.6.2.3 Motor stop/start cycle repeats for an adjustable number of counts (wash cycle counter) typically set at 4-7.

2.3.6.2.4 The press motor runs for an adjustable length of time (discharge timer), typically set at 13.5 seconds, to dewater and discharge the screenings.

2.3.6.2.5 The flush solenoid opens for an adjustable length of time after the press motor stops (flush off delay), typically set at 10 seconds. The system will reset after the flush solenoid closes.

2.3.6.3 Emergency Stop: The unit can be deactivated at any time by pressing either the control panel mounted or unit mounted Emergency Stop push buttons.

2.3.6.4 Zero Speed Switch: A zero speed switch will detect lack of movement of the spiral and send an alarm to the existing SCADA system.

2.3.6.5 Hopper Float/Pressure Switch: A float switch or pressure switch located in the hopper area will detect a rising solids/water level and send an alarm to the existing SCADA system.

2.3.6.6 Fault Conditions: Motor overload or high motor current conditions will stop the motor and illuminate the fault light.

2.3.7 Shop testing and assembly: The screens and screenings washers/compactors shall be factory assembled and tested for a minimum of 8 hours prior to delivery, and shall be delivered to the site fully assembled, except for motor/reducer units, discharge chutes, piping, and support legs. Screens shall be capable of being set in place and field erected with minimal field assembly.

2.4 Spare parts: The following spare parts shall be provided for the self-cleaning mechanical filter screens and the screenings washers/compactors.

2.4.1 (40) filter elements [(20) elements per screen]

2.4.2 (20) side plates [(10) plates per screen]

2.4.3 (40) snap rings, ¾-inch diameter [(20) snap rings per screen]

2.4.4 (20) snap rings, 63/64-inch diameter [(10) snap rings per screen]

2.4.5 (2) Rotating UltraBrush core replacement assemblies [(1) assembly per screen]

2.4.6 (2) sets wear bars with fasteners [(1) set per washer/compactor]

2.4.7 (2) brushes with clips and fasteners [(1) brush per washer/compactor]

3 EXECUTION

3.1 Inspection and Storage

3.1.1 The equipment will be shipped assembled and as much as possible (depending on size of unit, drives and supports may be shipped loose). The Contractor will be responsible for inspecting the equipment upon receipt of goods at the jobsite, unloading, and storing the equipment in a reasonable manner and protecting the motors, gearboxes, and controls from the weather in accordance with the manufacturer's written recommendations.

3.2 Installation

3.2.1 The Contractor will install the equipment in the structure, according to the Contract Documents and the approved submittals provided by the manufacturer, following the written instructions detailed in the manufacturer's Installation Operation and Maintenance manual.

3.2.2 The Contractor shall provide all field wiring between the electrical devices on the screens and washers/compactors (motors, switches, etc.) and the control panel. The Contractor shall also provide all required local disconnects and junction boxes

3.2.3 The Contractor shall provide all field piping, fittings, isolation valves, and components required to supply the necessary wash water to the spray system.

3.2.4 The Contractor shall provide Type 316 stainless steel expansion anchor bolts, sized in accordance with the manufacturer's written recommendations, for each screen and washer/compactor unit.

3.2.5 Erect equipment and provide the necessary oil and grease for initial operation. The grades of oil and grease shall be in accordance with the recommendations of the equipment manufacturer.

3.3 Upon completion of installation by the Contractor and startup of the equipment by the manufacturer's field service representative, the equipment shall be operated under the supervision of the Contractor for a minimum of 8 hours to ensure that all clearances, vibrations, tracking, and motor operating characteristics are within acceptable limits.

3.4 Submit a written report by the equipment manufacturer covering installation certification, all inspections, and outlining in detail any deficiencies noted.

End of Section

Section 11315
Electric Motor Valve Actuators

1 GENERAL

1.1 System Description: Electric motor valve actuators shall be provided as specified herein to operate valves and slide gates where indicated on the Drawings:

1.2 Reference Specifications where applicable to work under this section are referred to by abbreviation as follows:

1.2.1 American National Standards Institute..... ANSI

1.2.2 American Society for Testing and Materials..... ASTM

1.2.3 National Electrical Code.....NEC

1.2.4 National Electrical Manufacturers Association.....NEMA

1.3 Quality Assurance

1.3.1 The electric motor valve actuators shall be provided as a package with the valve it will service as specified and as indicated on the drawings. The electric motor valve actuators shall be designed to provide open/close service or throttling modulating service as indicated herein and sized to operate the valve on which it is installed.

1.3.2 The electric motor valve actuators specified in this section shall be furnished by one equipment supplier as an integrated package including the valve, electric motor valve actuator, stem extensions, adaptors, gearboxes, mounting brackets, floor stands, and other appurtenances required to provide a complete and proper installation ready for operation. The supplier shall provide all equipment and appurtenances and be responsible for the complete and satisfactory operation of the entire integrated system. The equipment supplier shall be the electric motor valve actuator manufacturer.

1.3.3 Electric motor valve actuators manufactured by Limitorque shall be the design standard. The contract drawings and design are based on the design standard. Rotork shall be considered an approved equal for electric motor valve actuator manufacturer.

1.3.4 If electric motor valve actuators other than the design standard is used, the Contractor shall provide a similar arrangement and revise the dimensional layout as necessary. Such revisions to the design must be certified by a professional engineer, approved by the Engineer in the shop drawing phase of construction, and shall be revised and constructed at no additional cost to the Owner.

1.4 Submittals: Provide the following in a timely manner in accordance with the approved submittals schedule as specified in Section 01400 – General Requirements.

1.4.1 Catalog cuts, shop drawings, and wiring diagrams for equipment and accessories.

1.5 Project Conditions

1.5.1 Equipment furnished in accordance with this section shall be installed at the location and in the space allocated on the contract drawings.

1.5.2 Manufacturers shall supply electric motor valve actuators as complete units, including motors, drives, belts, couplings, base plates, guards, and all other required accessories and appurtenances, to ensure compatibility and integrity of the individual components, and provide the specified warranty for all components.

1.5.3 Any structural, piping, electrical, wiring, instrumentation and controls, drawings, or other modifications required to accommodate equipment offered shall be done at no additional cost to the Owner.

2 PRODUCTS

2.1 Electric Motor Valve Actuator

2.1.1 Provide electric motor valve actuators as shown on the contract drawings and as specified herein. Electric motor valve actuators for valves located in the Sludge Processing Building and the Digester No. 1/No. 2 Valve Vault shall be mounted directly to the valves without extension stems.

2.1.1.1 Primary Sludge Pump Suction Valve

2.1.1.1.1 Location: Sludge Processing Building

2.1.1.1.2 Valve Type: Plug Valve

2.1.1.1.3 Valve Size/Quantity: As indicated on the contract drawings

2.1.1.1.4 Valve Service: On/Off

2.1.1.1.5 Actuator Size and Description: Limitorque QX5-STD

2.1.1.1.6 Speed: 30-120 seconds

2.1.1.1.7 Estimated Horsepower: 0.5 HP

2.1.1.2 Primary Sludge Pump Discharge Valve

2.1.1.2.1 Location: Sludge Processing Building

2.1.1.2.2 Valve Type: Plug Valve

2.1.1.2.3 Valve Size/Quantity: As indicated on the contract drawings

2.1.1.2.4 Valve Service: On/Off

2.1.1.2.5 Actuator Size and Description: Limitorque QX5-STD

2.1.1.2.6 Speed: 30-120 seconds

2.1.1.2.7 Estimated Horsepower: 0.5 HP

2.1.1.3 Thickened Waste Activated Sludge (TWAS) Valve

2.1.1.3.1 Location: Outside Sludge Thickening Building, outside at Aerobic Digester No. 3/No. 4, and Digester No. 1/No. 2 Valve Vault

2.1.1.3.2 Valve Type: Plug Valve

2.1.1.3.3 Valve Size/Quantity: As indicated on the contract drawings

2.1.1.3.4 Valve Service: On/Off

2.1.1.3.5 Actuator Size and Description: Limitorque QX5-STD

2.1.1.3.6 Speed: 30-120 seconds

2.1.1.3.7 Estimated Horsepower: 0.5 HP

2.1.1.4 Aerobic Digester No. 3/No. 4 Valve

2.1.1.4.1 Location: Outside at Aerobic Digester No. 3/No. 4

2.1.1.4.2 Valve Type: Plug Valve

2.1.1.4.3 Valve Size/Quantity: As indicated on the contract drawings

2.1.1.4.4 Valve Service: On/Off

2.1.1.4.5 Actuator Size and Description: Limitorque QX5-STD

2.1.1.4.6 Speed: 30-120 seconds

2.1.1.4.7 Estimated Horsepower: 0.5 HP

2.1.1.5 Aerobic Digester No. 1/No. 2 Valve

2.1.1.5.1 Location: Aerobic Digester No. 1/No. 2

2.1.1.5.2 Valve Type: Plug Valve

2.1.1.5.3 Valve Size/Quantity: As indicated on the contract drawings

2.1.1.5.4 Valve Service: On/Off

2.1.1.5.5 Actuator Size and Description: Limitorque QX5-STD

2.1.1.5.6 Speed: 30-120 seconds

2.1.1.5.7 Estimated Horsepower: 0.5 HP

2.1.1.6 Headworks – Mechanical Screen Chamber

2.1.1.6.1 Gate Type: Slide Gate

2.1.1.6.2 Gate Size/Quantity: As indicated on the contract drawings

2.1.1.6.2.1. Gate Service: Open/Closed

2.1.1.6.2.2. Actuator Size and Description: Limitorque MX-10 STD

2.1.1.6.2.3. Speed: 30-120 seconds

2.1.1.6.2.4. Estimated Horsepower: 0.5 HP

2.1.2 The actuator shall consist of an electric motor, mechanical gear reduction, absolute position encoder with redundancy, electronic torque sensor, solid state motor controller, electronic control, protection, and monitoring package, manual override handwheel, valve interface bushing, 32-character graphical Liquid Crystal Display (LCD), and local control switches all contained in an enclosure that is sealed to IP 68 to 20 meters for 168 hours for QX actuators and IP 68 to 15 meters for 96 hours for MX actuators. Actuator design life shall be at least one million drive sleeve turns.

2.1.3 The power transmission shall be completely bearing-supported, and consist of a hardened alloy steel worm and alloy worm gear, and spur gear reduction, all immersed in an oil-bath lubricated using a synthetic oil designed specifically for extreme pressure worm and worm gear transmission service.

2.1.4 The motor shall be able to energize on three-phase, 60-Hertz, 460 Volt incoming power. Advanced brushless DC motors shall be standard. Brushed DC motors are not permitted. Motor must permit a global range of voltages (single-phase and three-phase ACV and DCV) to be connected without modification. The motor must have as a minimum class F insulation and a thermistor embedded within the motor windings to prevent damage due to

over-load. The motor shall be easily removed through the use of a plug-in connector and shaft coupling.

2.1.4.1 For actuators requiring more than 1,500 ft-lb of output torque, the motor shall be 3-phase, 60 Hertz, 460 Volts squirrel cage induction type designed for valve actuation service.

2.1.5 Valve position shall be sensed by an absolute position encoder, employing system-on-chip technology using a contactless magnet that excites Hall effect devices to provide redundant, 12-bit resolution over 360 degrees. Each of the position sensing circuits shall be redundant, permitting up to 50% fault tolerance before the position is incorrectly reported. The BIST feature shall discern which failures signal a warning only and which require a warning plus safe shutdown of the actuator. Open and closed positions shall be stored in permanent, nonvolatile memory. The encoder shall measure valve position at all times, including both motor and handwheel operation, with or without power present, and without the use of a battery. The absolute encoder will be capable of resolving down to 0.1% of output shaft position over 360 degrees.

2.1.5.1 MX encoder shall be 18-bit resolution resolving ± 7 degrees of output shaft position over 10,000 output drive rotations.

2.1.6 An electronic torque sensor shall be included. The torque limit may be adjusted from 40 to 100% of rating in 1% increments. The motor shall be de-energized if the torque limit is exceeded. A boost function shall be included to prevent torque trip during initial valve unseating and during extreme arctic temperature operation (down to -60°C), and a "Jammed Valve" protection feature, with automatic retry sequence, shall be incorporated to de-energize the motor if no movement occurs.

2.1.7 The control module shall include logic circuit boards mounted to a steel plate and attached in the control compartment with captive screws. The use of O-rings or other such devices to secure the control boards shall not be permitted. The module shall be easily removed through the use of plug-in connectors. The module shall also include a solid-state motor controller board, local control switches, 32-character graphical LCD, and LED indicators. All internal wiring shall be flame-resistant, rated 105°C, and UL/CSA listed. Voltage shall be software detectable and configurable

2.1.8 The motor controller shall perform as the motor reverser and shall be solid state with no moving mechanical parts. The control module shall also include an auto reversal delay to inhibit high current surges caused by rapid motor reversals.

2.1.9 A phase correction circuit shall be included to correct motor rotation faults caused by incorrect site wiring. The phase correction circuit shall also detect the loss of a phase. The monitor relay shall trip and a warning message shall be displayed on the LCD screen to alert the User that, although the QX/MX

remains fully functional, higher current will be drawn from the remaining two power lines as long as the phase fault persists.

2.1.10 Discrete remote control may be configured as two, three, or four wires for open-stop-close control. Remote control functions may be powered by external 24 VDC, 125 VAC, or the actuator's internal 24 VDC supply. The voltage values for signal threshold shall be 19.2 VAC/VDC and 5.0 VAC/VDC, respectively. The maximum load for 24 VDC is 2 mA. The internal supplies shall be protected against over current and short circuit faults by utilizing optical isolation to minimize electromagnetic interference. Discrete control shall have an isolated common.

2.1.11 Multi-mode remote control shall be included which permits discrete two, three, or four wires, or network (Fieldbus) for open-stop-close control. The actuator shall be capable of also distinguishing analog control for modulating applications. The actuator shall respond to the last signal received. Remote control functions may be powered by external 24 VDC, 125 VAC, or the actuator's internal 24 VDC supply. The voltage values for signal threshold shall be 19.2 VAC/VDC and 5.0 VAC/VDC, respectively. The maximum load for 24 VDC is 2 mA. The internal supplies shall be protected against over current and short circuit faults and utilizes optical isolation to minimize electromagnetic interference. Discrete control shall have an isolated common.

2.1.12 Emergency Shut Down (ESD) provision shall be included in each actuator. The actuator shall permit up to three inputs for ESD and they shall be configurable. The ESD signal shall override any existing signal (except LOCAL, STOP, and INHIBIT) and send the valve to its configured emergency position. The ESD may also be configured to override LOCAL, STOP, and/or INHIBIT. Provision for an isolated common shall also be provided.

2.1.13 Inhibit movement provision shall be included in each actuator. The actuator shall permit up to three inputs for Inhibits and they shall be configurable. Provision for an isolated common shall also be provided.

2.1.14 Terminals shall be included to connect the electronic controls package, including display, to a backup 24 VDC power source. As an optional alternative, the actuator shall have the ability to maintain the status and alarm contacts in order to update status to the control room and also provides status visibility on the LCD screen without main power applied. It should be configurable for at least one hour and, once main power is restored, be available for the next unforeseen power outage. The use of an integral battery is prohibited.

2.1.15 A dedicated circuit to prevent undesired valve operation in the event of an internal circuit fault or erratic command signal shall be included. A single point failure will not result in erratic actuator movement. An open or short circuit in the internal circuit board logic shall not energize nor de-energize

the motor controller. The command inputs shall be optically coupled and require a pulse width from at least 250 ms to 350 ms to turn on or off. In the event of an internal circuit fault, an alarm shall be signaled by tripping the Monitor Relay and through LCD indication.

2.1.16 Four latched status contacts rated 125 VAC, 0.5 A and 30 VDC, 2 A shall be provided for remote indication of valve position, configured as 1-N/O and 1-N/C for both the open and closed positions. Two contacts may be configured to represent any other actuator status; mid-travel position, switched to local, over torque, motor over temperature, manual operation, switched to remote, switched to stop, valve moving, close torque switch, open torque switch, hardware failure, ESD active, inhibits active, valve jammed, analog IP (input) lost, lost phase, and network controlled. The other two will be complementary.

2.1.17 A monitor relay shall be included and shall trip when the actuator is not available for remote operation. Both N/O and N/C contacts shall be included, rated 125 VAC, 0.5 A and 30 VDC, 2 A. The monitor relay shall be configurable for three additional fault indications: lost phase, valve jammed, and motor over temperature. The yellow LED shall blink when the monitor relay is active. The monitor relay configuration shall provide provision to be disabled.

2.1.18 The ACP (Actuator Control Panel) cover and module shall use solid-state Hall-effect devices for local communication and configuration. The use of reed switches on the module is prohibited. A 32-character, graphical LCD shall be included to display valve position as a percent of open, 0-100%, and current actuator status. “STATUS OK” shall be displayed for an operable actuator. If the actuator is not operable, the appropriate alarm shall be displayed. The alarm shall be continuously displayed until the actuator is operable. Red, green, and yellow LEDs shall be included for open, close, stopped, and moving indication. The Red and Green LEDs shall be reversible. A padlockable LOCAL-STOP-REMOTE switch and an OPEN-CLOSE switch shall be included for local valve actuator control. The control switches shall not penetrate the controls cover and shall be designed to electrically isolate the actuator’s internal components from the external environment. The OPEN-CLOSE switch may be configured for maintained or push-to-run (inching) control.

2.1.19 Each actuator shall be equipped with a battery backup to ensure actuated valves fail in the closed position upon power outage.

1.1.1 The device shall be non-intrusive. All calibration/configuration shall be possible without removing any covers and without the use of any special tools. All calibration shall be performed in clear text languages; no icons shall be used. The languages shall be English, Spanish, French, German, Portuguese, Italian, Mandarin, Russian, Malay, and Katakana. All calibration shall be performed by answering the “YES” and “NO” questions displayed

on the LCD. “YES” is signaled by using the OPEN switch and “NO” by using the CLOSE switch, as indicated adjacent to the switches. A configurable password option shall be available to prevent unauthorized changes.

1.1.2 Double sealed terminal compartment and terminal block: All customer connections shall be located in a terminal chamber that is separately sealed from all other actuator components. Site wiring shall not expose actuator components to the environment. The internal sealing within the terminal chamber is suitable for IP68 to 20M for 168 hours. The terminal block shall include screw-type terminals, three for power and 54 for control, for site connections. It shall also have provisions for the addition of a safety shield to be attached over the incoming power terminals.

1.1.3 Four conduit entries, available as: (1) 1¼-inch NPT (M32) and (3) 1-inch NPT (M25 – 1 optional) shall be located in the terminal chamber.

1.1.4 Coatings: The actuator shall be coated with a polymer powder coat. The coating system shall be suitable for an ASTM B117 salt spray test of 1,500 hours. External fasteners shall be stainless steel. The fasteners shall be suitable for an ASTM B117 salt spray test of 500 hours.

1.1.5 A handwheel and declutch lever shall be provided for manual operation. The handwheel shall not rotate during electric operation nor can a seized motor prevent manual operation. Changing from motor to manual operation is accomplished by engaging the declutch lever. Energizing the motor shall return the actuator to motor operation. The lever shall be padlockable to permit motor operation only.

1.1.6 The actuator shall include a removable torque bushing to mate with the valve shaft.

1.1.7 Diagnostic facilities shall be included to accumulate and report the performance of the motor, encoder, contactor, cycle time, handwheel operations, actuator ID, firmware revision, and output turns. In addition, a torque profile of the reference baseline valve stroke and the last valve stroke shall be included. A feature for reset shall be provided. All diagnostic information shall be displayed on the LCD. Diagnostics shall also include a Frequency Domain Analysis (FDA) feature. The FDA methodology shall capture torque, position or speed values at regular time intervals while the actuator is motoring, and calculate the resulting data set with a Fast Fourier Transform (FFT). The resulting information shall be used to isolate any components in the mechanical drive train that may exhibit excessive wear or may affect normal actuator operation. FDA and resultant fault indications shall be displayed via the graphical LCD. The actuator shall contain the ability for diagnostics information to be downloaded to a PC or PDA via both IRDA and Bluetooth ports.

1.1.8 Factory testing: Every actuator shall be factory tested to verify: rated output torque, output speed, handwheel operation, local control, control power supply, valve jammed function, all customer inputs and outputs, motor current, motor thermistor, LCD and LED operation, direction of rotation, microprocessor checks, and position-sensor checks. A report confirming successful completion of testing shall be included with the actuator.

1.1.9 Actuators for valves that will be used for a throttling service shall be equipped with the Modutronic Option.

1.1.9.1 Modutronic Option: A controller that alters valve position in proportion to a 4-20 mA analog command signal shall be included. Positioning shall be accomplished by comparing the command signal to an internal position feedback. The internal feedback shall be of the non-contacting type. An automatic pulsing feature to prevent overshoot at the setpoint shall be included. Proportional bands, deadband, signal polarity, motion inhibits time, and fail position shall be adjustable through the LCD. Deadband shall be adjustable to 0.5% full span.

2 EXECUTION

2.1 Installation: Install equipment as shown on the contract drawings and according to the written instructions of the manufacturer. Provide all necessary interconnections, services, and adjustments required for a complete operating system.

2.2 Care shall be taken to ensure conduit penetrations and joints are sealed water tight to prevent water from entering the actuator via the conduit.

2.3 Performance Tests: Provide the services of the manufacturer to perform testing of each actuator as installed. During the tests, all manufacturer's equipment shall be tested under every condition of operation, and all controls shall be tested to demonstrate performance of the required function. All adjusting and balancing shall be completed to the satisfaction of the Engineer. All defects in the work and equipment shall be corrected by the Contractor at his own expense and the test repeated until proven satisfactory.

2.4 The equipment supplier shall have unit responsibility for its equipment startup. Provide services of experienced manufacturer-trained technicians for one site visit for startup. Each site visit shall consist of a total of two 8-hour working days on the site to demonstrate satisfactory valve operation and to provide training and instruction of the Owner's personnel for equipment operation.

2.5 Startup: Follow the manufacturer's recommended startup procedures and demonstrate to the Owner that the equipment is performing as specified in this section.

End of Section

Section 11320
Septage Receiving Station Equipment

1 GENERAL

1.1 System Description: Provide a septage receiving station consisting of all work associated with the following equipment:

1.1.1 (1) Septage Tank

1.1.2 (1) Rock Trap

1.1.3 (1) In-Line Grinder

1.1.4 (1) Auger

1.1.5 (1) Plug Valve with Electric Motor Actuator

1.1.6 (1) Magnetic Flow Meter

1.1.7 (1) Integral Local Motor Controller

1.2 Related Requirements: The following sections contain requirements that relate to this section.

1.2.1 Section 02730 – Wastewater Piping System

1.2.2 Section 11315 – Electric Valve Motor Actuators

1.2.3 Section 13300 – Flow, Level, and Pressure Instruments

1.3 Reference Specifications where applicable to work under this section are referred to by abbreviation as follows:

1.3.1 American National Standards Institute..... ANSI

1.3.2 American Society for Testing and Materials..... ASTM

1.3.3 National Electrical Code.....NEC

1.3.4 National Electrical Manufacturers Association.....NEMA

1.4 Quality Assurance

1.4.1 The septage receiving station equipment shall be provided as a package system as specified, as indicated on the drawings, and as required to provide a complete and proper installation ready for operation. The septage receiving station equipment shall be designed to grinder and transfer raw septage as specified.

1.4.2 The septage receiving station equipment specified in this section shall be furnished by one equipment supplier as an integrated design package. The supplier shall provide all equipment and appurtenances and be responsible for the complete and satisfactory operation of the entire integrated system. The equipment supplier shall be the septage receiving station equipment manufacturer.

1.4.3 Each equipment supplier shall have unit responsibility for its equipment startup. Provide services of experienced manufacturer-trained technicians for one site visit for each septage receiving station installed, consisting of a total of two 8-hour working days on the site, to demonstrate satisfactory equipment operation and to provide training and instruction of the Owner's personnel for equipment operation.

1.4.4 Septage receiving station equipment shall be manufactured by JWC Environmental. Other manufacturer substitutions will not be allowed and will be considered a non-responsive bid. The contract drawings and design of these pumps are based on the JWC Environmental equipment as the design standard. Contact information for the JWC Environmental company representative is as follows:

1.4.4.1 JWC Environmental
2850 Red Hill Avenue, Suite 125
Santa Ana, CA 92705
Telephone: (800) 331-2277
Internet: www.jwce.com
VA Sales Representative: Watermark Environmental Systems
Sales Representative Telephone: (610) 675-7680
E-Mail Address: eric@watermarkenvsys.com

1.4.5 If septage receiving station equipment other than the design standard is used, the Contractor shall provide a similar arrangement and revise the dimensional layout as necessary. Such revisions to the design must be certified by a professional engineer, approved by the Engineer in the shop drawing phase of construction, and shall be revised and constructed at no additional cost to the Owner. Equipment supplied other than the design standard shall conform to the paragraph entitled “Project Conditions” and all additional requirements specified in this section.

1.5 Submittals: Provide the following in a timely manner in accordance with the approved submittals schedule as specified in Section 01400 – General Requirements.

1.5.1 Catalog cuts, shop drawings, dimensional data, and wiring diagrams for equipment and accessories.

1.5.2 Equipment operational test reports.

1.5.3 Instrumentation and controls data for the following:

1.5.3.1 Instrumentation and controls, including equipment, point-to-point wiring diagrams, point-to-point instrumentation diagrams, and sequence of operation.

1.5.3.2 Control panel/motor controller

1.5.4 Spare Parts: Provide manufacturer's recommended spare parts list. In addition, provide a guaranteed price list for all spare parts, which will be binding for 1-year following contract award on this project.

1.5.5 Operation and Maintenance Manual: Submit one (1) electronic PDF copy for review by the Engineer. Submit three (3) hard copies of the final approved manual to the Owner.

1.5.5.1 The manuals' identification shall be inscribed on the cover.

1.5.5.2 The manuals shall include the names, addresses, and telephone numbers of the local representatives for each item of equipment and each system.

1.5.5.3 The manuals shall have a table of contents and be assembled to conform to the project manual table of contents with the tab sheets placed before instructions covering the subject. Additionally, each manual shall contain a comprehensive index of all manuals submitted in accordance with this paragraph.

1.5.5.4 Manuals and specifications shall be furnished which provide full and complete coverage of the following subjects:

1.5.5.4.1 Operational Requirement: This document shall describe, in concise terms, all the functional and operational requirements for the system.

1.5.5.4.2 Maintenance: Documentation of all user performed maintenance on all system components, including inspection, and periodic replacement of defective units. This shall include calibration, maintenance, and repair of all equipment, instrumentation, and controls, plus diagnosis and repair or replacement of all system hardware.

1.6 Project Conditions

1.6.1 Equipment furnished in accordance with this section shall be installed at the location and in the space allocated on the contract drawings.

1.6.2 Equipment manufacturers shall supply septage receiving stations as complete units, including motors, drives, belts, couplings, base plates, guards, and all other required accessories and appurtenances, to ensure

compatibility and integrity of the individual components, and provide the specified warranty for all components. Assembly by the Contractor of grinders, augers, motors, shafting, couplings, and the like supplied by various independent manufacturers will not be allowed.

1.6.3 Motors shall be designed to perform with a reasonable service life when operated continuously or intermittently. Motors shall be designed with a minimum service factor of 1.15.

1.6.4 Electrical Motors, Controllers, Starters, and Disconnects: Furnish motors, controllers, starters, and disconnects with their respective pieces of equipment. Motors, controllers, starters, and disconnects shall conform to and shall have electrical connections in accordance with the National Electrical Code. Controllers and starters shall have a maximum of 120-volt control circuits, and auxiliary contacts for use with the controls furnished.

1.6.5 Any structural, piping, electrical requirements, wiring, instrumentation and controls, drawings, or other modifications required to accommodate equipment offered shall be done at no additional cost to the Owner.

1.7 Manufacturer's Warranty

1.7.1 Each unit shall be warranted to be free from defects in materials and workmanship for a period of twelve months after substantial completion. The warranty shall cover all repairs for all systems furnished by the manufacturer. Manufacturer shall repair or replace, at its option, any such equipment found to be defective, provided written notice of the alleged defect is received within twelve months after substantial completion.

2 PRODUCTS

2.1 System Description

2.1.1 Model SRS3235-XE Honey Monster septage receiving system suitable for 400 GPM of septage material at approximately 10% solids (1,000 GPM of clean water), as received from septage hauling trucks through 4-inch diameter transfer lines.

2.2 Tank, Piping, and Supports

2.2.1 Tank, piping, and supports shall be constructed of Type 304 stainless steel. Tank shall be equipped with 4-inch Class 150 inlet flange, 12-inch diameter. straight-pipe liquid discharge, hinged tank lid, downstream inspection port, ultrasonic level transducer with analog outputs, upper and lower stainless steel spray wash assemblies with manual and explosion-proof bronze solenoid valves. Recommended wash water supply shall be 30 GPM at minimum 30 psi pressure.

2.3 Grinder

2.3.1 Septage grinder shall be in-line configuration, 12-inch cutter stack with 7-tooth cam-cutter design, motor-driven, permanently oil lubricated, continuously operable, automatically controlled unit. Grinder shall be Model 30004T-1204 Muffin Monster with 4-inch flanged connections.

2.3.2 Grinder housing shall be ASTM A536-77 ductile iron coated with green epoxy paint.

2.3.3 Internal moving parts of grinder shall be protected from septage leakage by cartridge-style tungsten carbide mechanical seals with BUNA-N elastomers rated for 90 psi.

2.3.4 Septage grinder shall be two-shaft, alternately stacked, intermeshing and counter-rotating design. One shaft shall not exceed 80 RPM, and the other shaft speed shall not exceed 40 RPM. The septage grinder shall be constructed of corrosion resistant material and shall be compatible to resist corrosion due to cavitation or galvanic action. The spacers and cutters shall be constructed from 17-4PH alloy steel, and shall be surface ground for uniformity.

2.3.5 Gear motor shall be vertical configuration, minimum 5 HP, TEFC Super E electric type, suitable for operation at 460 volt, 3 phase, 60 Hertz electrical service. Motor shall be provided with 29:1 speed reducer,

2.4 Auger Assembly

2.4.1 Auger assembly shall be ASA3200-500, 35° inclination, alloy steel trough and casings, ¼-inch perforated screen, nominal 20-inch diameter alloy steel spiral with nylon brush, 12-inch diameter alloy steel transport spiral with tapered element, 500 mm transport segment length, dewatering bottom discharge segment allowing approximately 75 inches of discharge clearance, and pivoting auger support for easy removal and service. Auger shall be provided with 160:1 speed reducer, and 2 HP TEFC Super E electric motor coated with green epoxy paint. Motor shall be suitable for 460 volt, 3 phase, 60 Hertz electrical service.

2.5 Weather Protection for Auger Transport

2.5.1 General

2.5.1.1 The weather protection system shall inhibit freezing of the conveyor contents. The heat-tracing shall be automatically energized when the ambient temperature is equal to or less than 40°F and will be automatically de-energized when the ambient temperature is greater than 40°F.

2.5.1.2 The auger transport and discharge sections shall be wrapped by weatherproofed heat-tracing covered by an insulation jacket. The

auger spray wash system shall be wrapped with heat-tracing to prevent freezing.

2.5.1.3 Each Weather Protection System shall be installed by affixing the heat-tracing to the auger components and then wrapping the insulation jacket around the heat-traced auger transport and discharge sections. The insulation jacket shall use lacing and/or an optional buckling system to hold the insulation jacket in place so the insulation jacket can be easily removed from the auger.

2.5.1.4 Temperature control shall be self-regulating.

2.5.1.5 The sensor shall be fitted with a junction/terminal connection for a 120/240V power connection. Power connection and control shall be provided and installed by the Contractor as defined by the National Electric Code.

2.5.1.6 Auger run sequence shall be set through the operator interface (OIT) of the controller and shall operate the auger regardless of the present condition (ON or OFF) of the heating cycle of the weather protection system.

2.5.2 Components

2.5.2.1 Heat Tracing

2.5.2.1.1 Heat tracing shall provide 6-watts/foot of heating at 40°F and shall be self-regulating.

2.5.2.1.2 The heat-tracing conductors shall be protected by a braided-metal sheathing and waterproof outer jacket.

2.5.2.2 Insulation Jacket

2.5.2.2.1 The insulation jacket shall consist of a silicon-based, fabric shell encapsulating 1½-inch thick fiberglass matting.

2.5.2.2.2 The insulation jacket shall be held in place with lacing and/or a buckling system.

2.5.3 Controller

2.5.3.1 Power connection and control shall be provided and installed by the Contractor as defined by the National Electric Code.

2.6 System Connections: 4-inch diameter cast aluminum “Cam and Groove” inlet connector for septage trucks, and 4-inch Schedule 10 304 stainless steel flanged inlet piping components.

2.7 Accessories

2.7.1 Plug Valve with Motor Actuator: Provide a 4-inch plug valve and electric motor actuator with analog inputs for proportional control. Plug valve shall be as specified in Section 02730 – Wastewater Piping System. Electric motor actuator shall be as specified in Section 11315 – Electric Motor Valve Actuators.

2.7.2 Magnetic Flow Meter: Provide a magnetic flow meter to indicate the flow rate of feed septage to the receiving station. The meter shall be a 4-inch diameter, Teflon lined, Type 316 stainless steel electrodes, Type 304 stainless steel metering tube as specified in Section 13300 – Flow, Level, and Pressure Instruments. Flow meter shall be provided with a signal converter and digital flow indicator. Flow meter shall send a 4-20 mA signal to the Septage Receiving Station motor controller.

2.7.3 Rock Trap: Rock trap shall be constructed of Type 304 stainless steel with 4-inch Class 150 flanged inlet and outlet connections, and fitted with a 4-inch knife gate valve for discharging collected solids.

2.8 Motor Controller

2.8.1 Model PC2450 motor controller shall be housed in a NEMA 4X 304 stainless steel enclosure with a sunshield, accepting 460 volt, 3 phase, 60 Hertz input power. Controller shall include, but not be limited to, IEC motor starters with over-current protection, jam-sensing current transformers, micro-PLC with operator interface, start and stop pushbuttons, closed-loop control system to maintain tank material level for optimum throughput/solids washing, magnetic swipe-card reader, 50 blank swipe cards, transaction printer, and choice of on-board flash card drive or data port (for connection to remote PLC or computer).

2.8.2 Receptacle: A duplex ground fault indicating utility receptacle providing 60 hertz, single phase current shall be mounted on inside the controller enclosure. Receptacle circuit shall be protected by a 15-amp thermal-magnetic circuit breaker.

2.9 Nameplates

2.9.1 Motor: List all data pertinent to proper installation of each motor and identification of motor for maintenance and replacement parts, including as a minimum:

2.9.1.1 Motor manufacturer’s serial or model number; horsepower; speed; voltage; number of phases; hertz; service factor; time rating, and manufacturer’s number of each bearing.

2.9.2 Shipping identification tags shall be attached to all equipment according to the tag numbers shown on drawings.

3 EXECUTION

3.1 Factory tests shall be performed as specified below:

3.1.1 Motors: All motors shall receive a routine test including, but not limited to, the following parameters:

3.1.1.1 No load current and speed at normal voltage and frequency.

3.1.1.2 Locked rotor current measurement at rated frequency.

3.1.1.3 High potential test.

3.1.1.4 Bearing inspection.

3.2 Installation

3.2.1 The Contractor shall install the equipment as specified herein, as shown on the drawings, and according to the written instructions of the manufacturer. Provide all necessary interconnections, services, and adjustments required for a complete operating system.

3.2.2 Check motor and control data plates for compatibility to site voltage. Install and test the station ground prior to connecting line voltage to station control panel.

3.2.3 Prior to applying electrical power to any motors or control equipment, check all wiring for tight connection. Verify that protective devices (fuses and circuit breakers) conform to project design documents. Manually operate circuit breakers and switches to ensure operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence and ground before actual start-up.

3.2.4 Weather protection systems shall be installed in accordance with the manufacturer's written installation instructions and in compliance with all OSHA, local, state, and federal codes and regulations.

3.3 Performance tests: The equipment manufacturer's experienced engineers shall perform testing of the system as installed. During the tests, all manufacturer's integrated design equipment shall be tested under every condition of operation, and all controls shall be tested to demonstrate performance of the required function. All adjusting and balancing shall be completed to the satisfaction of the Engineer. Warranty on adjustment of controls shall extend 1 year after the system is put into operation. All defects in the work and equipment shall be corrected by the Contractor and the manufacturer, respectively, at their own expense, and the test repeated until proven satisfactory.

3.4 Startup: The equipment startup shall be performed by the manufacturer's technical representative. The representative will inspect the completed installation. The

representative will calibrate and adjust instrumentation, correct or supervise correction of defects or malfunctions, and instruct operating personnel in proper operation and maintenance procedures. Follow the manufacturer's recommended startup procedures and demonstrate to the Owner that the equipment is performing as specified in this section.

End of Section

Section 11330
Aerobic Digester Equipment

1 GENERAL

1.1 System Description

1.1.1 Aeration equipment and piping assembly for Aerobic Digester Nos. 1, 2, 3, and 4 shall consist of, but not be limited to, all work associated with the following equipment:

1.1.1.1 Diffused air piping, fittings, and diffuser assemblies

1.1.1.2 Rotary lobe, positive displacement blowers

1.1.1.3 Blower control panels

1.1.2 The aeration equipment and piping assembly for the Aerobic Digesters shall be provided as a package assembly as specified, indicated on the drawings, and as required to provide a complete and proper installation ready for operation.

1.2 Reference specifications where applicable to work under this section are referred to by abbreviation as follows:

1.2.1 American Gear Manufacturers Association ..... AGMA

1.2.2 American National Standards Institute..... ANSI

1.2.3 American Society for Testing and Materials..... ASTM

1.2.4 National Electrical Code.....NEC

1.2.5 National Electrical Manufacturers Association.....NEMA

1.2.6 National Fire Protection Association..... NFPA

1.2.7 Southern Building Code Congress ..... SBCC

1.3 Quality Assurance

1.3.1 The aeration equipment and piping assembly specified in this section shall be an integrated system and as such shall be furnished by one equipment supplier as an integrated design package. Supplier shall provide all equipment and appurtenances and be responsible to the Contractor for the complete and satisfactory operation of the entire integrated system. The equipment supplier shall be the air diffuser equipment manufacturer.

1.3.2 Each equipment supplier shall have unit responsibility for its equipment startup. Provide services of experienced manufacturer-trained technicians for two site visits consisting of a total of three 8-hour working days on the site, to demonstrate satisfactory operation and to provide training and instruction of Owner's personnel for equipment operation.

1.3.3 Xylem, Inc. (Sanitaire) shall be the design standard for the coarse bubble air diffuser assemblies. The drawings and design of the air diffuser assemblies are based on the design standard. Air diffuser assemblies as manufactured by Environmental Dynamics International (EDI), Evoqua Water Technologies, or Aquarius shall be considered approved equals.

1.3.4 Aerzen shall be the design standard for the rotary lobe, positive displacement blower assemblies. The drawings and design of the blower assemblies are based on the design standard. Blower assemblies as manufactured by Kaeser Compressors that meet the technical requirements of this specification shall be considered approved equal.

1.3.5 If alternate equipment other than design standard is used, the Contractor shall provide a similar arrangement and revise the dimensional layout as necessary. Such revisions to the design must be certified by a professional engineer, approved by the Engineer in the shop drawing phase of construction, and shall be revised and constructed at no additional cost to the Owner. Equipment supplied other than design standard shall conform to paragraph entitled "Project Conditions" and all additional requirements specified in this section.

1.4 Submittals: Provide the following in a timely manner in accordance with the approved submittals schedule as specified in Section 01400 – General Requirements.

1.4.1 Diffuser oxygen transfer efficiency and pressure drop curves

1.4.2 Operation and maintenance manuals

1.5 Project Conditions

1.5.1 Equipment and piping furnished in accordance with this section shall be installed at the location and in the space allocated on the contract drawings.

1.5.2 Installation shall be inspected, tested, and approved as specified herein prior to being put into service. All incidental piping, controls, and accessories required for complete operating systems shall be at the expense of the Contractor. Equipment, materials, installation, and workmanship shall be in accordance with the Standard Plumbing Code.

1.5.3 Electrical Motors, Controllers, Starters, and Disconnects: Furnish motors, controllers, starters, and disconnects with their respective pieces of equipment. Motors, controllers, starters, and disconnects shall conform to and shall have electrical connections in accordance with the National Electrical Code. Controllers and starters shall have a maximum of 120-volt control circuits, and auxiliary contacts for use with the controls furnished.

1.5.4 Any structural, piping, electrical requirements, wiring, instrumentation and controls, drawings, or other modifications required to accommodate equipment offered other than that specified as the design standard and as shown on the drawings shall be done at no additional cost to the Owner.

2 PRODUCTS

2.1 Air Blower

2.1.1 Air blower assemblies for the digester shall include air blowers, blower drivers, speed reducers, base plates, pressure relief valves, pressure regulating valves, check valves, inlet and discharge silencers, flexible discharge connections, manometers, ball valves, thermometers, pressure gauges, guards, blower sound attenuation enclosure, and inlet filters. Air blower assemblies shall be factory painted with a baked enamel finish. Each blower assembly shall be provided with the piping and equipment accessories listed above.

2.1.2 Air blowers for Aerobic Digester Nos. 1 and 2 shall be an Aerzen Model GM 60S rotary lobe, positive displacement type. Performance requirements for each blower shall be as follows:

2.1.2.1 Blower Quantity: As indicated on the contract drawings.

2.1.2.2 Inlet air volume: 1,701 SCFM

2.1.2.3 Blower rotor speed: 2,869 RPM

2.1.2.4 Motor speed: 1,780 RPM

2.1.2.5 Maximum motor horsepower: 150 HP

2.1.2.6 Intake pressure: 14.50 psia

2.1.2.7 Intake temperature: 100ºF

2.1.2.8 Relative humidity: 80%

2.1.2.9 Discharge pressure: 10.50 psig

2.1.3 Air blowers for Aerobic Digester Nos. 3 and 4 shall be an Aerzen Model GM 60S rotary lobe, positive displacement type. Performance requirements for each blower shall be as follows:

2.1.3.1 Blower Quantity: As indicated on the contract drawings.

2.1.3.2 Inlet air volume: 1,360 SCFM

2.1.3.3 Blower rotor speed: 2,300 RPM

2.1.3.4 Motor speed: 1,780 RPM

2.1.3.5 Maximum motor horsepower: 75 HP

2.1.3.6 Intake pressure: 14.50 psia

2.1.3.7 Intake temperature: 100ºF

2.1.3.8 Relative humidity: 80%

2.1.3.9 Discharge pressure: 7.00 psig

2.1.4 The allowable tolerance on the stated inlet volume shall be ±4%. The unit shall be equipped with heavy-duty anti-friction bearings. Impellers shall be made of close-grained cast-iron conforming to ASTM A 48, Class 35. Impellers shall have strong, internal ribbing, shall be machined on all exterior surfaces and shall be dynamically balanced. Shafts shall be machined and shall be made of steel conforming to ASTM A 108 or alloy steel forgings conforming to ASTM A 668. When shaft and impeller are separate pieces, impeller shall be press fit onto the shaft and held by means of Woodruff key and lock nut. The casting shall be cast iron conforming to ASTM A 48, Class 30. The rotary displacement type unit shall have two timing gears machined from heat-treated steel to accurately synchronize the impellers so as to maintain maximum rotation efficiency. The surface durability, strength, and materials for spur gearing shall be in accordance with AGMA standards.

2.1.5 Gears shall be enclosed in an oil tight housing and shall be lubricated by a splash oiling system from oil contained in gear housing. Blower shall be v-belt driven by the blower driver. Blower shall be equipped with a Kingsbury type thrust bearing on the drive shaft so that no thrust from the driver will be transmitted to the blower impellers. The blower shall have an operating sound pressure level not to exceed 90 decibels over a frequency range of 37.5 to 9,600 cycles per second measured at 5 feet from the unit. Blowers shall be equipped with sound-proof enclosures.

2.1.6 Bearings for positive displacement type blowers shall have a minimum rated life expectancy (L-10) of 50,000 hours, based on the anti-friction bearing manufacturers standards. Internal bearings shall be splash lubricated from the gear housing oil reservoir. Drive-end bearings shall be grease lubricated through grease fittings in each bearing housing located so that they are easily accessible. Grease vents shall be provided in the bearing housing to prevent rupture of grease seals from over greasing. Air vents shall be provided between the seals and the impeller chamber to relieve excessive pressure on the seals.

2.1.7 Blower Drivers: Blower shall be driven by an electric motor through a V-belt drive at a speed corresponding to its peak efficiency. Motor shall be suitable for operation at the electrical service characteristics indicated on the drawings. Motor shall be totally enclosed, fan cooled (TEFC), in accordance with NEMA MG-1. Each motor shall have a 1.15 service factor with Class F insulation.

2.1.8 Speed reducers shall be V-belt drive.

2.1.9 V-belt drive shall include blower sheave, motor sheave, and V-belt. Sheaves shall be cast steel and keyed to the shaft. Multiple belts shall be sued when necessary to transmit the required power. V-belt shall be of a heavy-duty type, oil and heat resistant, and static dissipating. Drive shall be designed to have a minimum service factor of 1.6.

2.1.10 Base plates: A cast iron or welded steel base plate sized to carry the blower, speed reducer, and blower driver shall be provided with the necessary anchor lugs for foundation bolts. It shall have sufficient rigidity to maintain alignment between the various elements.

2.1.11 Inlet filter: Filter shall be dry-type, rated 99.5% on 2-micron particulate, complete with weather hood and shall have a minimum connection consistent with flow requirements. Inlet filter shall be as manufactured by universal or approved type.

2.1.12 Inlet/Discharge silences: Silencer shall be a chamber type. Silencer shall be of heavy gage welded steel construction. Silencer shall be provided for inlet and/or discharge of blower. Silencer shall provide a minimum sound attenuation of 25 decibels up to 10,000 cycles per second. Silencer piping connections shall be flanged.

2.1.13 Flexible discharge connections shall be of the rubber spool type made of duck and chloroprene with a single arch in the middle, reinforced with steel wire rings, flanged, and fitted with galvanized split retaining rings. Flexible discharge connections shall be suitable for use on blower discharges and shall be suitable for use with pressures up to 15 psig and temperatures up to 275ºF.

2.1.14 Manometer: Manometer shall have a steel body and indicating glass tube with a scale range selected by the aeration equipment manufacturer, plate glass cover, and front scale adjustment. An adequate supply of red oil manometer fluid having a specific gravity of 0.827 shall be provided.

2.1.15 Thermometers: Thermometer shall be straight form or dial type. Thermometer shall have brass or stainless steel case. Thermometer shall be moisture-proof, dust-proof, shock-proof, and vibration-proof. Thermometer shall have a stainless steel temperature sensing bulb not less than 2 inches long, with ½-inch or ¾-inch male pipe thread connection. Temperature range of the thermometer shall be suitable for the intended service.

2.1.16 Discharge pressure gauge: ANSI B 40.1. Pressure gauge shall be dial type and include a bourdon tube gearless movement. Dial shall be 2½ inches in diameter with a pressure range suitable for the intended service. Gauge shall have steel or brass case and have a ¼-inch male pipe thread connection. A similar filter restriction pressure gauge shall be mounted directly to the inlet silencer for monitoring of the inlet filter.

2.1.17 Guards: Belts, sheaves, gears, couplings, projecting setscrews, keys, and other rotating parts, located so that any person may come in close proximity thereto, shall be fully enclosed or properly guarded in accordance with ANSI B15.1.

2.1.18 Sound attenuation enclosure (for each blower): The Contractor shall install each blower package in a removable acoustical enclosure to reduce the resultant noise level. The acoustical enclosure shall encompass the entire blower package for maximum sound attenuation. The enclosure will be constructed of 16-gauge galvanized sheet steel supported by a 2-inch by 2-inch angle frame. Full height access doors shall be provided front and rear to facilitate servicing of the blower package. A baffled inlet port with louver and bird/insert screen shall be located opposite the blower package inlet filter to allow supply/cooling air to enter the enclosure during operation. The interior surfaces shall be lined with a 2-inch-thick convoluted acoustical foam to help absorb, dampen, and block noise transmission to the outside of the enclosure. An internal angle base shall be used to mount the unit to the concrete equipment pad. The enclosure shall be shipped completely assembled ready for installation.

2.1.19 Valves: Provide check valves and pressure relief valves as specified in this section.

2.2 Electrical Power/Control Panels

2.2.1 New triplex control panels (indoor application) shall be provided for the three new blowers serving Aerobic Digester Nos. 1 and 2, as well as the three new blowers (outdoor application) serving Aerobic Digester Nos. 3 and 4. Each set of three new blowers shall be controlled by a single control panel located as indicated on the contract drawings.

2.2.2 Each blower control panel shall be assembled and tested by the same manufacturer supplying the blowers to ensure suitability and assurance of experience in matching controls to motors and to ensure single source responsibility for the equipment.

2.2.3 The blower supplier shall provide triplex electrical power/control panels for electrical power supply and automatic operation of the blowers. Each control panel shall be located in a panel mounted on the electrical rack as shown on the electrical drawings. Each control panel shall include, but not be limited to, NEMA rated solid state, soft start type motor starters with thermal overload protection for each blower and main disconnect switch, circuit breakers, hand-off-automatic (HOA) selector switches, manual start pushbuttons, timers to control the run time for each blower, run light for each blower indicating running or stopped condition, alarm horn and light, push to test buttons for alarm horn and light, automatic reset for next alarm, connections for status alarm contacts, overloads, relays, run time meters, and 120-volt control transformer for each blower for automatic operation as specified herein.

2.2.4 Each control panel shall be pre-wired in a NEMA 4X (outdoor) and NEMA 3R (indoor), 12-gauge, stainless steel rack mounted cabinet enclosure as indicated

on the contract drawings. Each enclosure shall have an anti-condensation heater sized to prevent moisture accumulation in the enclosure. The blower supplier shall provide all wiring and conduit between each blower control panel and its respective blowers. The Contractor shall provide all wiring, conduit, and other appurtenances from each control panel to the motor control center as indicated on the contract drawings.

2.2.5 Functional Description: Sequence of operation for each set of digester blowers shall be as follows:

2.2.5.1 The operator shall manually choose which blower to operate using a Hand-Off-Automatic (HOA) switches for each blower.

2.2.5.2 A 7-day, 24-hour timer with 96 incremental adjustment points of 15 minutes each shall be provided for each blower for automatic control.

2.2.5.3 The control panel shall allow all blowers to run simultaneously, but shall be designed to prevent multiple blowers from starting at the same time.

2.2.5.4 Flashing red alarm light and alarm horn shall activate at the local control panel, and a status alarm shall be transmitted to the existing PLC when any of the following conditions occur.

2.2.5.4.1 High Pressure (for each blower)

2.2.5.4.2 Overload (for each blower)

2.2.5.4.3 High Temperature (for each blower)

2.2.5.5 Alarm light shall be equipped with long life bulb in guarded enclosure. Horn shall emit 120-decibel alarm at 10-foot distance. Each control panel shall include an alarm light for each of the alarm conditions specified herein.

2.2.6 The control panel shall have power on light, push to test button for light, light with automatic reset for next alarm, and the appropriate contacts to transmit a status alarm to the PLC when the alarm conditions specified herein are activated.

2.2.7 Each control panel shall send status and alarm information to SCADA through an ethernet connection.

2.2.8 Each control panel shall have one GFI 120-volt electrical double convenience outlet.

2.3 Fixed Header Aeration System

2.3.1 Furnish all materials and equipment for the fixed header aeration systems in the digester tanks.

2.3.2 Furnish all equipment as shown on the drawings and as specified herein.

2.3.3 Provide services and testing associated with the equipment.

2.3.4 All items furnished by the equipment supplier under this section are for installation by the Contractor.

2.3.5 Equipment Components Included

2.3.5.1 Stainless steel dropleg, distribution header(s) and diffusers.

2.3.5.2 Stainless steel manifold and supports.

2.3.5.3 Stainless steel supports and anchor bolts.

2.3.5.4 Stainless steel flanged and expansion joints.

2.3.5.5 Bolts, nuts and gaskets for aeration system flange connections

2.3.6 Materials, Fabrication, and Finishing

2.3.6.1 Stainless Steel

2.3.6.2 Fabricate all welded parts and assemblies from sheets and plates of 304L stainless steel with a 2D finish conforming to ASTM A240.

2.3.6.3 Fabricate non-welded parts and flanges from sheets, plates or bars of 304 stainless steel conforming to ASTM A240 or ASTM A276.

2.3.6.4 Provide droplegs, manifolds and headers of the diameter shown on the drawings with dimensional tolerances conforming to ASTM A554 and fabrication procedures in accordance to ASTM A774 & A778.

2.3.6.5 Furnish air distribution headers with the following minimum nominal wall thicknesses.

2.3.6.5.1 For diffuser connectors and headers that are not gusset reinforced as specified herein, the minimum allowable header wall thickness is 0.25 inches to minimize potential for connector failure.

2.3.6.6 Furnish diffuser connector from cast 316L Stainless Steel.

2.3.6.7 Furnish all flanges from stainless steel as specified herein.

2.3.6.8 Furnish all nuts, bolts and washers including anchor bolts in 18-8 series stainless steel.

2.3.6.9 Furnish 304L stainless steel diffusers with a cast 304L Schedule 80 threaded inlet nozzle.

2.3.6.10 Welds and Welding Procedure

2.3.6.10.1 Weld in the factory with ER 316L filler wire using MIG, TIG or plasma-arc welding inert gas processes. Provide a cross section equal to or greater than the parent metal.

2.3.6.10.2 Provide full penetration butt welds to the interior surface with gas shielding to interior and exterior of joint.

2.3.6.10.3 Provide smooth, even distribution interior weld beads with an interior projection not exceeding 1/16 inch beyond the I.D. of the air header or fittings.

2.3.6.10.4 Continuously weld both sides of face rings and flanges to eliminate potential for crevice corrosion.

2.3.6.10.5 Field welding is NOT permitted.

2.3.6.11 Corrosion Protection and Finishing

2.3.6.11.1 Clean all welded stainless steel surfaces and welds after fabrication by using the following procedure:

2.3.6.11.1.1 Clean all welded stainless steel surfaces and welds after fabrication by using the following procedure:

2.3.6.11.1.1.1 Pre-clean all outside weld areas to remove weld splatter with the use of stainless steel brushes and/or deburring and finish grinding wheels.

2.3.6.11.1.1.2 Finish clean all interior and exterior welds and piping by full immersion pickling and rinse with water to remove all carbon deposits, oxide film and contaminants to regenerate a uniform corrosion resistant chromium oxide film.

2.3.6.11.1.1.2.1 Completely immerse all stainless steel assemblies and components in an acid solution as described in Section 6.2.11 of ASTM A380-88. The acid shall be a nitric-hydrofluoric solution as defined in Table A.2.1 of Annex A2 of ASTM A380.

2.3.6.11.1.1.2.2 Provide a final thorough rinse using ordinary industrial or potable water and dry in conformance per Section 8.3 of ASTM A380.

2.3.6.11.1.1.2.3 Corrosion protection techniques not utilizing full immersion methods are unacceptable and will be cause for rejection of the equipment.

2.3.6.11.1.1.2.4 Engineer/Owner at their option may choose to observe the equipment cleaning procedure by notifying the manufacturer of their intent to visit thirty (30) days prior to the date. Cost of the travel and expenses are by the owner.

2.3.6.11.1.1.2.5 Neoprene – furnish all gaskets of fiber reinforced neoprene – 45 to 50 durometer (Shore A).

2.3.7 Fixed Aeration Headers, Manifold, and Droplegs

2.3.7.1 Provide a dropleg from the air main connection or air control valve to the aeration system as shown on the drawings.

2.3.7.1.1 Provide a stainless steel Van Stone style flange design with a 150 pound drill pattern flange ring for the top connection.

2.3.7.1.2 Provide a stainless steel band clamp coupling with gasket for the lower dropleg to header connection for ease of installation and alignment.

2.3.7.2 Fabricate manifold and air distribution headers in sections up to 41 feet in length.

2.3.7.2.1 Provide eccentric reducers for changes in diameter for constant invert elevation.

2.3.7.2.2 Provide 8-inch diameter and smaller headers with removable end caps and 10-inch diameter and larger headers with welded end caps.

2.3.7.3 Join sections of manifold or air distribution headers with flanged joints or expansion joints. Design individual header sections for rotation independent of adjacent sections for alignment purposes during installation.

2.3.7.3.1 Provide flanged joints consisting of face rings, rotating ring flanges, bolts and gaskets.

2.3.7.3.2 Provide expansion joints consisting of a welded flanged expansion barrel, O-ring gasket, O-ring locking flange and hardware to accommodate $\pm$ 2 inch of movement.

2.3.7.4 Furnish expansion/contraction system for all headers designed for temperature range of 125° F consisting of simple and fixed supports and expansion joints.

2.3.7.4.1 Lengths of header can extend up to 80 feet from restraining point without an expansion joint.

2.3.7.4.2 Limit maximum distance between restraining points on a continuous length of header to 120 feet maximum.

2.3.7.4.3 Provide an expansion joint on continuous lengths of header between two restraining points.

2.3.7.4.4 Provide simple supports to restrain header from buoyant uplift forces.

2.3.7.4.5 Provide fixed supports as specified herein.

2.3.7.4.5.1 Limit movement to prevent expansion joint blow apart and transmit expansion forces from the header to the fixed support stand.

2.3.7.4.5.2 Provide a mechanical link to connect the header and fixed support stand.

2.3.7.4.5.3 Reinforce the header at the attachment point of the mechanical link.

2.3.8 Duplex Diffuser Connectors

2.3.8.1 Factory weld to the invert centerline of the air header.

2.3.8.2 Design diffuser connectors for two diffusers.

2.3.8.3 Furnish PVC plugs for all unused diffuser connectors.

2.3.8.4 Provide connectors of length appropriate to the header diameter and positioned so that air exiting the diffusers clears the header.

2.3.8.5 Design header and diffuser connectors as follows:

2.3.8.5.1 Reinforce the connector header weld joint by providing and continuously welding gussets between the vertical side wall of the header and the connector ends to limit long term flexure failure. Minimum gusset thickness is 0.125 inch.

2.3.8.5.2 Weld connector to the header with a full penetration butt weld to minimize potential for crevice corrosion between header and connector. Use of fillet welds at the connection between the diffuser connector and header is NOT permitted.

2.3.8.5.3 Resist a vertical dead load applied to the threaded end of the connector that results in a bending moment of 1000 inch-lbs without exceeding 24,000 psi design stress in any part of the header wall or connector.

2.3.8.5.4 Header wall thickness for unreinforced connectors must comply with requirements herein.

2.3.9 Supports and Anchor Bolts

2.3.9.1 Provide each section of air header with a minimum of two supports with the maximum spacing between supports not to exceed 17 ft – 6 inches.

2.3.9.2 Limit header or manifold cantilever to no more than 4 feet.

2.3.9.3 Provide header supports with a vertically adjustable header hold down locking mechanism mounted on a stainless steel supporting structure.

2.3.9.4 Provide header supports with a vertically adjustable header hold down locking mechanism mounted on anchor bolts cast into 4,000 psi reinforced concrete pedestals.

2.3.9.5 Design support hold down locking mechanisms with a minimum width of 2 inch and a minimum thickness of .109 inch on headers 12-inch diameter or smaller.

2.3.9.6 Design support hold down locking mechanisms using a "U" bolt smaller diameter and larger.

2.3.9.7 Provide supports with a mechanism to provide for + 2 inch of vertical adjustment and + 1/2 inch of lateral adjustment for alignment of the header in the field.

2.3.9.8 Provide a wall or floor mounted support near the drop pipe to header connection for vertical support and restraint of movement due to thermal expansion and to prevent blowing apart.

2.3.10 Anchor Bolts

2.3.10.1 Design anchor bolts for embedment in 4,000 psi concrete with a pullout safety factor of 4.

2.3.10.2 Attach supports to the tank with two stainless steel anchor bolts.

2.3.10.3 Provide a mechanical stainless steel expansion type anchor bolt system.

2.3.10.4 Provide a chemical bond adhesive stainless steel anchor bolt system with stainless steel threaded stud bolts.

2.3.11 Air Diffusers

2.3.11.1 Provide coarse bubble diffusers fabricated of stainless steel material.

2.3.11.2 Design diffuser for operating range of 8 to 40 SCFM.

2.3.11.3 Design diffusers with cast Schedule 80 ¾-inch NPT threaded nozzle and acetyl orifice insert if required, an inverted air reservoir, air exit ports and a full-length deflector.

2.3.11.3.1 Design diffusers to provide full wide band aeration with a minimum air release perimeter of 48 inches per diffuser. Release air uniformly along a minimum two-foot band beyond each side of the header.

2.3.11.3.2 Locate exit ports discharging air into liquid on horizontal planes at two levels.

2.3.12 Diffuser Deflector

2.3.12.1 Provide deflector below each diffuser for its full length and width.

2.3.12.2 Design deflector to direct the liquid being aerated along the diffuser reservoir walls so that the air exits through the ports and is sheared into small bubbles and distributed into the liquid.

2.3.13 Spare Parts

2.3.13.1 Package spare parts in a separate container clearly marked “Spare Parts” and provide inventory list on exterior of the container.

2.3.14 Air Piping: All above grade air piping and piping located inside tanks required for Aerobic Digester Nos. 1, 2, 3 and 4 shall be welded Schedule 10 stainless steel. Provide flanges, connecting pieces, transition glands, transition sleeves, Victaulic couplings, and other adapters as required. Below grade air piping shall be Class 52 mechanical joint ductile iron pipe as specified in Section 02730 Wastewater Piping System.

2.3.14.1 Stainless Steel Piping: ASTM A 312, Type 316L, Schedule 10, with threaded end connections.

2.3.14.2 Threaded Fittings: ANSI B16.11, Class 600, except stainless steel shall conform to ASTM A 182, Type 316L.

2.3.14.3 Flanges and Unions: Provide at valves and connections to aeration equipment.

2.3.14.3.1 Flanges: ANSI B16.5, Class 600, raised face type, except stainless steel shall conform to ASTM A 182, Type 316L.

2.3.14.3.2 Unions: ANSI B16.39, Class 600, except stainless steel shall conform to ASTM A 312, Type 316L. Provide Victaulic couplings as required.

2.3.15 Butterfly Valves: Butterfly valves shall be high performance butterfly valves as manufactured by DeZurik, or approved equal. Above grade butterfly valves shall have threaded or flanged end connections.

2.3.15.1 Design

2.3.15.1.1 Design Pressure: ANSI Class 150

2.3.15.1.2 End Connections: Wafer Lug

2.3.15.1.3 Disc: Valve disc shall be double offset to provide 360° seating.

2.3.15.1.4 Seats: Valve seats shall be retained in the body and replaceable without removing the disc or stem.

2.3.15.1.5 Valve laying length shall conform to MSS-SP67.

2.3.15.1.6 Valves 6 inches in diameter and smaller shall be equipped with a lever operator. Valves 8 inches in diameter and larger shall be gear operated.

2.3.15.2 Materials and Construction

2.3.15.2.1 Body: Stainless steel, conforming to the design standards of ANSI B16.34 steel valves and ANSI B16.5 flange mating.

2.3.15.2.2 Seat: PTFE or RTFE, retained in the body and replaceable without moving the disc or steel.

2.3.15.2.3 Disc: Stainless steel.

2.3.15.2.4 Shaft: 17-4 Stainless steel.

2.3.15.2.5 A packing gland, utilizing "V" type Chevron PTFE packing, shall be provided at the operator end of the valve shaft.

2.3.16 Check Valves: Techno Corporation, Model 5412 wafer type check valve, aluminum construction, with Class 150 flanged end connections.

2.3.17 Pressure Relief Valve

2.3.17.1 Each package shall be supplied with a single pressure relief valve on the discharge side of the blower mounted downstream of the discharge silencer and upstream of the check valve.

2.3.17.2 The pressure relief valve shall be set to protect the blower from exceeding its maximum pressure rating, and shall be sized to pass 100% of the design flow.

2.3.17.3 The pressure relief valve shall be field adjustable, spring loaded, and have a certificate of conformity to PED.

2.3.17.4 The pressure relief valve shall be housed by the sound enclosure and shall relieve into a segmented section of the sound enclosure. Weighted relief valves inside in the enclosure are not permitted.

2.3.17.5 The valve shall be manufactured by the blower manufacturer.

2.3.18 Condensate Ball Valves: Ball valves shall be Class 150, meeting requirements of ANSI B16.34. Valves shall have ANSI stainless steel bodies and balls. Valves shall have stainless steel stems and trim, and Viton or Teflon seats, body seals, and stem seals. Valves shall be lever operated. Valves shall be manufactured by Velan Valve Corporation, ITT-Grinnell, Worchester, Inc., or approved equal.

3 EXECUTION

3.1 Install equipment and piping as shown on the contract documents and according to the written instructions of the manufacturer. Provide all necessary interconnections, services, and adjustments required for a complete operating system.

3.2 Installation of aeration piping, including equipment, materials, and workmanship, shall be in accordance with the SBCC Standard Plumbing Code.

3.3 Follow equipment manufacturer's recommendations for sequencing of equipment installation.

3.4 Layout and install support anchors in accordance with equipment manufacturer's recommendations and anchor setting plan.

3.5 Level aeration system such that all diffusers connected to a header are within plus or minus 3/8 inch of a common horizontal plane.

3.5.1 Piping systems: Piping system shall be hydrostatically tested at not less than 1.5 times the working pressure, but not less than 50 psig and shall show no leakage or reduction of gauge pressure after 4 hours.

3.5.2 Clean and flush air piping of all loose dirt, grit, and other extraneous materials before installing diffuser assemblies.

3.6 Startup: Follow the manufacturer's recommended startup procedures and demonstrate to the Owner that the equipment and piping are performing as specified in this section.

End of Section

Section 11350
Centrifuge Sludge Dewatering Equipment (Owner Furnished)

1. GENERAL

1.1 System Description: Refer to Appendices A and B in this project manual for system description, proposal, and design criteria for installation by the Contractor in the Sludge Processing Building at the Town's Wastewater Treatment Plant as indicated on the Contract Drawings. The Contractor shall provide a complete and properly functioning Dewatering System.

1.2 Reference specifications are referred to by abbreviation as follows:

1.2.1 American National Standards Institute ..... ANSI

1.2.2 American Society for Testing and Materials ..... ASTM

1.2.3 American Water Works Association ..... AWWA

1.2.4 National Electric Code .....NEC

1.2.5 National Electrical Manufacturers Association .....NEMA

1.3 Quality Assurance

1.3.1 Equipment manufacturer shall have unit responsibility for equipment recommissioning and startup. The Owner shall provide the services of experienced manufacturer-trained technicians for startup.

1.4 Project Conditions

1.4.1 Equipment furnished in accordance with this section shall be installed at the location and in the space allocated on the contract drawings.

1.4.2 The Owner will provide a set of the approved shop drawing submittals for the centrifuge and polymer system equipment to the selected Contractor for convenient reference during installation.

1.4.3 Any structural, piping, electrical requirements, wiring, instrumentation and controls, drawings, or other modifications required to accommodate equipment offered other than that specified as the design standard and as shown on the drawings shall be done at no additional cost to the Owner.

1.4.4 If equipment is not functioning properly after the equipment is installed and mechanically started up and fails to perform as specified or as represented by the manufacturer, the Contractor shall be responsible for satisfactory replacement, repair, or modification of such items at no additional cost to the Owner.

2. PRODUCTS

2.1 Design Criteria: Refer to Appendices A and B in this project manual for system description, proposal, and design criteria for new, Owner Furnished, centrifuge sludge assembly and polymer feed systems for installation by the Contractor in the Sludge Processing Building at the Town's Wastewater Treatment Plant.

3. EXECUTION

3.1 Installation

3.1.1 The Contractor shall install the Owner-furnished equipment as specified herein, as shown on the drawings, and according to the written instructions of the manufacturer. Provide all necessary interconnections, services, and adjustments required for a complete operating system.

3.1.2 Prior to applying electrical power to any motors or control equipment, check all wiring for tight connection. Verify that protective devices (fuses and circuit breakers) conform to project design documents. Manually operate circuit breakers and switches to ensure operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence and ground before actual start-up.

3.2 Piping systems shall be hydrostatically tested as specified in Section 02730 - Wastewater Piping System.

3.3 Performance tests: Alfa Laval's experienced engineers shall perform testing of the system as installed. During the tests, all manufacturer's integrated design equipment shall be tested under every condition of operation, and all controls shall be tested to demonstrate performance of the required function. All adjusting and balancing shall be completed to the satisfaction of the Engineer. Warranty on adjustment of controls shall extend 1 year after the system is put into operation. All defects in the work and equipment shall be corrected by the Contractor and the manufacturer, respectively, at their own expense, and the test repeated until proven satisfactory.

3.5 Startup: Startup of the centrifuge sludge dewatering assembly and polymer feed systems shall be performed by Alfa Laval. Alfa Laval's representative will inspect the completed installation. The representative will calibrate and adjust instrumentation, correct or supervise correction of defects or malfunctions, and instruct operating personnel in proper operation and maintenance procedures. Follow Alfa Laval's recommended startup procedures and demonstrate to the Owner that the equipment is performing as specified in this section.

End of Section

Section 11430
Chemical Piping and Appurtenances

1 GENERAL

1.1 Description

1.1.1 Chemical piping and appurtenances shall consist of, but not be limited to, all piping, valves, and other appurtenances required for complete and operable feed systems for the following chemicals:

1.1.1.1 Alum Solution

1.1.1.2 Polymer Solution

1.1.2 The Contractor shall provide all labor, materials, equipment, and incidentals required to install, test, and place in satisfactory services all chemical feed systems and equipment as indicated on the drawings and as specified herein.

1.2 Submittals: Provide the following in a timely manner in accordance with Section 01400 – General Requirements.

1.2.1 Catalog cuts, performance data, shop drawings, replaceable parts lists, and certificates of compatibility with intended chemical service for the following:

1.2.1.1 Piping, Fittings, and Pipe Appurtenances

1.2.1.2 Valves

1.2.1.3 Piping Insulation System

1.2.2 Provide piping schematics, wiring schematics with interconnection diagrams, and instrumentation diagrams.

1.2.3 Operation and Maintenance Manuals: Submit in PDF format.

1.2.3.1 Each manual shall include the names, addresses, and telephone numbers of the local representatives for each item of equipment and each system.

1.2.3.2 Each manual shall have a table of contents and be assembled to conform to the project manual table of contents with the tab sheets placed before instructions covering the subject. Additionally, each manual shall contain a comprehensive index of all manuals submitted in accordance with this paragraph.

1.2.3.3 Manuals and specifications shall be furnished which provide full and complete coverage of the following subjects:

1.2.3.3.1 Operational Requirement: This document shall describe, in concise terms, all the functional and operational requirements for the system.

1.2.3.3.2 Maintenance: Documentation of all user-performed maintenance on all system components including inspection, periodic preventative maintenance, fault diagnosis, and repair or replacement of defective units. This shall include calibration, maintenance, and repair of all equipment, instrumentation, and controls, plus diagnosis and repair or replacement of all system hardware.

1.2.4 Spare Parts: Each equipment manufacturer shall submit a recommended list of spare parts for the equipment supplied.

1.3 Quality Assurance

1.3.1 The Contractor shall provide all piping, valves, equipment, and appurtenances required for complete and operable chemical feed systems.

1.3.2 Each equipment manufacturer shall have unit responsibility to the Contractor for the installation of all equipment, instrumentation, and controls specified in this section.

1.4 Project Conditions

1.4.1 Equipment furnished in accordance with this section shall be installed at the location and in the space allocated on the contract drawings. The Contractor shall provide all labor, materials, equipment, and incidentals required to install, test, and place in satisfactory service all chemical feed equipment as indicated on the drawings and as specified herein.

1.4.2 Any structural, piping, electrical requirements, wiring, instrumentation and controls, drawings, or other modifications required to accommodate equipment offered and as shown on the drawings shall be done at no additional cost to the Owner.

1.5 Warranty

1.5.1 In addition to the manufacturer's standards guarantee, the Contractor shall include the services of a factory-trained serviceman to provide repair services for the equipment for the period of 1-year commencing with the time the equipment is placed in continuous permanent operation. This service shall include the cost of all replacement parts required during the interval.

2 PRODUCTS

2.1 Materials

2.1.1 All materials of construction provided shall be chemically compatible and resistant to the intended service in accordance with the manufacturer's written recommendations.

2.1.2 All chemical feed equipment shall have manufacturer's name, model number, working pressure if pertinent and other technical information as required cast in raised letters on body of equipment.

2.1.3 All flanged connections where required, unless otherwise specified, shall have chemically resistant ANSI 150-pound flanges.

2.1.4 Gasket materials and installation shall conform to the manufacturer's written recommendations.

2.2 Piping Application: Pipe leakage will not be allowed.

2.2.1 Solvent welded Schedule 80 polyvinyl chloride (PVC).

2.2.2 Above grade chemical tank fill piping inside buildings: Double-walled, solvent welded Schedule 80 polyvinyl chloride (PVC).

2.2.3 Provide piping insulation system for all outdoor exterior solution chemical piping systems as specified herein.

2.2.4 Above grade accessories: Provide chemically resistant flanges, quick disconnects, connecting pieces, transition glands, transition sleeves, and other adapters as required for complete and operable piping systems for service indicated.

2.3 Pipe

2.3.1 Polyvinyl Chloride (PVC) Piping

2.3.1.1 Pipe, couplings, and fittings shall be Schedule 80 meeting the requirements of ASTM D1785, manufactured of material meeting the requirements of ASTM D1784, Type 1120. Provide ASTM D2467 Schedule 80 fittings and ASTM D2564 solvent cement compatible with intended chemical service.

2.3.1.2 Provide screwed joints and flanges as required to connect dissimilar pipe materials, valves, equipment, and appurtenances.

2.3.1.3 Double-Walled Containment Piping: The Contractor shall provide a complete double-containment piping system, including piping, fittings, anchors, terminations, access tees, carrier pipe supports, containment boxes for valves, and associated pipe joining method, for each chemical service as indicated on the drawings. A certificate of compatibility shall be provided with each piping system to demonstrate its suitability with the intended chemical service. The

manufacturer shall be Asahi/America, Inc., Malden, Massachusetts, or approved equal.

2.3.2 Pipe Supports for Chemical Piping: Pipe supports shall be in accordance with Section 11450 – Pipe Supports and Anchors for Chemical Piping.

2.4 Chemical Valves: Valve leakage will not be allowed. Each valve manufacturer shall provide certificates indicating valve compatibility with the intended chemical service.

2.4.1 Ball Valves

2.4.1.1 Ball valves for service with polyvinyl chloride (PVC) piping shall be constructed of ASTM D 1784 PVC body, ball, carrier, and stem with TFE ball seat and Viton O-rings and gaskets. Socket welded construction shall be PVC full port, True Union (Double Union/Double Block through 3-inch diameter) design. Flanged construction shall be PVC flanges conforming to 150-pound drilling. Valves shall be suitable for 150-psi nonshock cold water service at 70°F. Valves shall be Nibco/Chemtrol, or approved equal by Hayward.

2.5 Piping Insulation System

2.5.1 Provide insulation system suitable for outdoor conditions for all exposed exterior above grade chemical piping systems specified in Piping Application to a depth of 3 feet below grade, and as required to prevent freezing. Piping insulation system shall consist of heat tracing, fiberglass insulation, and aluminum jacket.

2.5.2 Heat Tracing

2.5.2.1 Provide 120-volt AC electric heat tracing, thermostats and continuity lights and junction boxes to maintain pipe contents at 40ºF in a 0ºF ambient temperature. Heat trace shall be self-regulating rapid trace, 5 watts/foot Type SRL as manufactured by Chromalox, or approved equal. Activation setpoints for all chemical piping applications shall be 40ºF.

2.5.2.2 Composition: Tracing shall be composed of two copper conductors sized for the rating indicated, separated by a conductive matrix such that a constant heat output is produced per foot at any temperature in the range specified, degraded by the allowable voltage drop for specified running length. The active (conductive) element shall be covered with a minimum plastic coating 5 mils thick. The plastic coating shall be chemically inert in the temperature range of operation and installation ambient temperature, and shall not attack or be attacked by any metal or plastic piping nor any normal surface finish or piping, nor any normal insulating material installed over the tracing. The tracing shall not be affected by direct sunlight, ambient

temperature, operating temperature, rain, or salt laden atmosphere. Heat trace shall be capable of being overlapped without burnout.

2.5.2.3 Thermostats/controls shall be Chromalox Model RT, DL Series, or approved equal, single point on-off temperature controller with NEMA 4X enclosure constructed of high strength polymer. Control thermostat shall include corrosion resistant wiring, control enclosure terminal block ¾-inch conduit opening, and MP-1 mounting plate. Switch rating shall conform to the requirements specified on the drawings. Provide all required connection, end seal kits, and accessories as required for complete, operable installation. Mount unit in a position that prevents condensation from draining into the enclosure from the connecting conduit.

2.5.3 Fiberglass Insulation: ASTM C 547 fibrous glass insulation, minimum density 3 pounds per cubic foot, provided with a factory applied vapor barrier jacket. Minimum thickness 2-inch, and continue to 3 feet below grade.

2.5.4 Aluminum Jacket: Corrugated type, not less than 0.016-inch thick. Jackets shall be secured with stainless steel or aluminum bands not less than ⅜-inch wide with stainless steel or aluminum screws at 8 inches on center. Seams shall be lapped not less than 2 inches. Provide neat finish at valves, fittings, hangers and appurtenances.

3. EXECUTION

3.1 Installation: Install piping and equipment as shown on the drawings and according to the written instructions of the manufacturer. Provide all necessary interconnections, services, and adjustments required for complete operating chemical feed systems.

3.2 Installation of chemical piping, including equipment, materials, and workmanship, shall be in accordance with the SBCC Standard Plumbing Code.

3.2.1 Piping systems: Piping system shall be hydrostatically tested at 125 psig, and shall show no leakage or reduction of gauge pressure after 4 hours.

3.2.2 Clean and flush chemical piping of all loose dirt, grit, and other extraneous materials prior to installation.

3.3 Pipe Laying

3.3.1 Take all precautions necessary to ensure that pipe, valves, fittings, and other accessories are not damaged in unloading, handling, and placing in trench. Examine each piece of material just prior to installation to determine that no damage has occurred. Remove any damaged material from the site and replace with undamaged material.

3.3.2 Exercise care to keep foreign material and dirt from entering pipe during storage, handling, and placing in trench. Close ends of in-place pipe at the end of any work period to preclude the entry of animals and foreign material.

3.3.3 Bedding of pipe shall be as specified in Section 02200 – Earthwork.

3.3.4 Do not lay pipe when trench bottom is muddy or frozen, or has standing water. Keep excavations clear of water while work is being installed. Control subsurface water in accordance with Section 02200 – Earthwork.

3.3.5 Use only those tools specifically intended for cutting the size and material and type pipe involved. Make cut to prevent damage to pipe or lining and to leave a smooth end at right angles to the axis of the pipe.

3.4 Join and assemble solvent welded PVC pipe joints in accordance with requirements of ASTM D 2855.

3.5 Pipe Labeling

3.5.1 Above grade piping shall be labeled. Arrows shall be provided to indicate direction of flow. Provide labeling every 15 linear feet of pipe, close to valves, adjacent to changes in direction, branches, and where pipes pass through walls or floors. Labels shall be either black for light colored piping or white for dark colored piping and shall be of such size to be clearly visible and readable.

3.6 Install the following items in accordance with the manufacturer's written recommendations:

3.6.1 Piping insulation systems.

3.7 Performance Tests: Provide the services of the manufacturer's experienced engineers to perform testing of the chemical feed equipment as installed. During the tests, all manufacturer's integrated design equipment shall be tested under every condition of operation, and all controls shall be tested to demonstrate performance of the required function. All adjusting and balancing shall be completed to the satisfaction of WW Associates. Warranty on adjustment of controls shall extend 1 year after the system is put into operation. All defects in the work and equipment shall be corrected by the Contractor at his own expense and the test repeated until proven satisfactory.

3.8 Startup: Follow the manufacturer's recommended startup procedures and demonstrate to the Owner that the equipment is performing as specified in this section.

End of Section

Section 11450
Pipe Supports and Anchors for Chemical Piping

1 GENERAL

1.1 Description: This section covers the requirements for non-metallic channel framing systems.

1.2 Reference specifications are referred to by abbreviation as follows:

1.2.1 American National Standards Institute..... ANSI

1.2.2 American Society for Testing and Materials..... ASTM

1.2.3 Manufacturers Standardization Society of the Valve and Fittings Industry.....MSS

1.2.4 Underwriters Laboratory ..... UL

1.3 Quality Assurance

1.3.1 The non-metallic channel framing system shall be provided as a package system as specified, and as required to provide a complete installation ready for operation.

1.3.2 The non-metallic channel framing system specified in this section shall be an integrated system furnished by one equipment supplier as an integrated design package. The manufacturer shall provide all materials and appurtenances and be responsible for the complete and satisfactory operation of the entire integrated system.

1.3.3 Experience: The manufacturer shall certify to not less than 10 years experience in the application, design, and manufacture of non-metallic channel framing systems for use in pipe support applications.

1.3.4 All products shall be manufactured in the United States.

1.4 Submittals: Provide the following in a timely manner in accordance with Section 01400 – General Requirements.

1.4.1 Catalog cuts, performance data, shop drawings, installation manual, and certificates of compatibility with intended chemical services for the non-metallic channel framing system

1.5 Piping systems shall be supported in accordance with ANSI B31.1 “Power Piping” so as to maintain required pitch of lines, prevent vibration, and provide for expansion and contraction movement. Provide hangers in accordance with MSS SP-58 and MSS SP-69.

1.6 Acceptable Manufacturer: Aickinstrut, StrutTech, or approved equal.

2 PRODUCTS

2.1 General

2.1.1 Nonmetallic channel framing shall be furnished as a system which includes all necessary fasteners, channel splice plates, brackets, sealants, hangers, pipe clamps and appurtenances.

2.1.2 Nonmetallic fasteners shall be manufactured from long glass fiber reinforced polypropylene to ensure maximum strength and corrosion resistance.

2.1.3 All components of the channel framing system shall be nonmetallic.

2.2 Materials

2.2.1 Fiberglass reinforced plastic (FRP) channel shall be pultruded glass reinforced vinylester resin having the following physical properties:

Physical Property	**ASTM Test**	**Longitudinal Vinylester**	**Transverse Vinylester**
Ultimate Tensile Strength (psi)	D638	35,000	10,000
Tensile Modulus (psi) x 10^6	D638	3.0	1.0
Ultimate Compressive Strength (psi)	D695	35,000	20,000
Compressive Modulus (psi) x 10^6	D695	2.5	1.2
Ultimate Flexural Strength (psi)	D790	35,000	14,000
Flexural Modulus (psi) x 10^6	D790	2.0	1.0
Shear Strength Short Beam (psi)	D2344	7,000	6,000
Izod Impact Strength (ft-lb/in)	D256	30	5

2.2.2 Some accessories shall be of injection molded, 40% long glass fiber reinforced polypropylene.

2.3 Standards

2.3.1 Glass reinforced channels specified herein shall have a flame spread rating of 25 or less when tested per ASTM E84, and shall be self-extinguishing per the requirements of UL94V0, thereby qualifying as Class 1 material in the Uniform Building Code.

2.3.2 Glass reinforced channels specified herein shall comply with the requirements of ASTM D3917 and ASTM D4385 which govern the dimensional tolerance and visual defects of pultruded shapes.

2.4 Composition

2.4.1 Glass reinforced channel shall have a synthetic surfacing veil applied on exterior surfaces to improve weatherability and inhibit ultraviolet degradation. An ultraviolet stabilizer shall be incorporated in the resin formulation to further inhibit ultraviolet degradation.

2.5 Structural Design

2.5.1 Channel shall incorporate the manufacturer's flange profile design which allows full and positive interlocking contact of channel accessories and prohibits premature flange failure from torque accessories.

2.5.2 Channel profile dimensions shall be 1-5/8-inch x 1-5/8-inch x 1/4-inch.

2.5.3 All 1-5/8-inch x 1-5/8-inch channel profiles shall have a minimum pull out resistance of 1,000 pounds when the load is applied over a 3/8-inch long section of the inside flanges.

2.5.4 Channel sections shall be supplied in 10-foot lengths.

2.5.5 Universal pipe clamps shall have full interlocking contact with interior channel flanges to maximize pull-out resistance and be adjustable to accommodate a minimum 3/4-inch variance in piping or conduit outside diameter sizes.

3. EXECUTION

3.1 Space supports or hangers for horizontal piping as follows unless otherwise indicated on the drawings and the manufacturer's written recommendations. Provide additional supports for concentrated loads at valves or specialties.

Nominal Pipe Size	Maximum Span (feet) Plastic Pipe
1/2-inch	2
3/4-inch through 1-1/2-inch	3
2-inch and 2-1/2-inch	4
3-inch	5
4-inch	6

3.1.1 Provide pipe hanger or support within 18 inches or every change in direction for piping 1-1/2 inches and below and within 3 feet of every change in direction for piping 2 inches and larger.

3.1.2 Vertical Piping: Support plastic piping at each floor and at midpoint between floors, but not at more than 5-foot intervals.

End of Section

Section 13100
Precast Concrete Building Systems

1 GENERAL

1.1 System Description

1.1.1 The Contractor shall furnish precast concrete building systems for the Drain Pump Station Electrical Building. Each building shall be delivered and field erected by the manufacturer on the Contractor's poured-in-place floor slab as indicated on the contract drawings. The manufacturer shall provide each building with all necessary openings as indicated on the drawings in conformance with the manufacturer's structural requirements.

1.1.2 Precast concrete building systems manufactured by Smith-Midland Corporation shall be the design standard. The contract drawings and design of the precast concrete building systems are based on the design standard. Americast, Rotondo Precast, or other manufacturers as approved by WW Associates shall be considered approved equals for precast concrete building systems.

1.1.3 Precast concrete building systems for this project are summarized as follows:

1.1.3.1 Drain Pump Station Electrical Building (Smith-Midland Easi-Set Model 1012)

1.2 Related Requirements: The following sections contain requirements that relate to this section.

1.1.1 Section 02200 – Earthwork

1.3 References: The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1.1.2 ACI-318-02, "Building Code Requirements for Reinforced Concrete."

1.1.3 Concrete Reinforcing Institute, "Manual of Standard Practice."

1.1.4 ANSI/ASCE 7-02 "Building Code Requirements for Minimum Design Loads in Buildings and Other Structures."

1.1.5 American Society for Testing and Materials (ASTM)

1.1.6 Building Officials and Code Administrators (BOCA) National Building Code, latest addition

1.1.7 UL-752 Test Method Level 4 for bullet resistance certified by an independent structural engineer.

1.1.8 Building fabricator must be producer member of National Precast Concrete Association (NPCA) and participate in its plant certification program. In

addition, building fabricator must have a minimum of 5 years experience manufacturing and setting transportable precast concrete buildings.

1.2 Quality Assurance

1.2.1 Installer Qualifications: Engage an experienced installer to erect the pre-engineered precast concrete building who has specialized in the erection and installation of types of precast concrete building systems similar to that required for this project and who is certified in writing by the precast concrete building system manufacturer as qualified for erection of the manufacturer's products.

1.2.2 Single-Source Responsibility: Obtain the precast concrete building system components, including precast concrete wall and roof panels, and accessory components, from one source from a single manufacturer.

1.2.3 The precast building manufacturer shall coordinate all required openings, including size and location with the Contractor to reflect the actual equipment purchased.

1.2.4 A representative of the precast building manufacturer shall attend two mandatory coordination meetings at the project site with the Engineer and Contractor to coordinate the final design of the building and to verify building design criteria, building penetrations, and colors prior to the manufacturing of the building.

1.3 Design Criteria

1.3.1 Dimensions

1.3.1.1 Drain Pump Station Electrical Building

1.3.1.1.1 Exterior: 12’-0” wide x 10’-0” long x 8’-4” high

1.3.1.1.2 Interior: 11’-6” wide x 9’-6” long x 8’-0” high

1.3.2 Design Loads

1.3.2.1 Seismic Load Performance Category "B," Exposure Group III

1.3.2.2 Standard Live Roof Load: 60 psf

1.3.2.3 Standard Floor Load: 250 psf

1.3.2.4 Standard Wind Loading: 130 mph

1.3.2.5 Standard Snow Loading: 30 psf

1.3.2.6 Allowable Soil Bearing Capacity: 3,000 psf (Assumed)

1.3.3 All construction shall be in accordance with the latest editions of all applicable codes, including the International Building Code, the Virginia Uniform Statewide Building Code (USBC), the National Electric Code, the International Mechanical Code, the International Plumbing Code, and all local codes and requirements.

1.4 Submittals: Provide the following submittals to WW Associates in a timely manner for approval:

1.4.1 Shop drawings and product data consisting of precast concrete building system manufacturer's product information for building components and accessories.

1.4.2 Shop drawings for precast concrete roof and wall panels, and other precast concrete building system components and accessories that are not fully detailed or dimensioned in manufacturer's product data.

1.4.3 Shop drawings and product data for mechanical heating and ventilation equipment.

1.4.4 Shop drawings for concrete foundation floor slab.

1.4.5 Building engineering calculations prepared by or under supervision of a professional engineer legally authorized to practice in the jurisdiction where the project is located.

1.4.6 Manufacturer's color charts showing full range of colors, textures, and patterns available for precast wall panels with factory-applied finishes.

1.4.7 Professional engineer's certificate prepared and signed by a professional engineer, legally authorized to practice in the jurisdiction where the project is located, verifying that the precast concrete building system meets indicated loading requirements and codes of authorities having jurisdictions.

1.5 Delivery, Storage, and Handling

1.5.1 Deliver prefabricated components, panels, and other manufactured items so they will not be damaged or deformed. Package wall and roof panels for protection against transportation damage.

1.5.2 Handling: Exercise care in unloading, storing, and erecting wall, roof, and floor panels to prevent bending, warping, twisting, and surface damage.

1.5.3 Stack materials on platforms or pallets, covered with tarpaulins or other suitable weathertight ventilated covering. Store precast concrete wall and roof panels so that water accumulations will drain freely. Do not store panels in contact with other materials that might cause staining, denting, or other surface damage.

2 PRODUCTS

2.1 Materials

2.1.1 Concrete: ASTM C 260, steel-reinforced, 5,000-psi minimum 28-day compressive strength, air entrained for precast concrete panels. Reinforced concrete for the floor slab shall be as specified in Section 03300 – Cast-in-Place Concrete. Precast concrete roof panels shall be 4-inch minimum thickness. Precast concrete wall panels shall be 4-inch minimum thickness.

2.1.2 Reinforcing Steel: ASTM A 615, Grade 60.

2.1.3 Post-tensioning Strand: Post-tensioning cable shall be 41K Polystrand CP50, ½-inch, 270 ksi, 7-wire strand, ASTM A 416, greased plastic sheath. Post-tensioning cable shall be post-tensioned in field after grout keyway is filled and has cured to required PSI strength. There shall be a minimum of three post-tensioning cables connecting roof panels together to provide a watertight joint.

2.1.4 Caulking: All joints between panels shall be caulked on the exterior and interior surface of the joints. Caulking shall be Sikaflex-1A elastic sealant. Exterior caulk joint shall be ⅜-inch square so that sides of joint are parallel for correct caulk adhesion. Back of joint shall be taped with bond breaking tape to ensure adhesion of caulk to parallel sides of joint and not the back.

2.1.5 Panel Connections: All panels shall be securely fastened together with 3/8-inch thick steel brackets. Steel shall be structural quality, hot-rolled carbon complying with ASTM A 283, Grade C, and hot-dipped galvanized after fabrication. All fasteners shall be ½-inch diameter bolts complying with ASTM A 307 for low carbon steel bolts. Cast-in anchors used for panel connections shall be Dayton-Superior No. F-63. All inserts for corner connections must be bolted directly to form before casting panels. No floating-in of connection inserts shall be allowed. Wall panels shall be connected to floor slab with 4-inch expansion anchors provided by manufacturer.

2.2 Accessories

2.2.1 Doors and Frames: Doors and frames shall comply with Steel Door Institute "Recommended Specifications for Standard Steel Doors and Frames" (SDI-100), and as herein specified. The building shall be equipped with double 3'-0" x 6'-8" x 1¾-inch thick, 18-gauge galvanized/insulated CECO Imperial metal doors (orientation as shown on the drawings) with 16-gauge galvanized frame. Doors and frame shall be bonderized and painted with one coat of rust inhibitive primer and one finish coat of enamel paint selected by the Owner from the manufacturer's color charts.

2.2.2 Door Hardware

2.2.2.1 Handle: Lindstrom stainless steel, 8½ inches x 2 inches

2.2.2.2 Hinges: PB-31/NRP/26D 4½ inches x 4½ inches (chrome-plated with non-removable hinge pins), three per door.

2.2.2.3 Lock Set: DQ Industries KR116-32D (stainless steel finish)

2.2.2.4 Surface Bolt, Upper: Cal-Royal 045901426D (satin chrome finish)

2.2.2.5 Surface Bolt, Lower: Cal-Royal 045901426D (satin chrome finish)

2.2.2.6 Astragal: A4441/68R

2.2.2.7 Threshold: National Guard 897V60 raised interior, extruded aluminum threshold with neoprene seal.

2.2.2.8 Door Holder: Glynn-Johnson 904H US32D (stainless steel finish), overhead slide type surface mounted door holder.

2.2.2.9 Drip Cap: National Guard 15D72

2.2.2.10 Door Stop: Ives 445B26D (inactive leaf only)

2.2.3 Mechanical Heating and Ventilation Equipment/Accessories: Contractor shall provide as indicated on the drawings and specifications.

2.3 Gutters/Downspouts

2.3.1 Gutters shall be 5-inch x 0.032-inch thick K-style, aluminum construction (Alloy 3105 H24), with baked on enamel finish. Downspouts shall be 3-inch x 4-inch, aluminum construction (Alloy 315 H24), with baked on enamel finish. Color shall be approved by the Owner.

2.4 Finishes

2.4.1 Interior of Building: Smooth steel form finish on all interior panel surfaces.

2.4.2 Exterior of Building: Exposed river aggregate finish unless specified otherwise.

2.4.3 Doors shall be finished as selected by the Owner.

2.5 Roof

2.5.1 Roof panel shall have a minimum of ½--inch slope from front to back in 10-foot direction. The roof shall extend 2½-inches beyond the wall panel and have a turndown design which extends ½-inch below the top edge of the wall panels to prevent water migration into the building along top of wall panels. Roof shall also have an integral architectural ribbed edge.

2.5.2 Keyway Roof Joints: Grout in keyways shall be polymer concrete placed after coating keyways with a methyl methacrylate resin and isocyanate resin. Top of keyway must be coated with primer followed by one code of a polymeric joint sealant followed by a fiberglass resin fabric followed by a second coat of polymeric joint sealant.

2.6 The Contractor-supplied poured-in-place slab must have a ½-inch step-down around the entire perimeter to prevent water migration into the building along the bottom of wall panels.

3 EXECUTION

3.1 Site Preparation

3.1.1 Provide cast-in-place reinforced concrete floor slab as indicated on the drawings. The slab shall be sloped in both directions as indicated on the drawings and capable of supporting loads imposed by the structure.

3.1.2 The floor slab for the building shall bear fully on a crushed stone base that is at least 1 foot larger than the length and width of the building.

3.1.3 Stone layer beneath the building floor slab shall be a minimum of 6 inches thick. The vertical soil capacity under stone shall be compacted to have a minimum bearing capacity of 2,000 psf. Stone shall be VDOT No. 57 coarse aggregate fill. Stone shall be placed within a perimeter form to 1-inch above highest point of area where the building will be placed.

3.1.4 The crushed stone base shall be kept within the confines of the soil or perimeter form. Do not allow the stone base to become unconfined so that it may wash, erode, or otherwise be undermined.

3.1.5 Provide positive drainage for the concrete floor slab as indicated on the drawings.

3.1.6 All buildings shall be grounded in accordance with the National Electrical Code.

3.2 Site Access

3.2.1 The Contractor must provide a level, unobstructed area large enough for a crane and tractor-trailer to park adjacent to the floor slab. Crane must be able to place outriggers within 5 feet of edge of the slab, and truck and crane must be able to get side-by-side under their own power. No overhead lines may be within 75-foot radius of center of the slab.

3.3 Install mechanical heating and ventilation equipment in accordance with the manufacturer's written recommendations.

End of Section

Section 13300
Flow, Level, and Pressure Instruments

1 GENERAL

1.1 References

1.1.1 American Society of Mechanical Engineers (ASME) Publication

1.1.1.1. Fluid Meters, 6th Edition

1.1.2 Instrument Society of America (ISA) Publications

1.1.2.1. S5.1 Instrumentation Symbols and Identification

1.1.2.2. S5.4 Instrument Loop Diagrams

1.1.2.3. RP12.1 Recommended Practice for Electrical Instruments in Hazardous Atmospheres

1.1.2.4. RP12.6 Installation of Intrinsically Safe Instrument Systems in Class I Hazardous Locations

1.1.2.5. S51.1 Standard Process Instrumentation Terminology

1.1.3 National Electrical Manufacturers Association (NEMA) Publications

1.1.3.1. ICS 1 General Standards for Industrial Controls and Systems

1.1.3.2. ICS 2 Standards for Industrial Control Devices, Controllers, and Assemblies

1.1.3.3. ICS 6 Enclosures for Industrial Controls and Systems

1.2 Submittals: Provide the following in a timely manner in accordance with the approved submittals schedule as specified in Section 01400 – General Requirements.

1.2.1 Shop drawings, product data, and details of the following:

1.2.1.1. Magnetic flow meters and signal converter/transmitters

1.2.1.2. Air bubbler level instrument

1.2.1.3. Ultrasonic level instrument

1.2.1.4. Parshall flume with air bubbler flow meter/transmitter

1.2.1.5. Pressure indicating transmitter

1.2.1.6. Pressure switch

1.2.1.7. Flow switch

1.2.2 Operation and Maintenance Data: Submit detailed operation and maintenance data for magnetic flow meter equipment provided under this section.

1.3 Instrumentation loop shall be 4-20 mA. Loop loads shall be within the source load capacity.

1.4 Equipment supplier shall have unit responsibility for the start-up of the equipment and shall provide the services of an experienced mechanical serviceman for all required start up services including operator training and demonstration of satisfactory operation.

2 PRODUCTS

2.1 Magnetic Flow Meters: Each magnetic flow meter shall operate on electromagnetic induction principle and give an output signal directly proportional to the velocity of the process medium.

2.1.1 General – Primary Sludge Pump Flow Meter

2.1.1.1. Size/Quantity: As indicated on the contract drawings.

2.1.1.2. Medium: Raw Primary Sludge

2.1.1.3. Flow Range: 0-300 GPM

2.1.2 General – Waste Septage Pump Flow Meter

2.1.2.1. Size/Quantity: As indicated on the contract drawings.

2.1.2.2. Medium: Raw Septage

2.1.2.3. Flow Range: 0-300 GPM

2.1.3 General – Centrifuge Feed Pump Flow Meter

2.1.3.1. Size/Quantity: As indicated on the contract drawings.

2.1.3.2. Medium: Aerobically Digested Primary and Waste Activated (WAS) Sludge

2.1.3.3. Flow Range: 0-300 GPM

2.1.4 General – Drain Pump Station Flow Meter

2.1.4.1. Size/Quantity: As indicated on the contract drawings.

2.1.4.2. Medium: Raw Domestic Wastewater

2.1.4.3. Flow Range: 0-2,500 GPM

2.1.5 Primary (Flow Head)

2.1.5.1. Meter shall have a stainless-steel metering tube and a nonconductive hard rubber liner.

2.1.5.2. End connections shall be ASME/ANSI B16.5 Class 150 flanges. Flanges shall be compatible with the piping system in which it is installed.

2.1.5.3. The housing shall be epoxy coated steel, welded at all joints. Bolted coil enclosures shall not be acceptable.

2.1.5.4. The field coils of the meter shall be supplied with a precisely adjusted bi-polar direct current. The coils must be located on the outside of the flow tube. Coils embedded in liner are not acceptable.

2.1.5.5. There shall be no electronic components on the primary flow head. Coil drive power shall be supplied by an integral converter. Output signal from the primary shall be fed through DS or BTS proprietary cable supplied with the meter for remote signal converters.

2.1.5.6. The primary flow head shall have a NEMA 4X rated housing.

2.1.5.7. Electrodes shall be Hastelloy C22. Electrodes shall be removable without taking the meter out of service.

2.1.5.8. Meter shall be equipped with Type 316 stainless steel grounding rings.

2.1.5.9. Meter calibration shall be performed by a direct volumetric comparison method. A calibration certificate shall accompany each meter. Calibration facility shall be certified to 0.02% BMC, and be traceable to International standards

2.1.5.10. The meter shall be capable of reading within a velocity flow range of 0-20 fps with an accuracy of ± 2%.

2.1.5.11. The instrument shall be manufactured in an ISO 9001 approved facility.

2.1.5.12. All materials in Contact with the water shall be NSF 61 certified.

2.1.5.13. Meter Primary Head shall be an Optiflux 2000 as manufactured by Krohne, Inc, or approved equal by Rosemount.

2.1.6 Magnetic Inductive Flow Converter

2.1.6.1. Magnetic Inductive Flow Converter shall be the compact housing version and shall be mounted to the flow meter and provide precisely controlled and regulated, bi-polar DC primary field excitation pulses which are digitally selectable at 12 different frequencies. The unit shall convert the primary flow meter signal into a standard linear 4-20 mA analog output directly proportional to the flow rate or flow total. The accuracy of the converter shall be 0.2% +/- 1mm/s of measured value for all flow velocities above 3 feet per second in the flow tube. The converter shall have empty pipe indication/stabilization standard.

2.1.6.2. The converter shall be capable of up to (4) inputs or outputs with selectable combinations of:

2.1.6.2.1. Standard 4-20 mA DC with HART

2.1.6.2.2. Totalized pulses

2.1.6.2.3. Frequency output of 0 – 10 kHz

2.1.6.2.4. Control Input

2.1.6.2.5. Alarm/Status Output

2.1.6.3. The full-scale measuring range shall be a configurable input in all standard engineering units as well as any user defined unit, and freely adjustable over a range from 1.0 to 40 ft/sec velocity.

2.1.6.4. Converter shall be capable of continuously monitoring all common modes of failure of magnetic inductive flow meters, verifying a 100% check of flow meter software and hardware components, 100% check of accuracy and linearity, and 100% check of process conditions that may adversely affect flow measurement uncertainty. The converter shall provide local display of detected errors, as well as the ability to assign any or all errors to outputs. All diagnostics shall be available on the standard HART communication protocol, PACTware or other bus protocol as specified.

2.1.6.5. The converter shall be microprocessor based and be completely interchangeable with other converters of the same type. The converter housing shall contain an EEPROM memory, saving the original calibration data, factory default configuration settings, and (2) user defined configuration setting profiles, which can be

uploaded to temporarily test configuration changes or re-configure replaced electronics. No auxiliary test meter or primary simulator shall be required for commissioning, zeroing, or interchanging of the flow converter. The converter shall have two independent counters, which are assignable as Positive, Negative or Sum totals. Counters shall be password protected to prevent unauthorized resetting. The counters shall maintain their accumulated values with power loss, and continue counting when power resumes. The converter shall be provided with local graphical display (back-lit white), 128 x 64 pixels with three separate display pages; pages 1 and 2 shall allow viewing from 1 to 3 lines of measured values (user assignable) in engineering units or with 0-100% bar graph. User selectable measurements (i.e. flow rate, counter 1 and/or 2 (+, -, or sum), diagnostics, etc.) on either display page and display line. Display page 3 shall show all diagnostics that are currently active or occurred since last acknowledgement. The top line of the display shall show the meter Tag Number as configured into the unit, as well as a graphical indication of errors detected.

2.1.6.6. Programming of the flow converter shall be accomplished without removing the glass cover via 4 optical keys or remotely with hand held HART terminal or with vendor and protocol independent PC configuration software; PACTware (Process Automation Configuration Tool) over HART or other bus protocols. Manufacturer shall provide necessary drivers (DTM's) at no additional charge.

2.1.6.7. Analog outputs shall have user configurable time constant of 0 to 100 seconds. User adjustable low flow cutoff to force readings to zero on decreasing flow and de-activate on increasing flow, settable from 0% to 20% of full-scale setting, with the decreasing flow setting < increasing flow setting (providing hysteresis). The converters basic input and output shall contain four I/O's:

2.1.6.7.1. (1) Analog mA output

2.1.6.7.2. (1) Pulse or Analog Frequency output

2.1.6.7.3. (2) Status outputs.

2.1.7 The basic outputs can be altered in the field by programming. All inputs / outputs shall be galvanically isolated from each other and all other circuits. The analog outputs can be assigned to represent any of the following measurements; Flow Velocity, Volume Flow Rate, Mass Flow Rate, Coil Temperature (indicative of process temperature), or Process Conductivity.

2.1.8 The converter shall have HART smart protocol as standard. Optionally the converter shall have Foundation Fieldbus or Profibus PA or DP protocols as required

2.1.9 The converter shall provide the ability to simulate flow rates, to verify analog output spans are correct in receiving devices. The converter shall self-test for over load or open circuits on the analog output and alarm if either condition exists. The converter shall provide the capability to test all inputs and outputs for proper operation to assist in commissioning. The converter shall self-test all variables that can affect magnetic inductive flow meters performance, and verify all variables are within tolerance, and alarm when measurements are uncertain, without the use of additional test equipment. Ten-year data retention during storage, without the need for auxiliary power.

2.1.10 The signal converter shall be manufactured in an ISO 9001 Facility.

2.1.11 Magnetic Inductive Flow Converter shall be an IFC 300 compact model manufactured by Krohne, Inc. or approved equal by Siemens, EMCO Flow Systems, Rosemount, or Endress+Hauser. Magnetic Inductive Flow Converter shall be manufactured by the same manufacturer as the primary flow head

2.2 Air Bubbler Level Instrument (Drain Pump Station): Each air bubbler system shall consist of two redundant air compressors, pressure regulator, rotameter with integral needle valve, differential pressure regulator, pressure transmitter, digital display, level indicating gauge, purge solenoids, tubing, fittings, and other appurtenances to make a complete working system. Bubbler system for the Drain Pump Station shall be suitable for an operating range in the wetwell to operate the pumping equipment as indicated on the drawings.

2.2.1 Air bubbler tube shall enter the pump station wetwell at locations indicated on the contract drawings and shall be accessible within the pump station wetwell in case such access shall be required. The bubbler tube at the Drain Pump Station shall also be easily removable from the pump station floor. The tube shall be constructed and installed so there is a positive stop for correct insertion depth and to prevent dropping into the pump station wetwell. The tube shall be securely mounted to prevent causal misadjustment. The tube shall be of sufficient rigidity, or have appropriate guides to prevent motion at the lower end which may affect accuracy.

2.2.2 The air compressor shall consist of a 1/3-HP motor driving a single-stage, oiless, piston type compressor; an intake air filter; 2-gallon capacity receiver tank; pressure gauge for receiver; adjustable pressure switch for compressor control; adjustable pressure switch for compressor control; adjustable pressure switch for receiver low pressure alarm; and automatic receiver drain. The receiver shall drain outside the panel. The compressor and receiver shall be located within the bubbler panel.

2.2.3 The pressure regulator shall reduce the air from the compressor to 10 psi (adjustable) for use by the bubbler.

2.2.4 The rotameter shall permit manual setting of air flow from 0-2 SCFH and shall indicate air flow through the bubbler.

2.2.5 The differential pressure regulator shall maintain a constant pressure drop across the rotameter needle valve to ensure constant air flow through the rotameter regardless of wetwell level.

2.2.6 The pressure transmitter shall supply an analog 4-20 mA level signal to the local digital display at the Drain Pump Station and the existing SCADA system.

2.2.7 The digital display shall provide level indication at the bubbler panel.

2.2.8 The level indicating gauge shall provide level indication at the pressure transmitter. This indication shall be a direct reading of air pressure independent of transmitter calibration.

2.2.9 The purge solenoids shall be used to periodically clean the bubbler tube. The purge system shall employ sufficient logic, timers, and solenoid valves to prevent any fluctuations in the level readout due to purging. The purge cycle shall be capable of initiation by time based, manual, and bubbler calibration fault signals.

2.2.10 All pneumatic system components shall be interconnected with flexible ⅜-inch virgin polyethylene tubing meeting the requirements of ASTM D 1693 for stress crack tests and ASTM D 635 for flammability tests. All fittings shall be ⅜-inch stainless steel properly sealed. Run polyethylene tubing from compressor to the bubbler panel and from the bubbler panel to the connection with bubbler dip tube in 1-inch rigid steel conduit (minimum). Run conduit with sweeping bends only. Bubbler drip tube inside the wetwell shall be ⅜-inch Type 316 stainless steel.

2.2.11 Provide a 1½-inch outside diameter by 12-inch long bubbler tube PVC pipe bell.

2.2.12 Each bubbler system shall require 12-volt DC power for operation. Power shall be supplied from a 120-volt AC power converter with a built-in backup battery.

2.2.13 Each bubbler system shall be housed in a rugged, lockable, watertight, dust-tight, corrosion resistant (self-certified NEMA 4X and IP65) enclosure. The enclosure shall include a carrying strap, wall mounting bracket, and a clear polycarbonate window for viewing the LCD and printer without opening the enclosure. An internal, easily replaceable, rechargeable desiccant canister shall keep the inside of the bubbler system free of moisture. The bubbler system shall be capable of operating in indefinite submergence and harsh environments without degradation to the enclosure or internal electronics. The bubbler system shall be enclosure mounted and integral to the Drain

Pump Station SCADA system as indicated on the drawings. Type 316 stainless steel mounting hardware shall be supplied.

2.3 Ultrasonic Level Instruments (Aerobic Digesters)

2.3.1 Ultrasonic level instrumentation shall be used for level sensing/indicating and equipment control purposes. Instrumentation loop shall be 4-20 mA. Loop loads shall be within the current source load capacity. The system shall consist of two components, a sensor and an indicator/controller/ transmitter.

2.3.2 The principle operation shall rely on touch-free measurement of the liquid level in a tank and the conversion of that measured variable into a signal directly proportional to level (in engineering units of inches or feet) for indication, transmission, and/or control as indicated.

2.3.3 Level measurement shall be accomplished by propagation of sonic or ultrasonic pulses by the sensor, and temperature compensated measurement of travel time of the pulses from the sensor to the liquid surface and back to the sensor.

2.3.4 The sensor shall have a corrosion resistant glass filled nylon body. The wet-side material shall be PVDF. The sensor shall be submersible (IP 66/67), and equipped with appropriate bracket and provisions for mounting the sensor in the designated locations.

2.3.5 The indicator/controller/transmitter shall have a NEMA 4X outdoor enclosure with readout viewing window and internal space heaters.

2.3.6 The transmitter shall be microprocessor based, field programmable and shall accept two sensor inputs. Output shall be 4-20 mA proportional to level.

2.3.7 Accuracy: $\pm$ 0.5% of span over a temperature range of -4° F to + 158° F.

2.3.8 System shall have zero and span adjustment capabilities. The unit shall have a preassembled multi-conductor cabling for connection of sensor to the indicator/controller/transmitter.

2.3.9 Ultrasonic sensor and transmitter shall be a Rosemount Model 3101 Ultrasonic level transmitter, or approved equal by Siemens.

2.4 Parshall Flume

2.4.1 The Parshall flume shall have a 30-inch throat width, with a flow capacity of up to approximately 20 MGD. The Parshall flume shall be as manufactured by Plasti-Fab, Inc., or approved equal by Tracom, Inc.

2.4.2 The flume shall be full length, molded fiberglass reinforced polyester laminated in one piece. The interior surface shall have a 10–15 mil white gelcoat backed by a resin rich layer of resin and chopped glass forming a water and chemical resistant surface. The remainder of the laminate shall be fiberglass reinforced polyester containing not less than 30% glass content by weight. The thickness of the walls and floor of the flume shall be not less than ¼-inch. Parshall flumes shall be reinforced with box section stiffeners down the sides and across the bottom. The stiffeners shall be joined together at the knee to form a rigid dimensionally stable flume. The flume shall be free standing, strong enough to hold a 30-inch depth of water without visible distortion. Locking clips shall be fastened along the side of the flume for anchorage into the reinforced concrete channel.

2.4.3 Stiffeners across the top and end shall be 2-inch (minimum) permanent FRP pultruded angle/channel spreaders, and shall provide sufficient strength and structural support to resist the stresses that occur during shipping and proper installation of the flume. The flume shall be provided with a bubbler cavity containing a ¼-inch O.D. Type 304 stainless steel bubble pipe held in place by stainless steel fasteners.

2.4.4 Parshall flumes shall be equipped with a molded-in head gauge graduated in 0.01-foot increments. The scale shall be graduated in 0.05-foot increments, with ¾-inch high black numerals shown at 0.1-foot increments.

2.4.5 Physical properties shall be as follows:

2.4.5.1. Tensile Strength (ASTM D 638): 14,000 psi

2.4.5.2. Flexural Strength (ASTM D 790): 27,000 psi

2.4.5.3. Flexural Modulus (ASTM D 790): 1×10^6 psi

2.4.5.4. Barcol Hardness (ASTM D 2583): 50

2.4.5.5. Percent Elongation: 1.65%

2.5 Air Bubbler Flow Meter/Transmitter (Parshall Flume)

2.5.1 The flow meter shall accurately measure flow through a 30-inch Parshall flume under open channel, free flow conditions. The flow meter shall be a transmitter/data-logger. The flow meter operation shall be unaffected by temperatures in an ambient temperature range of –14 to 150ºF. The flow meter shall be a Model 4230 Bubbler Flow Meter manufactured by Teledyne ISCO, or approved equal.

2.5.2 A pressure transducer in the flow meter shall measure the liquid level. An internal air compressor shall provide a continuous supply of air to the bubble tube. A stainless steel bubble tube shall be supplied for installation in the

flow stream. The flow meter shall include automatic bubble line purge to minimize plugging of the bubble tube.

2.5.3 The level measurement range of the bubbler shall be from 0.01–10 feet. The level shall be measured with a maximum error of ±0.005 feet over a range of 0.01–1.0 feet, ±0.010 feet over a range of 0.01–5.0 feet, and ±0.035 feet from 0.01–10 feet. The temperature coefficient shall be ±0.0003 times the level in feet times the temperature change from 77ºF over the compensated temperature range of 32–140ºF.

2.5.4 The flow meter shall include automatic drift compensation to periodically reference both sides of the transducer to atmospheric pressure and automatically compensate for errors due to temperature, warm-up and long-term drift. After a 5-minute warm-up period, automatic drift compensation shall correct the zero level to ±0.002 feet at intervals between 2 and 15 minutes.

2.5.5 Measured liquid level readings shall be converted into corresponding flow rate readings using internal conversion algorithms. The flow meter shall contain conversions for Parshall flumes. The design flow range of the system shall be 0-20 MGD. The flow meter shall accept 4 sets of level-flow rate points, with up to 50 pairs of points in each set. The flow meter shall accept a two-term, level-flow rate polynomial equation.

2.5.6 The flow meter shall contain a tactile keypad and a 2-line, 80 character, backlit alphanumeric liquid crystal display (LCD). The LCD shall visually prompt the user through the programming sequence. The LCD shall display level, flow rate, and total flow. The totalizer on the LCD shall be resettable; a non-resettable, mechanical totalizer shall also be provided for the flow meter. The LCD shall display the signal strength from the air bubbler sensor to aid in installation and troubleshooting.

2.5.7 The field selectable units of measurement shall be as follows:

2.5.7.1. Level: Inches

2.5.7.2. Flow Rate: Million gallons per day (MGD)

2.5.7.3. Total Flow: Gallons

2.5.8 The internal data storage memory in the flow meter shall have a capacity of 80,000 bytes, divided into up to 12 user-defined partitions. Each partition shall be programmable to store level and flow rate. Timing for the data storage shall be selectable in 1, 2, 5, 10, 15, 30, 60, or 120-minute intervals. Each partition shall be programmable to operate in either rollover, slate or triggered slate mode. Triggering events in slate mode shall be selectable from level and flow rate. The internal data storage memory in the flow meter shall be programmed using a software program on an IBM personal computer. The software shall also retrieve stored data from the flow meter,

and generate graphs and reports from the stored data. The computer shall communicate with the flow meter using a direct RS-232 connection.

2.5.9 The flow meter shall include three internal isolated analog outputs. Each output shall be programmable to output level, flow rate, pH or dissolved oxygen, temperature, or pH, dissolved oxygen, conductivity, or temperature. The analog outputs shall be programmable to output 4–20 mA signal, which shall be transmitted to the existing SCADA system. The outputs shall be averaged on a programmable time interval of 0, 15, 30 or 60 seconds. The flow meter shall allow the analog outputs to be manually controlled to test the operation of connected equipment.

2.5.10 The flow meter shall have 2 form C relays with user-selectable trip points based on flow rate.

2.5.11 The flow meter shall have an RS-232 serial output to transmit information on all of its current readings. The data on the serial output shall be in ASCII format with values separated by commas. The serial output shall be at 1,200, 2,400, 4,800 or 9,600 baud. The flow meter shall output this data in response to the reception of a command on the serial port. The flow meter shall also be programmable to automatically transmit this data on a periodic time interval. The data shall include the flow meter description, identification number, model number, date and time, battery voltage, level, flow rate, total flow, and a checksum.

2.5.12 The program memory in the flow meter shall be non-volatile, programmable flash memory. The program memory shall be capable of being updated via the serial port on the flow meter without opening the enclosure.

2.5.13 The flow meter shall require 12-volt DC power for operation. Power shall be supplied from a 120-volt AC power converter with a built-in backup battery.

2.5.14 The flow meter shall be housed in a rugged, lockable, watertight, dust-tight, corrosion resistant (self-certified NEMA 4X and IP65) enclosure. The enclosure shall include a carrying strap, wall mounting bracket and a clear polycarbonate window for viewing the LCD and printer without opening the enclosure. An internal, easily replaceable, rechargeable desiccant canister shall keep the inside of the flow meter free of moisture. The flow meter shall be capable of operating in indefinite submergence and harsh environments without degradation to the enclosure or internal electronics. The flow meter shall be enclosure mounted adjacent to the Parshall Flume Chamber as indicated on the drawings. Type 304 stainless steel mounting hardware shall be supplied.

3 EXECUTION

3.1 General

3.1.1 Install instruments in accordance with manufacturer's recommendations.

3.1.2 All instruments shall be grounded in accordance with the National Electrical Code.

3.2 Magnetic Flow Meter

3.2.1 Install Magnetic Inductive Flow Meter and Signal Converter in strict accordance with the manufacturer's requirements and details shown on the drawings.

3.2.2 Install flow elements with straight unobstructed pipe runs upstream and downstream in accordance with the manufacturer's recommendations.

3.3 Performance Tests: Provide the services of the manufacturer's experienced engineers to perform testing of the equipment as installed. During the tests, all manufacturer's integrated design equipment shall be tested under every condition of operation, and all controls shall be tested to demonstrate performance of the required function. All adjusting and balancing shall be completed to the satisfaction of WW Associates. Warranty on adjustment of controls shall extend one (1) year after the system is put into operation. All defects in the work and equipment shall be corrected by the Contractor at his own expense and the test repeated until proven satisfactory. Manufacturer shall supply a technician to startup the equipment and provide training for three (3) consecutive days on-site following equipment installation.

3.4 Startup: Follow the manufacturer's recommended startup procedures and demonstrate to the Owner that the equipment is performing as specified in this section.

End of Section

Section 13700
Basic Instrumentation and Control Systems Requirements

1 GENERAL

1.1 Description:

1.1.1 The 13700 of specification sections provide the contract requirements for the purchase of instrumentation and controls equipment and are not intended to cover all the normal appurtenances. The Contractor shall provide working systems complete with all appurtenances to make the systems fully operable.

1.1.2 Control voltage shall not exceed 120 volts unless indicated otherwise.

1.1.3 Material, equipment, and installation shall meet requirements of applicable codes and standards. Electrical material and equipment shall bear the UL label except where UL does not label such types of material and equipment.

1.2 Quality Assurance

1.2.1 Provide the services of a single instrumentation and controls (IC) Contractor to furnish the specified equipment. The IC Contractor shall have the full in-house capabilities and personnel to design, fabricate, program, install, calibrate, start up, and troubleshoot all control and instrumentation equipment without subcontracting or otherwise involving any temporary or non-staff personnel. The IC Contractor shall be as follows:

1.2.1.1 E-Merge Systems, Inc./GrayMatter
11047 Pierson Drive, Unit D
Fredericksburg, VA 22408
Telephone: (804) 344-3511
Fax: (800) 608-6039

2 PRODUCTS: Not Used.

3 EXECUTION: Not Used.

End of Section

Section 13701
Data Submittals

1 GENERAL

1.1 Submittals: Provide the following in a timely manner in accordance with the approved submittals schedule as specified in Section 01400 – General Requirements.

1.1.1 Manufacturer's Data: Within 30 days after award of contract, submit manufacturer's data in one coordinated package for approval by WW Associates.

1.1.1.1 Submit data on each device to be installed. Data submitted shall be one Adobe Acrobat PDF copy of the manufacturer's original catalog sheets. Xerox or similar copies will not be accepted.

1.1.1.2 Arrange the submittals in the same sequence as these specifications and reference at the upper right-hand corner the particular specification section and paragraph number for which each submittal is intended. Place tab sheets between the devices specified in different specification sections. Submittals for each manufactured item shall be manufacturer's descriptive literature (equipment specification), equipment drawings, diagrams, performance and characteristic curves, and catalog cuts and shall include the manufacturer's name, trade name, catalog model or number, nameplate data, size, layout dimensions, capacity, specification reference, and all other information necessary to establish contract compliance.

1.1.2 Test Documents

1.1.2.1 Test Plan: Within six months of award of contract, submit test plan to WW Associates for approval. The test plan shall define the scope of tests required to ensure that the system meets all applicable specifications.

1.1.3 Operation and Maintenance Manual: 30 days prior to project closeout, submit one copy of the manual in Adobe Acrobat PDF format for review by WW Associates.

1.1.3.1 The manual's identification shall be inscribed on the cover.

1.1.3.2 The manuals shall include the names, addresses, and telephone numbers of each subcontractor installing equipment and systems and of the local representatives for each item of equipment and each system.

1.1.3.3 The manuals shall have a table of contents and be assembled to conform to the project manual table of contents with the tab sheets placed before instructions covering the subject. Additionally, each manual shall contain a comprehensive index of all manuals submitted in accordance with this paragraph.

1.1.3.4 Manuals and specifications shall be furnished which provide full and complete coverage of the following subjects:

1.1.3.4.1 Operational Requirements: This document shall describe, in concise terms, all the functional and operational requirements for the system.

1.1.3.4.2 Maintenance: Documentation of all user-performed maintenance on all system components including inspection, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective units. This shall include calibration, maintenance, and repair of all sensors and controls, plus diagnosis and repair or replacement of all system hardware.

1.1.3.5 The Owner shall receive one Adobe Acrobat PDF copy and five loose-leaf bound, paper copies of the final approved manual 30 days prior to project closeout.

1.1.4 Spare Parts: 30 days prior to project closeout, submit a recommended list of spare parts.

1.2 Installation drawings shall be in accordance with Section 13702 – Installation Drawings.

2 PRODUCTS: Not Used.

3 EXECUTION: Not Used.

End of Section

Section 13702
Installation Drawings

1 GENERAL

1.1 References

1.1.1 Instrument Society of America (ISA) Publications

1.1.1.1 S5.1: Instrumentation Symbols and Identification

1.1.1.2 S5.4: Instrument Loop Diagrams

1.1.1.3 S51.1: Standard Process Instrumentation Terminology

1.1.2 National Fire Protection Association (NFPA)

1.1.2.1 NFPA 79: Electrical Standard for Industrial Machinery

1.2 Design Criteria

1.2.1 The contract documents include P&I diagrams and ladder diagrams, but not detailed installation drawings of the system. Items, such as ladder diagrams, cabinet layout, tubing runs, wiring, and conduit runs, have been left for design by the Contractor.

1.2.2 Provide installation drawings as specified herein to completely document the controls and instrumentation installation.

1.3 Drawing Requirements

1.3.1 Drawings shall consist of the following:

1.3.1.1 Floor plans, elevations, and sections of equipment and control spaces identifying and indicating proposed location, layout and arrangement of items of equipment, control panels, accessories, piping, permanent nameplate identification, wiring, conduit and any other items that must be shown to assure a coordinated installation. Drawings shall indicate required clearance for operation, maintenance, and replacement of operating equipment devices.

1.3.1.2 Integrated pneumatic, electric, and electronic control diagrams similar to the P&I diagrams in the contract documents except detailed to show all variations required due to the actual equipment being supplied. Diagrams shall conform to ISA Standard S5.1. Identify each run of pneumatic control tubing with a unique number.

1.3.1.3 Electrical control diagrams of the ladder type similar to those in the contract documents annotated to conform to NFPA 79, Appendix E. Due to variations among manufacturers, generalized diagrams of this type have been included in the contract documents. The installation drawings shall contain ladder diagrams for each motor and the like showing equipment exactly as it shall be installed. Diagrams shall clearly indicate location of each device. Field wiring shall be shown dotted, panel wiring solid. Each wire shall have a unique identification number. If the systems house does not have an established system resulting in uniquely numbered wires, the following system shall be used. Each wire number shall consist of five digits. The first two digits shall be the last two digits of the drawing number on which the wire is shown or originates. The second two digits shall be the ladder-rung number where the wire is shown or originates. The fifth digit shall be the number of the wire on a given rung numbered in a left to right sequence. Number each device terminal with manufacturer's terminal number.

1.3.1.4 Develop control logic to meet the requirements shown by the sequence of operation and ladder diagrams as well as the following:

1.3.1.4.1 Upon power failure, control logic shall fail in a safe mode. Where automatic startup after power failure might occur, logic shall be such that proper startup sequences are followed and all safeties are automatically checked and functional.

1.3.1.4.2 Upon power failure and upon restoration of power, no erroneous alarms shall be initiated.

1.3.1.4.3 During equipment startup and during and after shutdown, no erroneous alarms shall be initiated.

1.3.1.4.4 Arrange circuitry involving hand/off/automatic switches such that all safeties shall be functional when switch is in hand and automatic positions.

1.3.1.4.5 Arrange start/stop pushbutton circuits such that the start pushbutton is "sealed" by a normally open contact and the circuit shall not allow automatic restart of the motor upon return of power after a failure.

1.3.1.4.6 Provide time delay relaying to assure the motors are stopped so that no damaging acceleration or deceleration or abnormal inrush current occurs.

1.3.1.5 Instrumentation loop diagrams showing interconnecting wiring and tubing between primary elements, transmitters, controllers, recorders,

indicators, computational devices, decision devices, valves, and the like. Diagrams shall conform to ISA Standard S5.4. Due to variations among manufacturers, generalized diagrams of this type have been included in the contract documents. Installation drawings shall contain a loop diagram for each loop showing equipment exactly as it shall be installed. Field wiring shall be shown dotted, panel wiring solid. Number each device terminal with manufacturer's terminal number. Number wires using a system similar to that used for ladder diagrams.

1.3.1.6 Panel interior and exterior elevations and sections, conforming to NFPA 79, Appendix E.

1.3.1.7 Programmable controller logic diagrams shall be the ladder type conforming to NFPA 79, Appendix E. Further annotate logic diagrams by identifying input contacts with their P&I diagram tag numbers as well as their programmable controller input address number. In addition, identify outputs by the P&I diagram tag number of the final element controlled, as well as their programmable controller output address number. Provide a narrative of the logic in English-language text format.

1.3.2 Preparation of Drawings

1.3.2.1 Drawings shall be prepared on a CAD (computer-aided-drafting) system. System disks or tapes shall become the property of the Owner at project closeout. A copy of the disks or tapes may be retained by the systems house.

1.3.2.2 All available information that defines the scope of the work shall be included on the drawings. A complete legend of abbreviations and symbols and equipment schedules shall also be included on the drawings. Drawings shall be final and complete, with all elements thoroughly checked and coordinated with each other and with the specifications.

1.3.2.3 Equipment tag numbers shall be the same as those indicated on the contract drawings.

1.3.2.4 Drawing Format: The drawing format, style, and lettering shall be the same as the contract drawings. Every effort shall be made to avoid unnecessary detail, poor spacing, careless lettering, weak lines, and crowded drawings.

1.3.2.5 Media: Installation drawings shall be provided in Adobe Acrobat PDF format.

1.3.2.6 Sizes of Drawings: The drawings shall be 24 by 36 inches.

1.3.2.7 Scales: Located directly under the title of each plan, elevation, section, detail, etc., shall be an indication of the scale of the object drawn.

1.3.2.8 Arrangement of Drawings: Drawings shall be arranged in the following order:

1.3.2.8.1 Index

1.3.2.8.2 Floor plans

1.3.2.8.3 P&I diagrams

1.3.2.8.4 Ladder diagrams

1.3.2.8.5 Programmable controller logic diagrams

1.3.2.8.6 Loop diagrams

1.3.2.8.7 Panel interior and exterior elevations and sections

1.3.2.9 Lettering: The minimum size lettering, which includes all alphanumeric symbols used on all project drawings shall be not less than 0.10-inch.

1.3.2.10 Checking Drawings: All drawings shall be checked and coordinated before being submitted to eliminate conflicts, errors, or omissions.

1.3.2.11 Certification and Signatures: Each tracing shall, before final submission, be signed by a corporate member of the systems house.

1.3.2.12 Changes to Drawings: When changes are made to the drawings, appropriate change symbols shall be used to indicate the changes and the "revision" block of the sheet shall be completed with the required information, symbols, and dates.

1.3.3 Submittal Requirements

1.3.3.1 Sample Review Submittal: Submit concurrently with manufacturer's data one set of original size drawings in Adobe Acrobat PDF format for review by WW Associates. This submittal shall consist of P&I diagrams, ladder diagrams, and instrumentation loop diagrams.

1.3.3.2 Approval Review Submittal: Within six months after award of contract, submit one set of original size drawings in Adobe Acrobat PDF format for review by WW Associates. Drawings shall be complete. Review does not constitute approval or acceptance of any variations from the contract documents unless such variations have been specifically pointed out in writing by the Contractor and specifically approved in writing by WW Associates.

1.3.3.3 Certified for Construction Submittal: After the changes required as a result of the approval review have been made to the original drawings, submit to WW Associates one original size set of drawings in Adobe Acrobat PDF marked "Certified for Construction."

1.3.3.4 As-Built Submittal: Prior to project closeout, update drawings to reflect "as-built" conditions. Mark drawings "As-Built," and submit in Adobe Acrobat PDF format to WW Associates. All drawings shall become the property of the Owner.

1.3.4 Work shall not be started until the "Certified for Construction" drawings have been issued by the Contractor.

2 PRODUCTS: Not Used.

3 EXECUTION: Not Used.

End of Section

Section 13703
Installation and Startup

1 GENERAL

1.1 Calibration instrumentation shall have been certified within 6 months of the date of use to have an accuracy 50% greater than the device being calibrated.

2 PRODUCTS

2.1 Nameplates shall have the following features:

2.1.1 Constructed from black laminated phenolic with a white center core sandwiched between two black strata.

2.1.2 Engraved to form white letters ⅜-inch high.

2.1.3 Mounting holes at each end to accept screw fastener.

2.2 Brass tags shall have the following features:

2.2.1 Minimum gauge: 16

2.2.2 Minimum dimensions: ¾-inch by 1½ inches

2.2.3 Stamped to form permanent letters minimum 0.10-inch high

2.2.4 Hole to receive cable tie

2.3 Cable ties shall have the following features:

2.3.1 Steel strapping coated with nylon

2.3.2 One-way detent head

2.3.3 Acceptable manufacturer and type: Thomas & Betts, Ty-Wraps

3 EXECUTION

3.1 Factory hardware/software validation test requirements

3.1.1 Connect the programmable logic controller to an I/O mimic panel to verify that hardware is fully operational and that programming logic is correct in accordance with P&I diagrams, I/O ladder diagrams, and Section 13709 - Sequence of Operation.

3.1.2 I/O mimic panel shall be equipped with the following I/O devices:

3.1.2.1 SPST switches for each binary input

3.1.2.2 Indicating light for each binary output

3.1.2.3 Current generator for each analog input

3.1.2.4 Milliammeter for each analog output

3.1.3 All hardware or programming problems shall be corrected prior to installation in field.

3.1.4 Conduct testing in the presence of a representative of WW Associates. Notify WW Associates 15 days in advance of testing.

3.2 Installation

3.2.1 Coordination for installation of instrumentation and controls

3.2.1.1 Coordinate instrumentation and controls work with the mechanical equipment suppliers regarding recommendations for proper installation of sensing devices in piping, ductwork, breeching, vessels, boilers, and the like. Size and select all sensors and primary signaling devices such as flowmeters, temperature sensors, pressure sensors, orifices, orifice flanges, pressure taps, and the like. Provide instructions for the proper installation of equipment, such as maintaining proper upstream and downstream straight-run dimensions on piping to receive orifices for flowmeters. Size and select all final control elements such as dampers, valves, and the like.

3.2.1.2 Where instrumentation or controls or both are called for on one drawing, but are not shown on another, they shall be provided. Where a device is specified but not shown on a drawing, it shall be provided.

3.2.2 Electrical and Electronic

3.2.2.1 Field devices, wiring, and conduit have not been shown in the contract documents in plan view. Device location shall be determined from the P&I diagrams and the mechanical and electrical drawings.

3.2.2.2 Field wiring requirements shall be determined from the installation drawings. Provide all required field wiring.

3.2.2.3 Shielded cables: Identify each cable at each splice and termination using the wire numbers assigned on the installation drawings.

3.2.2.4 Nonshielded Wires: Identify each wire at each splice and termination using the wire numbers assigned on the installation drawings. Wiring from each terminal at each field-mounted device shall be run from the

device back to its associated panel and all interconnecting splicing shall be done in the panel.

3.2.3 Support field devices which are not inherently self-supporting using floor stands, pipe brackets, wall brackets, or other suitable devices of stainless steel, aluminum, or both. Do not support devices from vibrating equipment or equipment operating at temperatures outside the limits of the device.

3.2.4 All devices shall be readily accessible.

3.2.5 Provide access doors for concealed equipment requiring periodic inspection, servicing, or maintenance where such equipment is located above non-removable ceilings or behind walls. "B" label doors shall be used where installed in fire partitions.

3.2.6 Painting: Touch up or repaint completely equipment on which factory paint has been damaged.

3.3 Calibration

3.3.1 Flow Instruments

3.3.1.1 Follow the manufacturer's recommended checkout procedure for all flow meters. Calibrate at a minimum of four points: 25%, 50%, 75%, and 100%.

3.3.2 Level Instruments

3.3.2.1 Calibrate sonic/ultrasonic level transmitters by artificially providing various levels of liquid in the measured vessel.

3.3.2.2 Verify float switch action by manually stroking the float. Check appendage connected to the float arm for freedom of operation.

3.3.2.3 All level instruments not listed above shall be calibrated using the manufacturer's recommended procedure.

3.3.3 Receiver Instruments (Indicators, Recorders, and Controllers)

3.3.3.1 Connect pens to a calibration source. Check calibration at five points: 10%, 25%, 50%, 75%, and 100% span.

3.3.3.2 Verify the operability of the chart drive(s).

3.3.3.3 Check full span of each controller manual output signal.

3.3.3.4 Verify the output action of each controller is correct.

3.3.3.5 Verify proper operation of burnout feature of temperature instruments having same.

3.3.3.6 Calibrate computational devices at five points. Use the manufacturer's instruction manual as a guide for selecting calibration points.

3.3.3.7 Calibrate decision devices using the manufacturer's instruction manual as a guide.

3.3.3.8 Tune controllers to minimize correction time, overshoot, oscillation, offset, and the like.

3.3.4 Control Valves

3.3.4.1 Inspect control valves to ascertain that they conform to the valve nameplate. Verify the following points prior to installation:

3.3.4.1.1 Valve body and trim materials of construction

3.3.4.1.2 Body size and type; trim size and type

3.3.4.1.3 Valve connection size and type

3.3.4.1.4 Valve action

3.3.4.1.5 Travel direction indicator installed correctly

3.3.4.2 Stroke the valve its entire length. Adjust the actuator spring compression as required. Check valve to insure that it shuts off tight when the appropriate signal is applied to the actuator.

3.3.4.3 If valve positioner or volume booster is installed on the valve, calibrate per manufacturer's procedure. Check split range positioners to verify proper operation.

3.3.4.4 Calibrate control valves designed to be self-contained regulators per manufacturer's recommended procedure.

3.3.4.5 Check control valves that are actuated by mechanical linkage for freedom of operation. Stroke fullstroke to verify travel.

3.3.4.6 Test self-contained temperature regulators with sealed, external thermal system by applying temperature to verify correct temperature range and control action.

3.4 Tests

3.4.1 Furnish calibrated testing equipment and competent, experienced testing engineers who shall conduct operating and performance tests for each system specified.

3.4.2 Test instruments shall be calibrated prior to tests.

3.4.3 Coordinate tests with requirements of other sections of the specifications.

3.4.4 Prior to conducting formal tests, operate systems and equipment for at least seven days.

3.4.5 Conduct formal tests in presence of WW Associates' representative to demonstrate that all contract requirements are met. These tests shall include performance tests for all equipment and operating tests for systems.

3.4.5.1 Malfunction in any tested system or piece of equipment or component part thereof that occurs before, during, or as a result of tests shall be corrected, repaired, or replaced at no additional cost and the tests repeated in the presence of WW Associates' representative.

3.4.5.2 Further malfunctions shall be similarly repaired and test shall be repeated in the presence of WW Associates' representative.

3.4.6 If completion of an environmental control system occurs during a season when final control settings and adjustments cannot be properly made to make a performance test, then such final control settings and adjustments shall be made during first actual season of use.

3.5 Nameplates

3.5.1 Install a nameplate on front of panel, beneath each front of panel-mounted device unless device has an integral nameplate. Engraving shall be device name on top line(s) followed by P&I diagram tag number on last line.

3.5.2 Install a nameplate on back of panel front, beneath each front of panel-mounted device. Engraving shall be P&I diagram tag number.

3.5.3 Install a nameplate on interior subpanel, beneath each inside of panel-mounted device. Engraving shall be P&I diagram tag number.

3.5.4 Fasten nameplates with screws or a nonadhesive type fastener.

3.6 Brass Tags

3.6.1 Install a brass tag on each field-mounted device.

3.6.2 Stamping shall be device name on top line(s) followed by P&I diagram tag number on last line.

3.6.3 Attach brass tags to associated devices using cable ties.

End of Section

Section 13704
Training

1 GENERAL

1.1 Provide the services of instructors who will give full instruction to designated personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the equipment and system specified.

1.1.1 The training shall be oriented toward the system installed rather than being a general (canned) training course.

1.1.2 Instructors shall be thoroughly familiar with all aspects of the subject matter they are to teach.

1.1.3 The number of person-days (8 hours) of instruction furnished shall be as specified below as a minimum. The training week shall be 40 hours, 8:00 A.M. to 12:00 noon and 12:30 P.M. to 4:30 P.M., Monday through Friday. A training day is defined as 8 hours of instruction, including two 15-minute breaks and excluding lunchtime.

1.1.4 A training manual shall be provided for each trainee which describes in detail the data included in each training program. It shall include, but not be limited to, all manufacturer's data, installation drawings, and operation and maintenance manuals. Provide one manual for each student in addition to those required in Section 13701 - Data Submittals. The Contractor shall provide all equipment and material required for classroom training.

1.1.5 The training program shall be accomplished in three phases for the time interval specified for each phase.

1.1.6 Training shall be geared toward maintenance personnel who have a maximum of 2 years community college, and technical backgrounds in pneumatic, hydraulic, and electric system operation and maintenance.

1.1.7 Training shall take place in an air-conditioned, well-lighted classroom. Location of the training classes shall be determined by the Owner.

1.2 Submittals: Provide the following in a timely manner in accordance with the approved submittals schedule as specified in Section 01400 - General Requirements.

1.2.1 Training manuals for approval by WW Associates.

1.2.2 Resumes of instructors as part of the training manuals.

1.3 Fundamentals of Process Control

1.3.1 As a result of attending this phase of study, the student shall understand the basic principles of automatic control, the function and principles of operation of typical process instruments, and how instruments are applied to the basic problems of measurement and control.

1.3.2 This training shall be a 1-day entry-level course for three men dedicated to the practical understanding of the basics of measurement and control. The course shall concentrate on fundamental principles common to all instruments and control systems regardless of the manufacturer. The basic feedback control loop shall be used to introduce the various devices for measuring and controlling process variables from a functional standpoint. The basic operating principles of these instruments shall be stressed, as well as the contribution each makes to overall loop operation. Process characteristics and criteria for controller selection shall be introduced. Flow diagrams, using ISA symbols, shall be utilized to present examples for discussion.

1.3.3 This training shall have as a minimum:

1.3.3.1 Introduction to process control including process descriptions, explanation of the need for control, and components of a basic control loop

1.3.3.2 Measurement of process variables including measurement principles, temperature, pressure, flow and liquid level measurements, primary elements, process variable transmitters, and recording and indicating devices

1.3.3.3 Control of process variables including principles of automatic control, the modes of control, three-mode control demonstration, and classical pneumatic control theory

1.3.3.4 Final control elements including electronic devices and pneumatic valves

1.3.3.5 How to obtain good control, including process characteristics, process responses, and tuning controllers

1.3.3.6 Control loop configurations including process flow diagrams and ISA symbols and identification

1.3.3.7 Electronic transmitters including pressure, differential, and transducers (I/P and P/I)

1.3.3.8 System components including indicating controllers, manual loading stations, panel indicators and recorders, single pen instruments, multipoint instruments, computational devices, decision devices, and the like

1.3.3.9 Wiring concepts (shielding and routing)

1.3.3.10 Auxiliary units including signal conditioners, computation devices, and signal selectors

1.3.3.11 Maintaining instruments including calibration standard, instrument alignment and adjustments, and instrument calibration procedures

1.3.3.12 Servicing systems including control loop analysis, troubleshooting techniques, and isolating instrument malfunctions

1.3.3.13 Recorder maintenance including gain and damping adjustments, instrument alignment, mechanical adjustments, and calibration procedures

2 PRODUCTS: Not Used.

3 EXECUTION: Not Used.

End of Section

Section 13705
Maintenance

1 GENERAL

1.1 Description of Work: The Contractor shall provide all services, materials, and equipment necessary for the maintenance of the entire control and instrumentation system for a period of one (1) year concurrent with the warranty period. Material required for the maintenance work shall be provided by the Contractor.

1.2 Service Personnel: Service personnel to maintain the installed controls and instrumentation system shall be factory trained and have a minimum of three (3) years working experience.

1.3 Inspections: The Contractor shall provide one minor inspection per quarter and two major inspections per year. Major inspections shall be scheduled in the 6th and 12th month of the warranty period.

1.3.1 Minor inspections shall include the following: visual inspection of each system to verify that all loops are operating properly.

1.3.1.1 Check of each binary device to assure proper operation.

1.3.1.1.1 Apply heat or cold to each temperature switch (freezestats and firestats only) and verify operation. Verify operation of associated temperature alarm when they exist.

1.3.1.1.2 Start and stop each pump and fan and verify proper operation of associated differential pressure switch. Disconnect hot wire of associated starter and verify that status alarm occurs when they exist.

1.3.1.1.3 Exercise each position switch and verify that status alarm occurs when they exist.

1.3.1.2 Visually inspect all analog devices for proper operation.

1.3.1.3 Record elapsed time on each motor.

1.3.1.4 Test annunciator lamps and horns.

1.3.2 Major inspections shall include the following:

1.3.2.1 Minor inspection

1.3.2.2 Check and calibrate or adjust, as applicable, each binary device. Check shall be as specified for minor inspection.

1.3.2.3 Check and adjust analog device span and zero calibration against test instrumentation with a certified accuracy of 50% greater than the displayed or logged output variable of the network.

1.3.2.4 Tune controllers

1.4 Programmable controller equipment shall be serviced in accordance with the manufacturers' recommendations.

1.5 Emergency Service: The Owner will initiate service calls when there is indication that the system is not functioning properly. The Contractor shall have qualified control personnel available during the contract period to provide service to the control system components whenever required at no additional cost to the Owner. The Contractor shall furnish a telephone number where the service mechanic can be reached at all times. The service mechanic shall be on the job ready to service the control system within 24 hours or the next working day, whichever is greater, after receiving a request for service, and the work shall be prosecuted continuously until the control system is back in reliable operating condition.

1.6 Operation: The performance of the foregoing noted items and all other services required shall provide proper sequencing of the equipment and satisfactory operation of the control and instrumentation system based on original design conditions and as recommended by the manufacturer.

1.7 Records and Logs: Records and logs shall be kept of each maintenance task. Cumulative records for each component and for the complete aggregate system shall be organized chronologically. Forms shall be completed and submitted monthly to the Owner by the 10^{th} day of the succeeding month indicating that planned and systematic maintenance has been accomplished for the control and instrumentation system.

1.8 Work Requests: Each service call request, when received, shall be separately recorded on an approved form. The form shall include the P&I diagram tag number and manufacturer's serial number identifying the component involved; its location; date and time the call was received; nature of trouble; names of the Contractor's employee(s) assigned to the task; instructions as to what is to be done; the amount and nature of the materials to be used; the time and date work started; time and date of completion; and a space for the Owner to indicate approval or further corrective action where found necessary. The Owner shall receive, within 5 days after work is accomplished, a record of the work performed.

1.9 System Modification: Recommendation for system modification shall be provided in writing to the Owner. No system modification, including operating parameters and control settings, shall be made without prior approval by the Owner.

2 PRODUCTS: Not Used.

3 EXECUTION: Not Used.

End of Section

Section 13709
Sequence of Operation

1 GENERAL

1.1 Summary

1.1.1 This section is intended to provide the following:

1.1.1.1 General description of Lab PLC Control Panel and SCADA operation.

1.1.1.2 Description of the control strategies and alarming to assist with the software development for the unit processes specified herein.

1.1.1.3 A description of the intended configuration of the wastewater treatment plant equipment to identify the requirements for equipment connected to and controlled by the existing Lab PLC Panel.

1.1.2 The Contractor shall provide the services of an instrumentation and controls (IC) Contractor as specified in Section 13700 – Basic Instrumentation and Control Systems Requirements to provide the specified control panel equipment and software programming for the wastewater treatment plant controls and SCADA system.

1.1.3 Field devices and applications programming for the programmable logic controller (PLC) and operator interface terminal (OIT) will be provided by the IC Contractor.

1.2 Related Requirements: The following sections contain requirements that relate to this section.

1.2.1 Section 11300 – Wastewater Pumping Equipment

1.2.2 Section 11301 – Sludge Pumping Equipment

1.2.3 Section 11310 – Self-Cleaning Mechanical Filter Screen

1.2.4 Section 11320 – Septage Receiving Station Equipment

1.2.5 Section 11330 – Aerobic Digester Equipment

1.2.6 Section 13700 – Basic Instrumentation and Control Systems Requirements

1.2.7 Section 13701 – Data Submittals

1.2.8 Section 13702 – Installation Drawings

1.2.9 Section 13703 – Installation and Startup

1.2.10 Section 13704 – Training

1.2.11 Section 13705 – Maintenance\

1.2.12 Section 264820 – Variable Frequency Drives

1.3 Control Philosophy

1.3.1 The existing Control Panel (Lab PLC) shall house a programmable logic controller (PLC), operator interface panel (OIT), and other operator interface devices necessary for controlling the wastewater treatment plant equipment. The Control Panel shall include all I/O indicated on the P&I diagrams and all other devices required to make a complete and useable communication/monitoring and control network.

1.3.2 The PLC will perform the control logic and shall accommodate the Input/Output (I/O) signals described herein.

1.3.3 The existing Lab PLC shall be upgraded by the IC Contractor to include the necessary accessories to allow it to serve as the SCADA system for the Town of Culpeper's new and existing Wastewater Treatment Plant. The Control Panel is located in the WWTP Laboratory.

1.4 References: Instrument Society of America (ISA) Publications

1.4.1 S5.1 Instrumentation Symbols and Identification

1.4.2 S5.4 Instrument Loop Diagrams

1.4.3 S51.1 Standard Process Instrumentation Terminology

1.5 The following new sequences of operation are provided to assist the Contractor to familiarize himself with the control logic required to operate, monitor, and control the following wastewater treatment processes at the Town of Culpeper Wastewater Treatment Plant:

1.5.1 Mechanical screening and screenings washers/compactors (see Section 11310)

1.5.2 Influent flow monitoring at Parshall flume chamber

1.5.3 Drain Pump Station (see Section 11300)

1.5.4 Septage Receiving Station (see Section 11320)

1.5.5 Owner-furnished Centrifuge No. 1 with PLC-equipped control panel

1.5.6 Existing Centrifuge No. 2

1.5.7 Owner-furnished polymer solution feed systems for centrifuges

1.5.8 Blowers for Aerobic Digester Nos. 1, 2, 3, and 4 (see Section 11330)

1.5.9 Waste sludge, waste septage, and centrifuge feed pumps

The sequence of operation presented herein is not intended to be all inclusive.

1.6 Existing Conditions

1.6.1 The existing SCADA system for the Town of Culpeper's Wastewater Treatment Plant uses the Rockwell Automation's Factory Talk View SE 9.00.00 (CPR9 SR9) to monitor the facility input/output (I/O) through PLCs, I/O blocks, and process controllers. All I/O is available information on computer screens at the SCADA computer. All PLCs shall be provided with operator interface units for monitoring and control. All alarm functions initiated shall be linked to the existing SCADA system. The existing SCADA system is equipped with an autodialer to transmit status alarms to a remote location, as well as allow monitoring of alarm functions from a remote location.

1.7 Computer Screens for Operator Interface Terminals

1.7.1 Computer screens shall be designated by the IC Contractor and shall include multiple screens for each wastewater treatment plant unit process specified herein and as shown on the contract drawings.

1.7.2 Screens shall be available at each PLC Operator Interface Terminal and at the SCADA Computer.

1.7.3 Computer screens shall be programmed using Rockwell Automation Factory Talk View SE 9.00.00 (CPR9 SR9) software.

1.7.4 Each screen shall present equipment details, and all I/O indicated on the drawings and as specified herein. All screens shall be submitted to WW Associates for review and approval. The IC Contractor shall make all revisions requested by WW Associates prior to programming.

1.8 New Conditions

1.8.1 The Lab PLC/SCADA computer will become the communication hub for this project. Certain functions will need to be modified by the I&C Contractor to accommodate these revisions. These revisions are described as follows.

1.8.2 Mechanical Screening: The mechanical screens and screenings washers/compactors shall be equipped with a local control panel to operate the screening equipment. This panel is specified with the mechanical screening equipment. Status alarm monitoring shall be provided by the existing Headworks SCADA PLC. The screening equipment status

monitoring and alarm functions shall be relayed on the existing data highway to the Lab PLC

1.8.3 Drain Pump Station: The Drain Pump Station is already connected to the data highway. The pump station controls shall be interfaced with the existing SCADA PLC relocated in the new Drain Pump Station Electrical Building. Pump monitoring and control functions will not materially change, but the new pumps will need to be retagged and labelled in this new configuration. Status alarm monitoring shall be provided by the relocated SCADA PLC. The relocated SCADA PLC shall be reconnected to the data highway to relay Drain Pump Station status monitoring and alarm functions to the Lab PLC.

1.8.4 Septage Receiving Station: The septage receiving station shall be equipped with a local control panel to operate the equipment. This panel is specified with the septage receiving station equipment. Status alarm monitoring shall be provided by the PLC in the new centrifuge control panel. The septage receiving equipment status monitoring and alarm functions shall be relayed on a new data highway to the Lab PLC.

1.8.5 Aerobic Digester Nos. 1 and 2: Two existing anaerobic digesters are being converted to Aerobic Digester Nos. 1 and 2. Three new blowers with a local control panel are being constructed in the Digester Control Building. A new data highway shall be constructed from the local control panel to the owner-furnished Centrifuge PLC. Blower monitoring and control functions shall be as specified herein. Modify the Lab PLC and SCADA computer accordingly.

1.8.6 Aerobic Digester Nos. 3 and 4: Existing Secondary Clarifiers A and B are being converted to Aerobic Digester Nos. 3 and 4. Three new blowers with a local control panel are being constructed at the Blower Station adjacent to the digesters. A new data highway shall be constructed from the local control panel to the owner-furnished Centrifuge PLC. Blower monitoring and control functions shall be as specified herein. Modify the Lab PLC and SCADA computer accordingly.

1.8.7 RAS Pump Station No. 1: RAS Pump Station No. 1 is being demolished in its entirety to construct the Blower Station associated with Aerobic Digester Nos. 3 and 4. The Contractor shall provide a communications manhole at this approximate location and associated wiring, conduit, pull boxes, etc. to maintain the instrumentation loop for the existing SCADA system.

1.8.8 Owner-Furnished Centrifuge No. 1: The centrifuge control panel with PLC shall be provided by the centrifuge manufacturer as part of the owner-furnished centrifuge package. The centrifuge PLC shall also contain the aerobic digester blower and level status information (Contractor installed) described herein. Status and alarm functions shall be provided with a data highway to the Lab PLC.

1.8.9 Existing Centrifuge No. 2: The existing centrifuge control panel with its Allen-Bradley SLC 5/05 PLC shall be relocated as shown on the contract drawings. A new data highway shall be constructed to the relocated panel and connected to the existing highway serving Centrifuge No. 2. Centrifuge monitoring and control functions will not materially change following control panel relocation.

1.9 PLC monitoring and control functions shall include, but not be limited to, the following:

1.9.1 Flow indication, recording, and totalizing for flow meters at the following locations

1.9.1.1 Parshall flume chamber

1.9.1.2 Septage Receiving Station

1.9.1.3 Waste Primary Sludge Pumps

1.9.1.4 Waste Septage Pumps

1.9.1.5 Centrifuge Feed Pumps

1.9.2 Level indication and recording for level instruments at the following locations:

1.9.2.1 Mechanical Screen Chamber

1.9.2.2 Septage Receiving Station

1.9.2.3 Septage Storage Tank

1.9.2.4 Aerobic Digester Nos. 1 through 4

1.9.2.5 Drain Pump Station wetwell

1.9.3 Provide status monitoring for the mechanical screening equipment, Septage Receiving Station, Drain Pump Station, Aerobic Digester Nos 1 through 4, Centrifuge Nos. 1 and 2, utility power available, and Digester Nos. 1 and 2 backup generator.

1.9.4 Provide modulating flow control for the logic loop between the variable frequency drives and the Waste Primary Sludge, Waste Septage, and the Centrifuge Feed Pumps.

1.9.5 Provide status monitoring and control of electric motor actuated plug valves (Primary Sludge/Digested Sludge service) in the Sludge Processing Building (Open/Close)(Quantity as indicated on the contract drawings).

1.9.6 Provide status monitoring and control of electric motor actuated plug valves (Primary Sludge/Digested Sludge/TWAS service) in the vault between Aerobic Digester Nos. 1 and 2 (Open/Close)(Quantity as indicated on the contract drawings).

1.9.7 Provide status monitoring and control of electric motor actuated plug valves (Primary Sludge/Digested Sludge/TWAS service) at Aerobic Digester Nos. 3 and 4 (Open/Close)(Quantity as indicated on the contract drawings).

1.9.8 Provide status monitoring and control of electric motor actuated plug valves (TWAS service) at the Sludge Thickening Building (Open/Close)(Quantity as indicated on the contract drawings).

1.9.9 Flow data, pump status, and pump run times shall be available at the SCADA computer located at the Town's Wastewater Treatment Plant. Thirty (30) days of flow, and pump run time data shall be available at the SCADA computer. Trending screens shall be provided that display ninety (90) days of flow, and pump run time data.

1.9.10 Flashing red alarm light shall activate at the Lab PLC Control Panel, and telemetry shall transmit a status alarm when any of the following conditions occur.

1.9.10.1 Mechanical screening monitoring system status alarm

1.9.10.2 Septage receiving station monitoring system status alarm

1.9.10.3 Septage storage tank high level alarm

1.9.10.4 Septage storage tank low level alarm

1.9.10.5 Drain Pump Station status alarm

1.9.10.6 Drain Pump Station high level alarm

1.9.10.7 Drain Pump Station low level alarm

1.9.10.8 Centrifuge Nos. 1 and 2 monitoring system status alarm

1.9.10.9 Fault Condition for VFDs on Waste Primary Sludge, Waste Septage, and Centrifuge Feed Pumps

1.9.10.10 Aerobic Digester Nos. 1 through 4 blower status alarm

1.9.10.11 Aerobic Digester Nos. 1 through 4 high level alarm

1.9.10.12 Aerobic Digester Nos. 1 through 4 low water alarm

1.9.10.13 Loss of utility power – Aerobic Digester Nos. 1 and 2

1.9.10.14 Generator failure – Aerobic Digester Nos. 1 and 2

1.10 Control Techniques

1.10.1 Unless otherwise indicated, alarms shall be as described below. Alarms shall annunciate at the SCADA computer. An unacknowledged alarm shall cause both audible and flashing visual indication. Acknowledgement silences the audible alarm and causes the visual alarm to remain on steadily until the alarm condition is cleared. Alarms where personnel safety or equipment damage are not at risk shall be allowed to reset without acknowledgement.

1.10.2 Equipment involved in sequential control shall be monitored for control availability. If equipment has faulted or been turned off, the PLC shall automatically advance to the next pieced of equipment or override duty selector positions. The PLC shall not attempt to start equipment which is faulted or off.

1.10.3 Equipment and interlocks shall be designed to fail safely, preserving both life and property. Life safety shall take precedence. All interlocks, safeties, and alarms shall be configured such that failure of the sensor, wiring, relays, etc., shall have the same effect as the alarm condition.

1.10.4 No common equipment shall share the same I/O card.

1.11 Specific Operations

1.11.1 Mechanical Screens and Screenings Washers/Compactors: A functional description is presented in Section 11310 – Self-Cleaning Mechanical Filter Screen.

1.11.2 Septage Receiving Station: A functional description is presented in Section 11320 – Septage Receiving Station Equipment.

1.11.3 Drain Pump Station: A functional description is presented in Section 11300 – Wastewater Pumping Equipment.

1.11.4 Aerobic Digester Blower Control – Digester Nos. 1 and 2: Aerobic digester aeration system shall consist of three positive displacement blowers, diffused air system, and motor starters and timers in a local control panel. Aerobic Digester blower control shall be by automatic timer for intermittent operation (HOA switch in “Automatic” position) and manually controlled at the motor starters for continuous operation (HOA switch in “Manual” position.) A maximum of two blowers will operate simultaneously; the third blower will serve as an offline backup in the event of mechanical failure. Sequence of operation shall be as follows:

1.11.4.1 Manual butterfly valves on the discharge header shall be opened or closed to control individual blower operation to Aerobic Digester Nos. 1 and 2.

1.11.4.2 Each blower shall be deactivated from a low-level cutoff signal from the ultrasonic level instruments in Aerobic Digester Nos. 1 and 2 through the SCADA system.

1.11.4.3 When blower failure is sensed from auxiliary contact in the blower motor starter, a status alarm shall be transmitted to the SCADA system.

1.11.4.4 If liquid level in the Aerobic Digesters continue to rise, "High Water Level Alarm" signal from the ultrasonic level instrument shall initiate the high-level alarm, and a status alarm shall be transmitted to the SCADA system.

1.11.4.5 The ultrasonic level instruments in Aerobic Digester Nos. 1 and 2 shall be interlocked with the Aerobic Digester Nos. 1 and 2 blowers and the Waste Primary Sludge Pumps, the Waste Septage Pumps, and the Centrifuge Feed Pumps in the Sludge Processing Building.

1.11.5 Aerobic Digester Blower Control – Digester Nos. 3 and 4: Aerobic digester aeration system shall consist of three positive displacement blowers, diffused air system, and motor starters and timers in a local control panel. Aerobic Digester blower control shall be by automatic timer for intermittent operation (HOA switch in "Automatic" position) and manually controlled at the motor starters for continuous operation (HOA switch in "Manual" position.) A maximum of two blowers will operate simultaneously; the third blower will serve as an offline backup in the event of mechanical failure. Sequence of operation shall be as follows:

1.11.5.1 Manual butterfly valves on the discharge header shall be opened or closed to control individual blower operation to Aerobic Digester Nos. 3 and 4.

1.11.5.2 Each blower shall be deactivated from a low-level cutoff signal from the ultrasonic level instruments in Aerobic Digester Nos. 3 and 4 through the SCADA system.

1.11.5.3 When blower failure is sensed from auxiliary contact in the blower motor starter, a status alarm shall be transmitted to the SCADA system.

1.11.5.4 If liquid level in the Aerobic Digesters continue to rise, "High Water Level Alarm" signal from the ultrasonic level instrument shall initiate the high-level alarm, and a status alarm shall be transmitted to the SCADA system.

1.11.5.5 The ultrasonic level instruments in Aerobic Digester Nos. 3 and 4 shall be interlocked with the Aerobic Digester Nos. 3 and 4 blowers and the Waste Primary Sludge Pumps, the Waste Septage Pumps, and the Centrifuge Feed Pumps in the Sludge Processing Building.

1.11.6 Centrifuge No. 1 Control

1.11.6.1 Prior to starting the centrifuge, the operator shall select one of the two Centrifuge Feed Pumps to feed sludge and one of the two polymer feed systems to feed polymer solution to the centrifuge.

1.11.6.2 The operator shall open the motorized valves on the pump suction based on the Aerobic Digester being emptied. The operator shall open the motorized valve on the inlet of the selected centrifuge. Once dewatering activities have been completed, motorized valves shall be closed.

1.11.6.3 The Centrifuge PLC Control Panel shall operate each centrifuge feed pump individually based on an operator selectable flow input at the Lab PLC as measured by the Centrifuge Feed Pump discharge flow meter. The PLC shall adjust the Centrifuge Feed Pump VFD to maintain the operator selected input set point.

1.11.6.4 The operator interface unit for the Centrifuge PLC Control Panel shall be capable of displaying the following readings:

1.11.6.4.1 Centrifuge drive motor amp

1.11.6.4.2 Actual sludge and polymer flow rates

1.11.6.4.3 Desired sludge and polymer flow rates

1.11.6.4.4 Fault monitoring

1.11.6.4.5 Pre-set and actual timing operations

1.11.6.4.6 Local/remote control status

1.11.6.4.7 Auto/manual control status.

1.11.6.5 The control system shall have the capability to be connected to the existing PLC Control Panel located in Lab Building No. 13 via Ethernet communication for remote operation and monitoring of auto start/stop, emergency stop, differential or torque mode selection, common alert monitoring, common alarm monitoring, centrifuge running, sludge feed permissive, polymer feed permissive, sludge feed start/stop, polymer start/stop, flush water solenoid energized, and centrifuge inlet valve energized.

1.11.6.6 The centrifuge shall be able to be started automatically or manually. To automatically start the centrifuge, press "Auto Start" key on the operator interface unit.

1.11.6.7 The control system will issue a "run" command to the centrifuge main drive motor and the bowl will begin to accelerate. The polymer and feed systems shall be interlocked with the centrifuge controls to prevent their operation at this time. During acceleration of the centrifuge, the system shall issue a "run" command to the back drive and a "start-up speed" command. This will make the back drive run at a pre-programmed start-up speed as set in the system to provide the maximum scrolling of residual solids from the bowl. After a pre-set, timed interval, during which the bowl has reached full operating speed, the feed and polymer pumps will then start automatically. As process requirements vary, the back drive speed shall be adjustable via the control system which shall maintain the set speed utilizing a closed loop, feedback. In this mode, the back drive speed shall be maintained while the torque is allowed to vary as process parameters change.

1.11.6.8 Automatic torque mode may also be selected at any time. In this mode, the back drive torque shall be maintained while the speed is allowed to vary, within pre-set limits, in order to maximize residence time. If torque begins to rise above the set point, the differential speed shall be increased to scroll solids out of the bowl at a faster rate, thereby lowering the torque back to the set point. The system shall be equipped with a built in PID Auto-tune feature that will allow for automatic adjustment of the PID Proportional, Integral, and Derivative values from the operator interface. Separate software, computers, and communication cables shall not be required to activate this feature.

1.11.6.9 The centrifuge shall be able to be started manually as well, by pressing the appropriate keys as prompted by the manual operation screen of the operator interface unit.

1.11.6.10 Upon stopping the centrifuge by pressing the "Auto Stop" key on the operator interface unit, or via a fault condition, the feed and polymer system interlock contact shall open thereby insuring feed to the centrifuge is stopped. An auto flush valve will also be opened for a pre-determined time during shutdown.

1.11.6.11 Should low water level be reached in the selected Aerobic Digester, the Centrifuge Feed pump shall deactivate.

1.11.6.12 A Clean-In-Place (CIP) function is also provided. This function is used for optimal cleaning of the centrifuge. The CIP run cycle can be started anytime the main drive motor is at rest as determined by

the shutdown timer. Before initiation of the CIP start sequence, all faults must be cleared. A "CIP Start" key is pressed to begin the CIP cycle. The back drive will be energized and begin to rotate in the normal direction at a low speed for a predetermined time. At the same time, the main drive will accelerate the bowl to a low speed in the forward direction. At the end of the set time, the main drive will then toggle direction, causing a water "sloshing" effect within the centrifuge bowl and conveyor. The process will continue until the predetermined overall time ends, a "CIP Stop" key is depressed, or a fault occurs. Any shutdown fault will terminate the CIP cycle.

1.11.6.13 In the event that a fault condition occurs, the sounding of an alarm horn will take place, and an alarm text fault message will be displayed on the operator interface unit to facilitate trouble shooting. An Alarm "Acknowledge" push-button, on the HMI interface, will flash when a fault condition occurs. When pressed, the horn will be silenced, and the flashing will turn solid. When the alarm fault is corrected, and reset, the solid light will be turned off.

1.11.6.14 The following faults shall be provided as alert conditions and shall shut off the centrifuge feed pump and the polymer system:

1.11.6.14.1 Centrifuge Feed pump fault

1.11.6.14.2 Polymer system fault

1.11.6.14.3 Torque alert

1.11.6.14.4 Low differential

1.11.6.14.5 High Vibration

1.11.6.14.6 Main or back drive motor shutdown

1.11.6.14.7 Temperature

1.11.6.15 The following faults shall be provided as alarms and will cause shutdown of the Main Drive and Back drive motors:

1.11.6.15.1 Main motor overheat

1.11.6.15.2 Main drive malfunction

1.11.6.15.3 Excessive vibration

1.11.6.15.4 Back drive motor overheated

1.11.6.15.5 Back drive malfunction

1.11.6.15.6 Centrifuge cover open

1.11.6.15.7 Torque alarm

1.11.6.15.8 Centrifuge bowl over speed

1.11.6.15.9 High bearing temperature

1.11.7 Waste Primary Sludge Pumps: Three Waste Primary Sludge pumps and manual/automatic control from variable frequency drives shall be provided to waste primary sludge from Primary Clarifiers A and B to Aerobic Digester Nos. 1 through 4. The pumps operate in either Hand or Automatic mode based on the position of the variable frequency drives (VFDs). Sequence of operation for the pumps shall be as follows:

1.11.7.1 The operator shall open the motorized valves on the pump suction and discharge piping based on the Primary Clarifier being emptied and the Aerobic Digester being filled. Once wasting activities have been completed, motorized valves shall be closed.

1.11.7.2 The operator shall dedicate one pump to waste sludge from Primary Clarifier A and a second pump to waste sludge from Primary Clarifier B using the HOA switches for the VFDs located in the Digester Control Building. A maximum of two pumps will operate simultaneously; the third pump will serve as an offline backup in the event of mechanical failure.

1.11.7.3 The manual mode of operation shall be in the "Hand" position as initiated by an HOA switch in the pump VFD.

1.11.7.4 In the "Automatic" HOA switch position, the Centrifuge PLC Control Panel shall operate each pump individually based on an operator selectable flow input at the SCADA computer as measured by the respective Waste Primary Sludge discharge flow meter. The PLC shall adjust the pump VFDs to maintain the operator selected input set point.

1.11.7.5 Under normal operating conditions, control shall consist of controlling the pump speed between 50 and 100 percent of full rate speed. Pump speed shall be adjusted based on the 4-20 mA control signal from the magnetic flow meter on the pump discharge piping. Each Waste Primary Sludge pump shall develop and maintain a constant discharge rate, independent of tank liquid level. Adjustable operating range for flow for each pump shall be as indicated in Section 11301 – Sludge Pumping Equipment.

1.11.7.6 Waste Primary Sludge pumps shall be manually deactivated by the operator. Automatic deactivation shall occur once the high water level is reached in the selected Aerobic Digester.

1.11.8 Waste Septage Pumps: Two Waste Septage Pumps and manual/automatic control from variable frequency drives shall be provided to transfer septage from the Septage Holding Tank to Aerobic Digester Nos. 1 through 4. The pumps operate in either Hand or Automatic mode based on the position of the variable frequency drives (VFDs). Sequence of operation for the Waste Septage Pumps shall be as follows:

1.11.8.1 The operator shall open the motorized valves on the pump suction and discharge piping based on the Aerobic Digester being filled. Once septage transfer activities have been completed, motorized valves shall be closed.

1.11.8.2 The operator shall select either of the two Waste Septage Pumps for operation using the HOA switches for the VFDs located in the Digester Control Building. The second pump will serve as an offline backup in the event of mechanical failure.

1.11.8.3 The manual mode of operation shall be in the "Hand" position as initiated by an HOA switch in the pump VFD.

1.11.8.4 In the "Automatic" HOA switch position, the Centrifuge PLC Control Panel shall operate each pump individually based on an operator selectable flow input at the SCADA computer as measured by the respective Waste Septage discharge flow meter. The PLC shall adjust the pump VFD to maintain the operator selected input set point.

1.11.8.5 Under normal operating conditions, control shall consist of controlling the Waste Septage pump speed between 50 and 100 percent of full rate speed. Pump speed shall be adjusted based on the 4-20 mA control signal from the magnetic flow meter on the Waste Septage pump discharge piping. The Waste Septage pump shall develop and maintain a constant discharge rate, independent of the tank liquid level. Adjustable operating range for flow for each pump shall be as indicated in Section 11301 – Sludge Pumping Equipment.

1.11.8.6 Waste Septage pump shall be manually deactivated by the operator. Automatic deactivation shall occur once the high water level is reached in the selected Aerobic Digester or the low water level is reached in the Septage Holding Tank.

1.11.9 Motorized Valve Actuators

1.11.9.1 The operator shall open or close a motorized valve via an HOA switch at the electric valve actuator. In the "Automatic" HOA switch position, the operate can open or close a given valve from the Lab PLC panel. The local mode of actuator operation shall be in the "Hand" position of the HOA switch. Alarms shall also be

provided for valve positions. Should a valve be directed to open or close and not do so based on valve position, a status alarm shall be initiated at the Lab PLC panel

1.11.10 Polymer

1.11.11 Emergency Power (New Generator – Aerobic Digester Nos. 1 and 2): The SCADA system shall monitor the status of electrical power at the WWTP. When the new automatic transfer switch initiates the generator, an alarm condition shall annunciate on the SCADA system.

1.12 Submittals: Provide the following in a timely manner in accordance with the approved submittals schedule as specified in Section 01400 – General Requirements:

1.12.1 Installation drawings

1.12.2 Manufacturer's product data

1.12.3 Operation and maintenance (O&M) manuals

1.12.4 Recommended list of spare parts

2 PRODUCTS

2.1 Programmable Logic Controller (PLC) Hardware

2.1.1 PLC hardware supplied under this section for the Town of Culpeper Wastewater Treatment Plant shall be Allen-Bradley CompactLogix 5000 Series processors.

2.1.2 Each PLC shall be programmable using an IBM PC compatible computer with the ability to download the program to the PLC using a laptop computer. The application used to develop the PLC program shall be provided to the Owner at the end of the project.

2.1.3 Enclosure for PLC Panels shall be corrosion resistant NEMA 4 for indoor locations. Enclosure shall be fabricated from a minimum of 14 gauge cold rolled steel with a baked enamel finish in the manufacturer's standard color. Units shall include a single gasket front door. Continuous hinge with removable pin, locking hasp, and door clamping hardware shall be included. Enclosure shall include operator interface terminal (OIT) as indicated on the contract drawings.

2.1.4 Operator Interface Terminal (OIT): Each PLC enclosure shall have an operator interface with a minimum 10-inch TFT-color LCD touch screen display, 50,000-hour average life backlit, displayed to support multiple fonts and font sizes, memory to hold approximately 200 screens. Minimum OIT

communication shall be by Ethernet connection. OIT shall be Allen-Bradley PanelView Plus 7.

2.1.5 Provide one spare Allen-Bradley CompactLogix 5000 Series processor to maximize reliability.

2.1.6 Uninterruptible Power Systems (UPS): Provide UPS systems with complete power protection, surge and lightning protection for maximum hardware safety. Provide enhanced protection against long duration brownouts and over voltages. UPS systems shall have sufficient capacity to power the PLC, PLC enclosure, and all associated I/O for two (2) hours. UPS systems shall be manufactured by American Power Conversion (APC).

3 EXECUTION

3.1 Install SCADA system components and appurtenances in accordance with the manufacturer's written recommendations and as indicated on the contract drawings. Provide all necessary interconnections, services, and adjustments required for a complete and operable system.

3.2 Install PLC and associated equipment within NEMA 4 painted steel enclosures. Provide with tamper proof hardware.

3.3 Develop the user ladder diagram program to perform the functions specified in the sequence of operation.

3.4 Load the user program into PLC and debug.

3.5 Copy the user program onto working disks and backup disks.

3.6 Document the user program in ladder diagram format in accordance with installation drawings.

3.7 Factory Validation Testing

3.7.1 Quality Assurance Inspection

3.7.1.1 Provide the Owner access to the panel, or a representative example, required by this Section. Provide access prior to the Factory Acceptance Test.

3.7.1.2 The intent is to provide the Owner an opportunity to examine and comment on the overall quality of workmanship.

3.7.1.3 Poor workmanship, as evaluated by the Owner, shall be addressed and corrected.

3.7.2 Pre-Factory Acceptance Test Verification

3.7.2.1 Perform in-house testing of the panel in preparation for the Factory Acceptance Test.

3.7.2.2 After the panel is assembled and completed, thoroughly inspect and test the panel to verify correct wiring and functionality.

3.7.2.3 Simulate signals as required to test every device, instrument, loop and control function provided by the panel.

3.7.2.4 Verify communications and functionality between interconnected panels and between panels and other system components (remote I/O racks, PLCs, SCADA workstations, etc.).

3.7.2.5 Provide written confirmation upon completion of successful verification.

3.7.3 Factory Acceptance Test

3.7.3.1 Perform a Factory Acceptance Test for the panel before shipping to project site.

3.7.3.2 Provide at least 24 days written notice to the Engineer and Owner so that a representative may be present.

3.7.3.3 Test procedures shall be submitted and approved prior to scheduling the test.

3.7.3.4 Test results shall be documented and submitted at the conclusion of the test.

3.7.3.5 Documentation shall include an itemized line-by-line list of procedures performed and results.

3.7.3.6 The test shall essentially duplicate the Pre-Factory Acceptance Test Verification

3.8 Perform a 120-minute uninterruptible power supply (UPS) test. Disconnect normal power supply and operate system from the UPS system for 120 minutes. After 120 minutes, verify that the system is fully functional with no loss of capabilities. Reconnect normal power supply. Verify the UPS system raises battery from full discharge to full charge within 24 hours. Repeat test 12 months after initial system acceptance. If system fails either test, replace the UPS system with larger size that shall be capable of passing the test 12 months after its installation.

3.9 Provide 10% installed spare I/O for each type of I/O provided in each PLC.

3.10 Provide rack space for a minimum of four additional I/O modules in each PLC.

3.11 Each PLC cabinet shall have space provisions for a minimum of four additional I/O cards for future use.

3.12 Connect the PLC equipment to the autodialer as directed by the equipment manufacturer.

End of Section

260500
Common Work Results for Electrical

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data: For raceways, conductors, and grounding materials.

PART 2 - PRODUCTS

2.1 RACEWAYS

A. Raceways:

1. EMT: ANSI C80.3, zinc-coated steel, with compression fittings.

2. LFMC: Zinc-coated, flexible steel with sunlight-resistant and mineral-oil-resistant plastic jacket.

3. RNC: NEMA Type EPC-80-PVC, with NEMA TC3 fittings.

4. RSC: Rigid Steel Conduit, ANSI C80.1 threaded fittings.

5. PVC coated RSC: Where specified and where indicated on the construction drawings.

6. Raceway Fittings: Specifically designed for raceway type used in Project.

2.2 CONDUCTORS AND CABLES

A. Conductors:

1. Conductors, No. 10 AWG and Smaller: Solid copper.

2. Conductors, Larger than No. 10 AWG: Stranded copper.

3. Insulation: Thermoplastic, rated at 75 deg C minimum.

4. Wire Connectors and Splices: Units of size, ampacity rating, material, type, and class suitable for service indicated.

2.3 GROUNDING MATERIALS

A. Conductors: Solid for No. 8 AWG and smaller, and stranded for No. 6 AWG and larger unless otherwise indicated.

1. Insulated Conductors: Tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

2. Bare, Solid-Copper Conductors: Comply with ASTM B 3.

3. Bare, Stranded-Copper Conductors: Comply with ASTM B 8.

B. Ground Rods: Copper-clad steel, sectional type; 3/4" by 96 inches in diameter, unless otherwise indicated.

2.4 ELECTRICAL IDENTIFICATION MATERIALS

A. Raceway Identification Materials: Self-adhesive, color-coding vinyl tape; flexible, preprinted, self-adhesive vinyl.

B. Conductor Identification Materials: Color-Coding Conductor Tape: Self-adhesive vinyl tape 1 to 2 inches wide.

C. Underground-Line Warning Tape: Permanent, bright-colored, continuous-printed, polyethylene tape with continuous metallic strip or core.

D. Tape Markers for Wire: Vinyl or vinyl-cloth, self-adhesive, wraparound type with circuit identification legend machine printed by thermal transfer or equivalent process.

E. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

F. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.

G. Equipment Identification Labels: Engraved, laminated acrylic or melamine label; punched or drilled for screw mounting. White letters on a dark-gray background; red letters for emergency systems.

H. Fasteners: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

2.5 SUPPORT AND ANCHORAGE COMPONENTS

A. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed under this Project, with a minimum structural safety factor of five times the applied force.

B. Steel Slotted Support Systems: Comply with MFMA-3, factory-fabricated components for field assembly, and provide finish suitable for the environment in which installed.

1. Channel Dimensions: Selected for structural loading.

C. Raceway and Cable Supports: As described in NECA 1.

D. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and fittings.

E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded malleable-iron body and insulating wedging.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

G. Mounting, Anchoring, and Attachment Components:

1. Powder-Actuated Fasteners: Threaded-steel stud.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete.

3. Concrete Inserts: Steel or malleable-iron, slotted-support-system units similar to MSS Type 18; complying with MFMA-3 or MSS SP-58.

4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

5. Through Bolts: Structural type, hex head, high strength; complying with ASTM A 325.

6. Toggle Bolts: All-steel springhead type.

7. Hanger Rods: Threaded steel.

2.6 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

2.7 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 GENERAL ELECTRICAL EQUIPMENT INSTALLATION REQUIREMENTS

A. Install electrical equipment to allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.

B. Install electrical equipment to provide for ease of disconnecting the equipment with minimum interference to other installations.

C. Install electrical equipment to allow right of way for piping and conduit installed at required slope.

D. Install electrical equipment to ensure that connecting raceways, cables, wireways, cable trays, and busways are clear of obstructions and of the working and access space of other equipment.

E. Install required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

F. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed.

G. Install sleeve and sleeve seals of type and number required for sealing electrical service penetrations of exterior walls.

H. Comply with NECA 1.

3.2 RACEWAY AND CABLE INSTALLATION

A. Outdoor Raceways Applications:

1. Exposed or Concealed: PVC Coated RSC.

2. Underground and Beneath Roadways: Concrete-encased RNC.

3. Connection to Vibrating Equipment: LFMC.

4. Boxes and Enclosures: Metallic, NEMA 250, Type 4X.

5. Underground and Not Subject to Vehicular Traffic: Direct-buried RNC.

B. Indoor Raceways Applications:

1. Exposed: PVC Coated RSC.

2. Concealed within Masonry Walls: EMT.

3. Connection to Vibrating Equipment: LFMC; in wet or damp locations, use LFMC.

4. Damp or Wet Locations: PVC Coated RSC.

5. Boxes and Enclosures: Cast Metal, unless otherwise indicated.

6. Embedded in Slabs: RNC.

C. Install raceways and cables at least 6 inches above hot-water pipes. Locate horizontal raceway runs above water piping.

D. Install raceways embedded in slabs in middle third of slab thickness where practical, and leave at least 1-inch- thick concrete cover.

1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.

2. Space raceways laterally to prevent voids in concrete.

3. Install conduit larger than 1-inch trade size, parallel to or at right angles to main reinforcement. Where conduit is at right angles to reinforcement, place conduit close to slab support.

4. Transition from RNC to PVC coated RSC before rising above floor; above the floor transition to RAC.

E. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.

2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.

F. Install pull wires in all empty raceways.

G. Connect motors and equipment subject to vibration, noise transmission, or movement with a 72-inch maximum length of flexible conduit.

3.3 WIRING METHODS

A. Service Entrance including Power from Generator to Transfer Switch: Type XHHW-2, single conductors in raceway.

B. Exposed Feeders, Branch Circuits, and Class 1 Control Circuits, Including in Crawlspaces: Type THHN-THWN, single conductors in raceway.

C. Feeders and Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and underground: Type XHHW-2, single conductors in raceway.

D. Class 2 Control Circuits: Type THHN-THWN, in raceway.

3.4 GROUNDING

A. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches below grade.

B. Pipe and Equipment Grounding Conductor Terminations: Bolted.

C. Underground Connections: Welded.

D. Install grounding conductors routed along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

E. Install ground rods driven into ground until tops are 2 inches below finished floor or final grade unless otherwise indicated.

F. Make connections without exposing steel or damaging coating, if any.

G. Install bonding straps and jumpers in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

H. Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.

I. Bond to equipment mounted on vibration isolation hangers and supports so vibration is not transmitted to rigidly mounted equipment.

3.5 IDENTIFICATION

A. Power-Circuit Conductor Identification: For No. 3 AWG conductors and larger, at each location where observable, identify phase using color-coding conductor tape.

B. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring.

C. Warning Labels for Enclosures for Power and Lighting: Comply with 29 CFR 1910.145; identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.

D. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Ungrounded service, feeder, and branch-circuit conductors.

1. Colors for 480/277-V 3P/4W Circuits:

    a. Phase A: Brown.

    b. Phase B: Orange.

    c. Phase C: Yellow

2. Colors for 208/120-V Circuits:

    a. Phase A: Black.

    b. Phase B: Red.

    c. Phase C: Blue.

3. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points.

E. Underground-Line Warning Tape: Continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade.

3.6 INSTALLATION OF HANGERS AND SUPPORTS

A. Fasten hangers and supports securely in place, with provisions for thermal and structural movement. Install with concealed fasteners unless otherwise indicated.

B. Separate dissimilar metals and metal products from contact with wood or cementitious materials, by painting each metal surface in area of contact with a bituminous coating or by other permanent separation.

C. Raceway Support Methods: In addition to methods described in NECA 1,RAC may be supported by openings through structure members, as permitted in NFPA 70.

D. Multiple Raceways or Cables: Install on trapeze-type supports fabricated with steel slotted channel.

E. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

F. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods, unless otherwise indicated or required by Code:

1. To Wood: Fasten with lag screws or through bolts.

2. To New Concrete: Bolt to concrete inserts.

3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.

4. To Existing Concrete: Expansion anchor fasteners.

5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.

6. To Light Steel: Sheet metal screws.

7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount on slotted-channel racks attached to substrate.

G. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.7 SLEEVE AND SLEEVE SEALS INSTALLATION

A. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

B. Cut sleeves to length for mounting flush with both wall surfaces.

C. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and cable.

D. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

E. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint.

F. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

3.8 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.9 INSTALLATION OF DIRECT-BURIED CONDUIT

A. Excavation of Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of conduit. Shape subgrade to provide continuous

support for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

B. Backfill and Compaction:

1. Place backfill on subgrades free of mud, frost, snow, or ice.

2. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for joints, fittings, and bodies of conduits.

3. Backfill trenches excavated under footings and within 18 inches of bottom of footings with #57 stone; fill with concrete to elevation of bottom of footings.

4. Place and compact initial backfill of #57 stone to a height of 12 inches over the conduit.

a. Carefully compact initial backfill up on both sides and along the full length of conduit to avoid damage or displacement. Firmly hand-tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction to 85%.

C. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.

D. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

1. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.

2. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

E. Warning Tape: Bury underground warning tape approximately 12 inches above direct-buried conduits. Align tape along the width and along the centerline of conduit.

3.10 INSTALLATION OF CONCRETE-ENCASED CONDUIT

A. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.

B. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.

1. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.

2. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing rod dowels extending 18 inches into concrete on both sides of joint near corners of envelope.

C. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.

D. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.

E. After placing concrete, place and compact initial backfill of #57 stone to a height of 12 inches over the concrete. After placing controlled backfill to within 12 inches of finished grade, complete backfilling with normal compaction to 85%.

F. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.

G. Minimum Space between Ducts: 3 inches between ducts and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and signal ducts.

H. Depth: Install top of duct bank at least 24 inches below finished grade in areas not subject to deliberate traffic, and at least 30 inches below finished grade in deliberate traffic paths for vehicles, unless otherwise indicated.

I. Stub-Ups: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

1. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.

2. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of base. Install insulated grounding bushings on terminations at equipment.

J. Warning Tape: Bury warning tape approximately 12 inches above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches of the centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

End of Section

260526
Grounding and Bonding for Electrical Systems

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes grounding and bonding systems and equipment.

1.2 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Burndy; Part of Hubbell Electrical Systems.
2. Dossert; AFL Telecommunications LLC.
3. ERICO International Corporation.
4. Fushi Copperweld Inc.
5. Galvan Industries, Inc.; Electrical Products Division, LLC.
6. Harger Lightning & Grounding.
7. ILSCO.
8. O-Z/Gedney; a brand of Emerson Industrial Automation.
9. Robbins Lightning, Inc.
10. Siemens Power Transmission & Distribution, Inc.

2.2 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.3 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.

2. Stranded Conductors: ASTM B 8.

3. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.

4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.

5. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.4 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.5 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.

1. Bury at least 24 inches below grade.

C. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.

2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.

3. Connections to Ground Rods at Test Wells: Bolted connectors.

4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

3.3 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

3.4 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.

C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.

2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.

3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

3.5 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.

a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

b. Perform tests by fall-of-potential method according to IEEE 81.

B. Grounding system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

D. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

End of Section

260529
Hangers and Supports for Electrical Systems

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hangers and supports for electrical equipment and systems.

2. Construction requirements for concrete bases.

1.2 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M.

2. AWS D1.2/D1.2M.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4 factory-fabricated components for field assembly.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit; a part of Atkore International.

b. Cooper B-Line, Inc.; a division of Cooper Industries.

c. ERICO International Corporation.

d. Flex-Strut Inc.

e. GS Metals Corp.

f. G-Strut.

g. Haydon Corporation.

h. Metal Ties Innovation.

i. Thomas & Betts Corporation, A Member of the ABB Group.

j. Unistrut; an Atkore International company.

2. Material: Galvanized steel or Stainless Steel, Type 316.

3. Channel Width: 1-5/8 inches.

4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

5. Channel Dimensions: Selected for applicable load criteria.

B. Aluminum Slotted Support Systems: Comply with MFMA-4 factory-fabricated components for field assembly.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Cooper Industries, Inc.

b. Flex-Strut Inc.

c. Haydon Corporation.

d. MKT Metal Manufacturing, Inc.

e. Thomas & Betts Corporation, A Member of the ABB Group.

f. Unistrut; an Atkore International company.

2. Channel Width: 1-5/8 inches.

3. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.

4. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

5. Channel Dimensions: Selected for applicable load criteria.

C. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c., in at least one surface.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit; a part of Atkore International.

b. Cooper B-Line, Inc.; a division of Cooper Industries.

c. Fabco Plastics Wholesale Limited.

d. G-Strut.

e. Haydon Corporation.

f. Seasafe, In.; AMICO; a Gibraltar Industries Company.

2. Channel Width: 1-5/8 inches.

3. Fittings and Accessories: Products provided by channel and angle manufacturer and designed for use with those items.

4. Fitting and Accessory Materials: Same as those for channels and angles.

5. Rated Strength: Selected to suit applicable load criteria.

6. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

D. Conduit and Cable Support Devices: Stainless-steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.

G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

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) Hilti, Inc.

2) ITW Ramset/Red Head; Illinois Tool Works, Inc.

3) MKT Fastening, LLC.

4) Simpson Strong-Tie Co., Inc.

2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

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) Cooper B-Line, Inc.; a division of Cooper Industries.

2) Empire Tool and Manufacturing Co., Inc.

3) Hilti, Inc.

4) ITW Ramset/Red Head; Illinois Tool Works, Inc.

5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.

4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.

5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.

6. Toggle Bolts: Stainless-steel springhead type.

7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems unless requirements in this Section are stricter.

B. Comply with requirements for raceways and boxes specified in Section 260533 “Raceways and Boxes for Electrical Systems.”

C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for RMCs as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

D. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.

B. Raceway Support Methods: In addition to methods described in NECA 1, RMCs may be supported by openings through structure members, according to NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.

2. To New Concrete: Bolt to concrete inserts.

3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.

4. To Existing Concrete: Expansion anchor fasteners.

5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.

6. To Light Steel: Sheet metal screws.

7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

B. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi, 28-day compressive-strength concrete.

C. Anchor equipment to concrete base as follows:

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

2. Install anchor bolts to elevations required for proper attachment to supported equipment.

3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

End of Section

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.

2. PVC Coated RSC and fittings.

3. Nonmetal conduits, tubing, and fittings.

4. Metal wireways and auxiliary gutters.

5. Boxes, enclosures, and cabinets.

6. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1. Section 260543 “Underground Ducts and Raceways for Electrical Systems” for exterior ductbanks, manholes, and underground utility construction.

1.2 DEFINITIONS

A. GRSC or RSC: Galvanized Rigid Steel Conduit.

B. PVC RSC: Poly Vinyl Coated Rigid Steel Conduit.

C. EMT: Electric Metallic Tubing.

D. ARC: Aluminum Rigid Conduit.

1.3 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

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. AFC Cable Systems, Inc.
2. Allied Tube & Conduit; a part of Atkore International.
3. Anamet Electrical, Inc.
4. Electri-Flex Company.
5. O-Z/Gedney; a brand of Emerson Industrial Automation.
6. Republic Conduit.
7. Robroy Industries.
8. Southwire Company.
9. Thomas & Betts Corporation, A Member of the ABB Group.
10. Western Tube and Conduit Corporation.
11. Wheatland Tube Company.

B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. PVC Coated RSC: UL6 and ANSI C80.1

E. ARC: Comply with ANSI C80.5 and UL 6A.

F. EMT: Comply with ANSI C80.3.

G. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

H. Joint Compound for GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 METAL WIREWAYS AND AUXILIARY GUTTERS

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. Cooper B-Line, Inc.; a division of Cooper Industries.
2. Hoffman; a brand of Pentair Equipment Protection.
3. Mono-Systems, Inc.
4. Square D.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1, Type 4, Type 12 unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Flanged-and-gasketed type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.3 BOXES, ENCLOSURES, AND CABINETS

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. Cooper Technologies Company.
2. EGS/Appleton Electric.
3. Erickson Electrical Equipment Company.
4. FSR Inc.
5. Hoffman; a brand of Pentair Equipment Protection.
6. Hubbell Incorporated.
7. Milbank Manufacturing Co.
8. O-Z/Gedney; a brand of Emerson Industrial Automation.

9. RACO; Hubbell.

10. Robroy Industries.

11. Spring City Electrical Manufacturing Company.

12. Stahlin Non-Metallic Enclosures.

13. Thomas & Betts Corporation, A Member of the ABB Group.

14. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 12 with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

D. Cabinets:

1. NEMA 250, Type 12 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.

2. Hinged door in front cover with flush latch and concealed hinge.

3. Key latch to match panelboards.

4. Metal barriers to separate wiring of different systems and voltage.

5. Accessory feet where required for freestanding equipment.

6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: PVC Coated RSC.

2. Underground Conduit: RNC, Type EPC-80-PVC.

3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFNC.

4. Boxes and Enclosures, Aboveground: NEMA 250, Type 4X.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Interior conduits, concealed within masonry walls, EMT.

2. Exposed: PVC coated RSC.

3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

4. Damp or Wet Locations: PVC coated RSC.

5. Boxes and Enclosures: NEMA 250, except use NEMA 250, Type 4X stainless steel for damp or wet locations.

C. Minimum Raceway Size: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.

2. EMT: Compression fittings.

E. Install surface raceways only where indicated on Drawings.

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches away from parallel runs of flues or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Comply with requirements in Section 260529 “Hangers and Supports for Electrical Systems” for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

G. Install conduits parallel or perpendicular to building lines.

H. Support conduit within 12 inches of enclosures to which attached.

I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

K. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts.

L. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

M. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

N. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

O. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

End of Section

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Conduit, ducts, and duct accessories for direct-buried and concrete-encased duct banks, and in single duct runs.

1.3 DEFINITION

A. RNC: Rigid nonmetallic conduit.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

B. Store other factory-fabricated underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.

1.5 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Owner no fewer than five days in advance of proposed interruption of electrical service.

2. Do not proceed with interruption of electrical service without Owner’s written permission.

1.6 COORDINATION

A. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes.

PART 2 - PRODUCTS

2.1 CONDUIT

A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.

B. RNC: NEMA TC 2, Type EPC-80-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.2 NONMETALLIC DUCTS AND DUCT ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ARNCO Corp.
2. Beck Manufacturing.
3. Cantex, Inc.
4. CertainTeed Corp.; Pipe & Plastics Group.
5. Condux International, Inc.
6. ElecSys, Inc.
7. Electri-Flex Company.
8. IPEX Inc.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT; a division of Cable Design Technologies.
11. Spiraduct/AFC Cable Systems, Inc.

B. Underground Plastic Utilities Duct: NEMA TC 6 & 8, Type EB-20-PVC, ASTM F 512, UL 651A, with matching fittings by the same manufacturer as the duct, complying with NEMA TC 9.

C. Duct Accessories:

1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
2. Warning Tape: Underground-line warning tape specified in Division 26 Section “Identification for Electrical Systems.”

PART 3 - EXECUTION

3.1 UNDERGROUND DUCT APPLICATION

A. Ducts for Electrical Feeders 600 V and Less: RNC**,** NEMA Type EPC-80-PVC, in direct-buried duct bank, unless otherwise indicated.

3.2 EARTHWORK

A. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

B. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching.

3.3 DUCT INSTALLATION

A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.

B. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.

C. Direct-Buried Duct Banks:

1. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.

2. Space separators close enough to prevent sagging and deforming of ducts, with not less than 4 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches between tiers.

3. Excavate trench bottom to provide firm and uniform support for duct bank.

4. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand-place backfill to 4 inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only.

5. Install ducts with a minimum of 3 inches between ducts for like services and 6 inches between power and signal ducts.

6. Depth: Install top of duct bank at least 36 inches below finished grade, unless otherwise indicated.

7. Set elevation of bottom of duct bank below the frost line.

8. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.

9. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.

    b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

3.4 GROUNDING

A. Ground underground ducts and utility structures according to Division 26 Section “Grounding and Bonding for Electrical Systems.”

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:

1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.

2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.

B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.6 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of manholes, including sump. Remove foreign material.

End of Section

260575
Power System Analysis

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. The minimum interrupting capacity of circuit protective devices.

2. Overcurrent protective device coordination to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.

3. Arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

1.3 DEFINITIONS

A. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

B. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

C. SCCR: Short-circuit current rating.

D. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.4 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Qualification Data: For Electrical Engineer who will perform power system analysis.

1. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.

2. Overcurrent protective device coordination study report; signed, dated, and sealed by a qualified professional engineer.

3. Arc-flash study report; signed, dated, and sealed by a qualified professional engineer.

1.5 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Electrical Engineer Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the Commonwealth of Virginia. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

PART 2 - PRODUCTS

2.1 SHORT-CIRCUIT STUDY REPORT CONTENTS

A. Executive summary.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of the computer printout.

C. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short-circuit ratings.

2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.

D. Short-Circuit Study Output:

1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a. Voltage.

b. Calculated fault-current magnitude and angle.

2.2 PROTECTIVE DEVICE COORDINATION STUDY REPORT CONTENTS

A. Executive summary.

B. Study descriptions, purpose, basis and scope. Include case descriptions, definition of terms and guide for interpretation of the computer printout.

C. Protective Device Coordination Study:

1. Report recommended settings of protective devices, ready to be applied in the field. Use manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available.

a. Circuit Breakers:

1) Adjustable pickups and time delays (long time, short time, ground).

2) Adjustable time-current characteristic.

3) Adjustable instantaneous pickup.

4) Recommendations on improved trip systems, if applicable.

b. Fuses: Show current rating, voltage, and class.

D. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation.

2.3 ARC-FLASH STUDY REPORT CONTENT

A. Executive summary.

B. Study descriptions, purpose, basis and scope.

C. Incident Energy and Flash Protection Boundary Calculations:

1. Arcing fault magnitude.

2. Protective device clearing time.

3. Duration of arc.

4. Arc-flash boundary.

5. Working distance.

6. Incident energy.

7. Hazard risk category.

8. Recommendations for arc-flash energy reduction.

D. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

2.4 ARC-FLASH WARNING LABELS

A. Produce a 3.5-by-5-inch thermal transfer label of high-adhesion polyester for each work location included in the analysis.

B. The label shall follow ANSI requirement and shall include the following information taken directly from the arc-flash hazard analysis:

1. Location designation.

2. Nominal voltage.

3. Flash protection boundary.

4. Hazard risk category.

5. Incident energy.

6. Working distance.

7. Engineering report number, revision number, and issue date.

C. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Gather and tabulate input data to support the study. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field.

B. Examine Project overcurrent protective device submittals. Proceed with studies only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.2 SHORT-CIRCUIT STUDY

A. Perform study following the general study procedures contained in IEEE 399.

B. Calculate short-circuit currents according to IEEE 551.

C. Perform study for equipment added by this project.

D. Begin short-circuit current analysis at the service, extending down to the system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 5 kA or less.

E. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

F. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each of the following pieces of equipment added or altered by this project:

1. Motor-control centers.

2. Control panels.

3. Branch circuit panelboards.

4. Disconnect switches.

3.3 PROTECTIVE DEVICE COORDINATION STUDY

A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.

B. Comply with IEEE 399 for general study procedures.

C. The study shall be based on the device characteristics supplied by device manufacturer.

D. The extent of the electrical power system to be studied includes equipment added or altered by this project.

E. Begin analysis at the first device upstream of the added or altered device, extending down to the system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 5 kA or less.

3.4 ARC-FLASH HAZARD ANALYSIS

A. Comply with NFPA 70E and its Annex D for hazard analysis study.

B. Preparatory Studies:

1. Short-Circuit Study.

2. Protective Device Coordination Study.

C. Calculate maximum and minimum contributions of fault-current size.

1. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.

2. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

D. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.

E. Include low-voltage equipment locations that are added or altered by this project.

F. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.

G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:

1. Fault contribution from induction motors should not be considered beyond three to five cycles.

2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).

H. Arc-flash computation shall include both line and load side of a circuit breaker.

I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.5 LABELING

A. Apply one arc-flash label for 600-V ac, 480-V ac, and applicable 208-V ac panelboards and disconnects and for each of the following locations that are added or altered by this project:

1. Motor-control center.

2. Control panel.

3. Panelboards.

4. Local disconnect switches.

5. Local starters and VFDs.

3.6 APPLICATION OF WARNING LABELS

A. Install the arc-fault warning labels.

3.7 ADJUSTING

A. Make minor modifications to equipment as required to accomplish compliance with short-circuit study.

3.8 FIELD ADJUSTING

A. Adjust relay and protective device settings according to the recommended settings provided by the coordination study. Field adjustments shall be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

B. Make minor modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.

End of Section

260923
Lighting Control Devices

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Time switches.

2. Indoor occupancy sensors.

3. Lighting contactors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show installation details for occupancy and light-level sensors.

1. Interconnection diagrams showing field-installed wiring.

2. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 TIME SWITCHES – EXTERIOR AND SITE LIGHTING

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. Cooper Industries, Inc.

2. Intermatic, Inc.

3. Invensys Controls.

4. Leviton Manufacturing Co., Inc.

5. NSi Industries LLC.

B. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Contact Configuration: Four (4) sets of DPST.

3. Contact Rating: 30-A inductive or resistive, 240-V ac.

4. Programs: Four channels; each channel is individually programmable with two on-off set points on a 24-hour schedule, allowing different set points for each day of the week.

5. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program on selected channels.

6. Astronomic Time: All channels.

7. Automatic daylight savings time changeover.

8. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.2 INDOOR OCCUPANCY SENSORS

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. Bryant Electric.

2. Cooper Industries, Inc.

3. Hubbell Building Automation, Inc.

4. Leviton Manufacturing Co., Inc.

5. Lithonia Lighting; Acuity Brands Lighting, Inc.

6. Lutron Electronics Co., Inc.

7. NSi Industries LLC.

8. Philips Lighting Controls.

9. RAB Lighting.

10. Sensor Switch, Inc.

11. Square D.

B. Ceiling Mounted Occupancy Sensors:

1. Dual technology type (passive infrared and ultrasonic), 120/277 V, adjustable time delay up to 30 minutes, 360-degree field of view, with a minimum coverage area of 1,200 SF.

2. Sensor to operate at line voltage without the need for external power racks or relays.

3. Sensor to include concealed "OFF" time delay selector with settings between 5 minutes and 30 minutes.

4. Sensor settings shall be adjustable at the sensor without the need for specialized tools or programmers.

5. Switch Rating: Two sets of contacts, each located rated for 800-W LED load at 120 VAC

2.3 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

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. Bryant Electric.

2. Cooper Industries, Inc.

3. Hubbell Building Automation, Inc.

4. Leviton Manufacturing Co., Inc.

5. Lithonia Lighting; Acuity Brands Lighting, Inc.

6. Lutron Electronics Co., Inc.

7. NSi Industries LLC.

8. Philips Lighting Controls.

9. RAB Lighting.

10. Sensor Switch, Inc.

11. Square D.

B. Wall Occupancy Sensors:

1. Dual technology type (passive infrared and ultrasonic), 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 1,000 SF.

2. Provide control positions for “OFF”, “ON”, and “AUTO”.

3. Sensor to operate at line voltage without the need for external power racks or relays.

4. Sensor to include concealed “OFF” time delay selector with settings between 5 minutes and 30 minutes.

5. Sensor settings shall be adjustable at the sensor without the need for specialized tools or programmers.

6. Switch Rating: Two sets of contacts, each located rated for 800-W LED load at 120 VAC.

2.4 TIME SWITCHES – INTERIOR LIGHTING

A. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.

1. Listed and labeled as defined in NFPA 70 and marked for intended location and application.

2. Contact Configuration: SPDT.

3. Contact Rating: 20-A ballast load, 120-/240-V ac.

4. Programs: Eight on-off set points on a 24-hour schedule.

5. Switchbox mounted.

6. Two-hour override capability.

2.5 LIGHTING CONTACTORS

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. Allen-Bradley/Rockwell Automation.

2. ASCO Power Technologies, LP; a business of Emerson Network Power.

3. Eaton Corporation.

4. General Electric Company.

B. Description: Electrically operated and mechanically held, combination-type lighting contactors with nonfused disconnect, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).

2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.

3. Enclosure: Comply with NEMA 250.

4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

2.6 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260500 "Common Work Results for Electrical."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 CONTACTOR INSTALLATION

A. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION

A. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

B. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

C. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260500 "Common Work Results for Electrical."

1. Identify controlled circuits in lighting contactors.

2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to evaluate lighting control devices and perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Lighting control devices will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.6 ADJUSTING

A. Occupancy Adjustments: Provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.

2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.

3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

4. For timers, adjust setpoints and schedules to suit Owner’s operations.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

End of Section

262200
Low-Voltage Transformers

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data.

PART 2 - PRODUCTS

2.1 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. Enclosure: Ventilated, NEMA 250, Type 2 and Type 3R.

1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

C. Taps:

1. Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

D. Energy Efficiency for Transformers Rated 15 kVA and Larger: Comply with NEMA TP 1, Class 1 efficiency levels, as tested according to NEMA TP 2.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fasten transformers securely in place, with provisions for thermal and structural movement. Install with concealed fasteners unless otherwise indicated.

B. Separate dissimilar metals and metal products from contact with wood or cementitious materials, by painting each metal surface in area of contact with a bituminous coating or by other permanent separation.

C. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions

End of Section

262416
Panelboards

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NEMA PB 1.

2.2 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Indoor Enclosures: Surface-mounted cabinets; NEMA 250, Type 1 with door-within-door - hinged front cover.

B. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

C. Panelboard Short-Circuit Current Rating: Fully rated for system.

2.3 PANELBOARDS

A. Mains: Circuit breaker.

B. Branch Overcurrent Protective Devices: Bolt-on circuit breakers.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.

2. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Receive, inspect, handle, store and install panelboards and accessories according to NECA 407.

B. Comply with mounting and anchoring requirements specified in Section 260500 "Common Work Results for Electrical."

C. Mount top of trim 90 inches above finished floor unless otherwise indicated.

D. Arrange conductors into groups; bundle and wrap with wire ties.

E. Create a directory to indicate installed circuit loads and incorporating Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory.

End of Section

262419
Motor-Control Centers

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes MCCs for use with ac circuits rated 600 V and less and having the following factory-installed components:

1. Incoming main lugs and OCPDs.
2. Full-voltage magnetic controllers.
3. Reduced-voltage magnetic controllers.
4. Reduced-voltage, solid-state controllers.
5. Multispeed controllers.
6. VFC's.
7. Feeder-tap units.
8. TVSS.
9. Instrumentation.
10. Auxiliary devices.
11. Line reactors.

1.2 DEFINITIONS

A. CPT: Control power transformer.

B. DDC: Direct digital control.

C. EMI: Electromagnetic interference.

D. GFCI: Ground fault circuit interrupting.

E. IGBT: Insulated-gate bipolar transistor.

F. LAN: Local area network.

G. LED: Light-emitting diode.

H. MCC: Motor-control center.

I. MCCB: Molded-case circuit breaker.

J. MCP: Motor-circuit protector.

K. NC: Normally closed.

L. NO: Normally open.

M. OCPD: Overcurrent protective device.

N. PCC: Point of common coupling.

O. PID: Control action, proportional plus integral plus derivative.

P. PT: Potential transformer.

Q. PWM: Pulse-width modulated.

R. RFI: Radio-frequency interference.

S. SCR: Silicon-controlled rectifier.

T. TDD: Total demand (harmonic current) distortion.

U. THD(V): Total harmonic voltage demand.

V. TVSS: Transient voltage surge suppressor.

W. VFC: Variable-frequency controller.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of controller and each type of MCC. Include shipping and operating weights, features, performance, electrical ratings, operating characteristics, and furnished specialties and accessories.

B. Shop Drawings: For each MCC, manufacturer's approval drawings as defined in UL 845. In addition to requirements specified in UL 845, include dimensioned plans, elevations, and sections; and conduit entry locations and sizes, mounting arrangements, and details, including required clearances and service space around equipment.

1. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Each installed unit's type and details.

b. Factory-installed devices.

c. Enclosure types and details.

d. Nameplate legends.

e. Short-circuit current (withstand) rating of complete MCC, and for bus structure and each unit.

f. Features, characteristics, ratings, and factory settings of each installed controller and feeder device, and installed devices.

g. Specified optional features and accessories.

2. Schematic Wiring Diagrams: For power, signal, and control wiring for each installed controller.

3. Nameplate legends.

4. Vertical and horizontal bus capacities.

5. Features, characteristics, ratings, and factory settings of each installed unit.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain MCCs and controllers of a single type from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver MCCs in shipping splits of lengths that can be moved past obstructions in delivery paths.

B. Handle MCCs according to the following:

1. NEMA ICS 2.3, “Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers Rated Not More Than 600 Volts.”

2. NECA 402, “Recommended Practice for Installing and Maintaining Motor Control Centers.”

C. If stored in space that is not permanently enclosed and air conditioned, remove loose packing and flammable materials from inside MCCs; install temporary electric heating, with at least 250 W per vertical section.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service or Distribution Systems: Do not interrupt electrical service to, or distribution systems within, a facility occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Owner no fewer than five days in advance of proposed interruption of electrical service.

2. Indicate method of providing temporary electrical service.

3. Do not proceed with interruption of electrical service without Owner's written permission.

4. Comply with NFPA 70E.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for MCCs, including clearances between MCCs and adjacent surfaces and other items.

1.7 COORDINATION

A. Coordinate sizes and locations of concrete bases. Cast anchor-bolt inserts into bases.

B. Coordinate features of MCCs, installed units, and accessory devices with remote pilot devices and control circuits to which they connect.

C. Coordinate features, accessories, and functions of each MCC, each controller, and each installed unit with ratings and characteristics of supply circuits, motors, required control sequences, and duty cycle of motors and loads.

1.8 WARRANTY

A. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB.

2. Eaton.

3. General Electric

4. Siemens Industry, Inc.

5. Square D; a brand of Schneider Electric.

6. Or Approved Equal.

B. General Requirements for MCCs: Comply with NEMA ICS 18 and UL 845.

2.2 FUNCTIONAL FEATURES

A. Description: Modular arrangement of main units, controller units, control devices, feeder-tap units, instruments, metering, auxiliary devices, and other items mounted in vertical sections of MCC.

B. Controller Units: Combination controller units.

1. Install units up to and including Size 3 on drawout mountings with connectors that automatically line up and connect with vertical-section buses while being racked into their normal, energized positions.

2. Equip units in Type B and Type C MCCs with pull-apart terminal strips for external control connections.

C. Feeder-Tap Units: Through 225-A rating shall have drawout mountings with connectors that automatically line up and connect with vertical-section buses while being racked into their normal, energized positions.

D. Future Units: Compartments fully bused and equipped with guide rails or equivalent, ready for insertion of drawout units.

E. Spare Units: Installed in compartments indicated “spare.”

2.3 INCOMING MAINS

A. Incoming Mains Location: Top.

B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

3. Electronic trip circuit breakers with RMS sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

a. Instantaneous trip.

b. Long- and short-time pickup levels.

c. Long- and short-time time adjustments.

4. MCCB Features and Accessories:

a. Standard frame sizes, trip ratings, and number of poles.

b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.

2.4 COMBINATION CONTROLLERS

A. Full-Voltage Reversing and Non-Reversing Controllers:

1. General Requirements for Full-Voltage Enclosed Controllers: Comply with NEMA ICS 2, general purpose, Class A.

2. Magnetic Controllers: Full voltage, across the line, electrically held.

2.5 VFCs:

A. Bypass Mode: Manual.

1. Bypass Style: Two contactor style.

2. Bypass Contactor Classification: Reduced-voltage autotransformer, open transition.

3. Overload Relays: Solid state Class 10.

4. Isolated Overload Alarm Contact: NC.

5. Disconnecting Means and OCPDs.

6. Disconnecting means and OCPDs must be closely coordinated with calculated short-circuit current values at the controller locations because they are directly related to short-circuit withstand ratings of their combination controllers. Although fusible switches (with appropriate fuses) can provide Type 2 controller protection from very high short-circuit currents, not all circuit breakers or MCPs can. See Editing Instructions No. 9 and No. 10 in the Evaluations for explanation of protection types and when they should be considered. The Section Text does not include nonfusible disconnecting means because they are usually not an option with MCCs.

7. MCP disconnecting means must be used in combination with integral overload relays.

8. MCP Disconnecting Means:

    a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

    b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

    c. Auxiliary contacts “a” and “b” arranged to activate with MCP handle.

    d. NC alarm contact that operates only when MCP has tripped.

9. MCCB Disconnecting Means:

    a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.

    b. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

    c. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

    d. Auxiliary contacts “a” and “b” arranged to activate with MCCB handle.

    e. NC alarm contact that operates only when MCCB has tripped.

B. Overload Relays:

1. Solid-State Overload Relays:

    a. Switch or dial selectable for motor running overload protection.

    b. Sensors in each phase.

    c. Class 10 tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.

    d. Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.

    e. Analog communication module.

2. NC isolated overload alarm contact.

3. External overload reset push button.

C. Control Power:

1. Control Circuits: 120-V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.

2.5 FEEDER-TAP UNITS

A. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

a. Instantaneous trip.

b. Long- and short-time pickup levels.

c. Long- and short-time time adjustments.

2.6 VFC

A. Controller Units: Combination controllers, consisting of variable-frequency power converter that is factory packaged in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged for self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency. Comply with NEMA ICS 7, NEMA ICS 61800-2, UL 508C, and UL 508E.

1. Units suitable for operation of NEMA MG 1, Design A and Design B motors as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."

2. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."

3. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.

4. Listed and labeled for single-phase use by an NRTL acceptable to authorities having jurisdiction.

5. Disconnects:

6. Fusible Switch:

   a. UL 98 and NEMA KS 1, heavy-duty, horsepower-rated fusible switch, with clips or bolt pads to accommodate UL 248-8 Class J fuses.

   b. Lockable Handle: For three padlocks and interlocks with cover in closed position.

   c. Auxiliary Contacts: NC, arranged to activate before switch blades open.

7. MCP:

   a. UL 489, with interrupting capacity complying with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

   b. Lockable Handle: For three padlocks and interlocks with cover in closed position.

c. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.

d. NC alarm contact that operates only when MCP has tripped.

e. Current-limiting module to increase controller short-circuit current (withstand) rating to 100 kA.

8. MCCB:

a. UL 489, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.

b. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

c. Lockable Handle: For three padlocks and interlocks with cover in closed position.

d. Auxiliary contacts "a" and "b" arranged to activate with MCCB handle.

e. NC alarm contact that operates only when MCCB has tripped.

9. Molded-Case Switch:

a. UL 489, with in-line fuse block for UL 248-8 Class J power fuses (depending on ampere rating), providing an interrupting capacity to comply with available fault currents; MCCB with fixed, high-set instantaneous trip only.

b. Lockable Handle: For three padlocks and interlocks with cover in closed position.

c. Auxiliary contacts "a" and "b" arranged to activate with molded-case switch handle.

d. NC alarm contact that operates only when molded-case switch has tripped.

10. Disconnect Rating: Not less than 115 percent of NFPA 70 motor full-load current rating or VFC input current rating, whichever is larger.

a. Auxiliary Contacts: NC, arranged to activate before switch blades open.

b. Auxiliary contacts "a" and "b" arranged to activate with circuit-breaker handle.

c. NC alarm contact that operates only when circuit breaker has tripped.

11. Operating Requirements:

a. Input AC Voltage Tolerance: Plus 10 and minus 10 percent of VFC input voltage rating.

b. Input AC Voltage Unbalance: Not exceeding 3 percent.

c. Input Frequency Tolerance: Plus or minus 3 percent of VFC frequency rating.

d. Minimum Efficiency: 96 percent at 60 Hz, full load.

e. Minimum Displacement Primary-Side Power Factor: 96 percent under any load or speed condition.

f. Overload Capability:

1) For variable-torque controllers, 1.1 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.

2) For constant-torque controllers, 1.5 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.

g. Starting Torque: Minimum of 100 percent of rated torque from 3 to 60 Hz.

h. Speed Regulation: Plus or minus 5 percent.

i. Output Carrier Frequency: Field selectable.

j. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.

k. Internal Adjustability Capabilities:

1) Minimum Speed: 5 to 25 percent of maximum rpm.

2) Maximum Speed: 80 to 100 percent of maximum rpm.

3) Acceleration: 0.1 to 999.9 seconds.

4) Deceleration: 0.1 to 999.9 seconds.

5) Current Limit: 30 to a minimum of 150 percent of maximum rating.

B. Self-Protection and Reliability Features:

1) Input transient protection by means of SPDs for three-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.

2) Loss of Input Signal Protection: Selectable response strategy including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.

3) Under- and overvoltage trips.

4) Inverter overcurrent trips.

5) VFC and Motor Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFC overtemperature and motor overload alarm and trip; settings selectable via the keypad; NRTL approved and listed and labeled by an NRTL.

6) Critical frequency rejection, with three selectable, adjustable dead-bands.

7) Instantaneous line-to-line and line-to-ground overcurrent trips.

8) Loss-of-phase protection.

9) Reverse-phase protection.

10) Short-circuit protection.

11) Motor overtemperature fault.

C. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

D. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

E. Operator Station:

1) Inverter Logic: Microprocessor based, 32 bit, isolated from all power circuits.

2) Isolated Control Interface: Allows VFCs to follow remote-control signal over a minimum 40:1 speed range.

3) Panel-mounted, manufacturer's standard front-accessible, sealed keypad and plain-English-language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.

a) Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.

b) Security Access: Electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.

F. Displays:

1. Historical Logging Information and Displays:

a. Real-time clock with current time and date.

b. Running log of total power versus time.

c. Total run time.

d. Fault log, maintaining last four faults with time and date stamp for each.

2. Indicating Devices: Digital display mounted flush in VFC door and connected to display VFC parameters including the following:

a. Output frequency (Hz).

b. Motor speed (rpm).

c. Motor status (running, stop, fault).

d. Motor current (amperes).

e. Motor torque (percentage).

f. Fault or alarming status (code).

g. PID feedback signal (percentage).

h. DC-link voltage (V dc).

i. Set-point frequency (Hz).

j. Motor output voltage (V ac).

Solid State Overload Relays: NEMA ICS 2.

3. Switch or dial selectable for motor-running overload protection.

4. Sensors in each phase.

5. Class 10 tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.

6. Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.

7. Analog communication module.

B. NC isolated overload alarm contact.

C. External overload reset push button

G. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.

H. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Autospeed Search" feature is available and engaged.

I. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.

J. Communication Port: Ethernet or equivalent connection Capable of connecting a printer and a notebook computer.

2.7 MCC CONTROL POWER

A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from CPT.

B. Control Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.

C. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.8 ENCLOSURES

A. Indoor Enclosures: Freestanding steel cabinets unless otherwise indicated. NEMA 250, Type 12 unless otherwise indicated to comply with environmental conditions at installed location.

B. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

C. Compartments: Modular; individual lift-off doors with concealed hinges and quick-captive screw fasteners. Interlocks on units requiring disconnecting means in off position before door can be opened or closed, except by operating a permissive release device.

D. Interchangeability: Compartments constructed to allow for removal of units without opening adjacent doors, disconnecting adjacent compartments, or disturbing operation of other units in MCC; same size compartments to permit interchangeability and ready rearrangement of units, such as replacing three single units with a unit requiring three spaces, without cutting or welding.

E. Wiring Spaces:

1. Vertical wireways in each vertical section for vertical wiring to each unit compartment; supports to hold wiring in place.

2. Horizontal wireways in bottom and top of each vertical section for horizontal wiring between vertical sections; supports to hold wiring in place.

2.9 AUXILIARY DEVICES

A. General Requirements for Control-Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.

1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty, type.

a. Push Buttons: Covered types; maintained contact unless otherwise indicated.

b. Pilot Lights: LED types; push to test.

c. Selector Switches: Rotary type.

B. Control Relays: Auxiliary and adjustable solid-state time-delay relays.

2.10 CHARACTERISTICS AND RATINGS

A. Wiring: NEMA ICS 18, Class II, Type B-D, for starter Size 3 and below.

B. Control and Load Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

C. Short-Circuit Current Rating for Each Unit: Fully rated; 65 kA.

D. Short-Circuit Current Rating of MCC: Fully rated with its main overcurrent device; 65 kA.

E. Pull Box on Top of an MCC:

1. Adequate ventilation to maintain temperature in pull box within same limits as MCC.

2. Set back from front to clear circuit-breaker removal mechanism.

3. Removable covers forming top, front, and sides. Top covers at rear easily removable for drilling and cutting.

4. Insulated bottom of fire-resistive material with separate holes for cable drops into MCC.

5. Cable supports arranged to facilitate cabling and adequate to support cables, including those for future installation.

6. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.

F. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of unit.

G. Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Minimum insulation temperature rating of 105 deg C.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and surfaces to receive MCCs, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.

B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Coordinate layout and installation of MCCs with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Floor-Mounting Controllers: Install MCCs on 4-inch nominal thickness concrete base.

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.

C. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Section 260553 “Identification for Electrical Systems” for identification of MCC, MCC components, and control wiring.

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.

2. Label MCC and each cubicle with engraved nameplate.

3. Label each enclosure-mounted control and pilot device.

3.4 CONTROL WIRING INSTALLATION

A. Install wiring between enclosed controllers and remote devices.

B. Bundle, train, and support wiring in enclosures.

C. Connect selector switches and other automatic-control selection devices where applicable.

1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.

2. Connect selector switches within enclosed controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.5 CONNECTIONS

A. Comply with requirements for installation of conduit in Section 260533 “Raceways and Boxes for Electrical Systems.” Drawings indicate general arrangement of conduit, fittings, and specialties.

B. Comply with requirements in Section 260526 “Grounding and Bonding for Electrical Systems.”

3.6 FIELD QUALITY CONTROL

A. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

B. Tests and Inspections:

1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.

2. Test insulation resistance for each enclosed controller element, component, connecting motor supply, feeder, and control circuits.

3. Test continuity of each circuit.

4. Verify that voltages at controller locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Owner before starting the motor(s).

5. Test each motor for proper phase rotation.

6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

9. Mark up a set of manufacturer’s drawings with all field modifications incorporated during construction and return to manufacturer for inclusion in Record Drawings.

C. Enclosed controllers will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports, including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.7 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.8 ADJUSTING

A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

B. Adjust overload relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.

C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to six times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes and 11 times for NEMA Premium Efficient motors. Where these maximum settings do not allow starting of a motor, notify Owner before increasing settings.

D. Set field-adjustable switches and program microprocessors for required start and stop sequences in reduced-voltage, solid-state controllers.

End of Section

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data and color palette for multi-outlet assemblies.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

2.2 COMMERCIAL-GRADE DEVICES

A. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.

2. Devices shall comply with the requirements in this Section.

B. Device Color:

1. White unless otherwise indicated or required by NFPA 70 or device listing.

C. Convenience Receptacles: NEMA WD 1, NEMA WD 6, Configuration 5-20R, and UL 498.

1. 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:

a. Eaton (Arrow Hart).

b. Hubbell Incorporated; Wiring Device-Kellems.

c. Leviton Manufacturing Co., Inc.

d. Or Approved Equal.

D. Duplex Ground-Fault Circuit-Interrupter (GFCI) Convenience Receptacles: 125-V, 20-A, straight blade, non-feed-through type. NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

1. 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:

a. Eaton (Arrow Hart).

b. Hubbell Incorporated; Wiring Device-Kellems.

c. Leviton Manufacturing Co., Inc.

d. Or Approved Equal.

E. Toggle Switches: NEMA WD 1 and UL 20. Single-pole, 120/277 V, 20 A.

1. 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:

a. Eaton (Arrow Hart).

b. Hubbell Incorporated; Wiring Device-Kellems.

c. Leviton Manufacturing Co., Inc.

d. Or Approved Equal.

F. Pilot-Light Switches, 20 A: Single pole, with neon-lighted handle, illuminated when switch is "off."

1. 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:

a. Eaton (Arrow Hart).

b. Hubbell Incorporated; Wiring Device-Kellems.

c. Leviton Manufacturing Co., Inc.

d. Or Approved Equal.

2.3 WALL PLATES

A. Wall Plates, Finished Areas: Stainless steel, fastened with metal screws having heads matching plate color.

B. Wall Plates, Unfinished Areas: Galvanized steel with metal screws.

C. Wall Plates, Damp Locations: Cast aluminum with metal weather resistant covers, listed and labeled for use in damp locations.

D. Wall Plates, Wet Locations: Cast aluminum with metal weatherproof-while-in-use cover, listed and labeled for use in wet locations.

2.4 FLOOR SERVICE FITTINGS

A. Modular, flap-type, dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: Rectangular, die-cast aluminum with satin finish.

D. Power Receptacle: NEMA WD 6, Configuration 5-20R, gray finish, unless otherwise indicated.

E. Voice and Data Communication Outlet: Blank cover with bushed cable opening.

2.5 PREFABRICATED, MULTIOUTLET ASSEMBLIES

A. Components produced by a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles. Metal, with manufacturer's standard finish raceway with No. 12 AWG wire. One receptacle per 6 inches. Provide samples of the full range of manufacture’s colors for color selection during the submittal process.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

C. Mount devices flush, with long dimension vertical, and grounding terminal of receptacles on top unless otherwise indicated. Group adjacent devices under single, multigang wall plates.

End of Section

262816
Enclosed Switches and Circuit Breakers

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMNTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 FUSIBLE AND NONFUSIBLE SWITCHES

A. Fusible Switches, 600 A and Smaller: UL 98 and NEMA KS 1, Type HD, that accommodate specified fuses, and with lockable handle interlocked with cover in closed position.

B. Nonfusible Switches, 600 A and Smaller: UL 98 and NEMA KS 1, Type HD, with lockable handle interlocked with cover in closed position.

2.3 MOLDED-CASE CIRCUIT BREAKERS

A. Description: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Electronic Trip Circuit Breakers: Field-replaceable rating plug, RMS sensing, with field-adjustable instantaneous trip settings.

2.4 ENCLOSURES

A. NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Outdoor Locations: NEMA 250, Type 4X.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Comply with mounting and anchoring requirements specified in Section 260529 "Hangers and Supports for Electrical Systems."

C. Install fuses in fusible devices.

D. Comply with NECA 1.

3.2 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

End of Section

262920
Motor Starters

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data.

B. Coordinate features of controllers and accessory devices with pilot devices and control circuits to which they connect.

C. Coordinate features, accessories, and functions of each motor controller with ratings and characteristics of the supply circuit, the motor, the required control sequence, and the duty cycle of the motor and load.

PART 2 - PRODUCTS

2.1 CONTROLLERS AND ACCESSORIES

A. Manual Controller: NEMA ICS 2, general purpose, Class A with toggle action and overload element, in each phase.

B. Magnetic Controller: NEMA ICS 2, Class A, full voltage, nonreversing, across the line, unless otherwise indicated; with integral control transformer.

1. Combination Controller: Factory-assembled combination controller and circuit-breaker disconnecting means.

2. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.

C. Enclosures: NEMA 250, Type 4X.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Select features of each enclosed controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, controller, and load; and configuration of pilot device and control circuit affecting controller functions.

B. Select horsepower rating of controllers to suit motor controlled.

C. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall.

D. Connect selector switches to bypass only the manual and automatic control devices that have no safety functions when switch is in the hand position.

E. Connect selector switches with motor-control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

F. Set field-adjustable switches and circuit-breaker trip ranges.

End of Section

263213
Packaged Engine Generator

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes packaged engine-generator sets for emergency power supply with the following features:

1. Diesel engine.

2. Unit-mounted cooling system.

3. Unit-mounted control and monitoring.

4. Outdoor enclosure.

B. Related Sections include the following:

1. Division 26 Section "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.3 SUBMITTALS

A. Product Data: For each packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:

1. Thermal damage curve for generator.

2. Time-current characteristic curves for generator protective device.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.

2. Wiring Diagrams: Power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. Include the following:

1. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.

E. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

B. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with ASME B15.1.

E. Comply with NFPA 37.

F. Comply with NFPA 70.

G. Comply with NFPA 110 requirements for Level 2 emergency power supply system.

H. Comply with UL 2200.

I. Engine Exhaust Emissions: Comply with applicable federal, state, and local government requirements.

1.5 PROJECT CONDITIONS

A. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: Minus 15 to plus 40 deg C.

2. Relative Humidity: 0 to 95 percent.

3. Altitude: Sea level to 1000 feet.

B. Space Limitations: Available space is indicated on drawings. Provide unit that fits within the space and provides the proper clearances.

C. Provide access stairs and work platforms where specified on the drawings.

1.6 COORDINATION

A. Coordinate size and location of concrete bases for package engine generators. Cast anchor-bolt inserts into bases.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five (5) years from date of Substantial Completion.

1.8 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.

2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.

3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Caterpillar; Engine Div.

2. Cummins Power Generation; Industrial Business Group.

3. MTU

4. Or Approved Equal

2.2 ENGINE-GENERATOR SET

A. Factory-assembled and -tested, engine-generator set.

B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.

C. Capacities and Characteristics:

1. Output Connections: As indicated.

2. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of components.

D. Generator-Set Performance:

1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.

2. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.

3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.

4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.

5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.

6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.

7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.

2.3 ENGINE

A. Fuel: Fuel oil, Grade DF-2.

B. Rated Engine Speed: 1800 rpm.

C. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm.

D. Lubrication System: The following items are mounted on engine or skid:

1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.

2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.

3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

E. Engine Fuel System:

1. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.

2. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.

F. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system.

G. Governor: Electronic.

H. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.

1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.

2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 100 percent load condition.

3. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.

4. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.

a. Rating: 50-psig maximum working pressure with coolant at 180 deg F, and noncollapsible under vacuum.

b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

5. Radiator to have vertical air discharge.

I. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.

1. Minimum sound attenuation of 25 dB at 500 Hz.

J. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

K. Starting System: 24-V electric, with negative ground.

1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.

2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.

3. Cranking Cycle: 60 seconds.

4. Battery: Adequate capacity within ambient temperature range specified in Part 1 "Project Conditions" Article to provide specified cranking cycle at least three times without recharging.

5. Battery Cable: Size as recommended by engine manufacturer. Include required interconnecting conductors and connection accessories.

6. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.

7. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:

a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.

b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.

c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.

d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.

e. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

f. Powered by 120V, 20A, single-phase circuit.

2.4 FUEL OIL STORAGE

A. Comply with NFPA 30.

B. Base-Mounted Fuel Oil Tank: Comply with UL 142, freestanding, factory-fabricated fuel tank assembly, with the following features:

1. Containment: Integral rupture basin with a capacity of 150 percent of nominal capacity of tank.

a. Leak Detector: Locate in rupture basin and connect to provide audible and visual alarm in the event of leak.

2. Low-Level Alarm Sensor: Liquid-level device operates alarm contacts at 25 percent of normal fuel level.

3. Piping Connections: Factory-installed fuel supply and return lines from tank to engine; local fuel fill, vent and tank drain line.

4. Tank level indicator.

5. Capacity: Fuel 2,200-gallon fuel tank for fifty-one (51) minimum hours of continuous operation at 100 percent rated power output.

6. Vandal-resistant fill cap.

2.5 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or

equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.

B. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.

C. Indicating and Protective Devices and Controls:

1. AC voltmeter.
2. AC ammeter.
3. AC frequency meter.
4. DC voltmeter (alternator battery charging).
5. Engine-coolant temperature gage.
6. Engine lubricating-oil pressure gage.
7. Running-time meter.
8. Ammeter-voltmeter, phase-selector switch(es).
9. Generator-voltage adjusting rheostat.
10. Start-stop switch.
11. Overspeed shutdown device.
12. Coolant high-temperature shutdown device.
13. Coolant low-level shutdown device.
14. Oil low-pressure shutdown device.
15. Fuel tank derangement alarm.

D. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

E. Common Remote Alarm: Signal the occurrence of any events listed below without differentiating between event types through a factory-wired set of Form C dry contacts. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset.

1. Battery-charger malfunction alarm.

2. Battery low-voltage alarm.

3. Engine high-temperature shutdown.

4. Lube-oil, low-pressure shutdown.

5. Overspeed shutdown.

6. Remote emergency-stop shutdown.

7. Engine high-temperature pre-alarm.

8. Lube-oil, low-pressure pre-alarm.

9. Fuel tank, low-fuel level.

10. Low coolant level.

2.6 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Generator Circuit Breaker: Molded-case, thermal-magnetic type; 100 percent rated; complying with NEMA AB 1 and UL 489.

1. Tripping Characteristic: Designed specifically for generator protection.

2. Trip Rating: Matched to generator rating.

3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.

4. Mounting: Adjacent to or integrated with control and monitoring panel.

2.7 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H or Class F.

D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.

E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

F. Enclosure: Drip-proof.

G. Instrument Transformers: Mounted within generator enclosure.

H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.

1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.

I. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

J. Subtransient Reactance: 12 percent, maximum.

2.8 OUTDOOR GENERATOR-SET ENCLOSURE

A. Description: Vandal-resistant, sound attenuating, weatherproof steel housing with a dBA rating of 73 dBA at 23 feet under 100% load and wind resistant up to 100 mph. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.

B. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 100 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.

1. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof louvers prevent entry of rain and snow. Radiator discharge is through a vertical plenum.

C. Convenience Outlets: Factory wired, GFCI. Arrange for external electrical connection.

2.9 VIBRATION ISOLATION DEVICES

A. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint or manufacturer’s equivalent integral linear type.

B. Provide 3/4" depth x 3” wide neoprene rubber strip the length of the generator under each side of the base tank between the concrete pad and the bottom of the tank.

2.10 FINISHES

A. Outdoor Enclosures, Fuel Tank and Components: Manufacturer's Standard color, environmentally friendly, polyester power baked paint.

2.11 SOURCE QUALITY CONTROL

B. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.

B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.

B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.

C. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.3 CONNECTIONS

A. Ground equipment according to Division 26 Section "Common Work Results for Electrical."

B. Connect wiring according to Division 26 Section "Common Work Results for Electrical."

C. Use liquid-tight flexible metal conduit for final electrical connections to generator.

3.4 IDENTIFICATION

A. Identify system components according to Division 26 Section "Common Work Results for Electrical."

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection (except those indicated to be optional) for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.

2. NFPA 110 Acceptance Tests: Perform single-step full-load pickup test using a 100% rated load bank.

3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.

a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.

b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.

c. Verify acceptance of charge for each element of the battery after discharge.

d. Verify that measurements are within manufacturer's specifications.

4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.

5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.

6. Voltage and Frequency Transient Stability Tests: monitor voltage and frequency, using engine mounted control panel during step-load increases and decreases, and verify that performance is as specified.

C. Coordinate tests with tests for transfer switches and run them concurrently.

D. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.

E. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

H. Remove and replace malfunctioning units and retest / reinspect as specified above.

I. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

J. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.

B. Coordinate training with that required for automatic transfer switch.

C. Provide two (2) hours of training for each generator.

3.7 FUELING

A. Provide all fuel for testing and commissioning. Leave generator tank FULL at end of Substantial Completion and Testing.

End of Section

263600
Transfer Switches

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes transfer switches rated 600 V and less, including the following:

1. Automatic transfer switches.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.

1. Single-Line Diagram: Show connections between transfer switch, power sources, and load.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. Include the following:

1. Features and operating sequences, both automatic and manual.

2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NEMA ICS 1.

D. Comply with NFPA 70.

E. Comply with NFPA 110.

F. Comply with UL 1008 unless requirements of these Specifications are stricter.

1.5 WARRANTY

A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of Automatic Transfer Switch that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Contactor Transfer Switches:

a. Caterpillar; Engine Div.

b. Emerson; ASCO Power Technologies, LP.

c. Kohler.

d. Onan/Cummins Power Generation; Industrial Business Group.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

C. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to

IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

E. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.

2. Switch Action: Double throw; mechanically held in both directions.

3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.

F. Neutral Terminal: Solid and fully rated, unless otherwise indicated to be switched.

G. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. Color-coding and wire and cable tape markers are specified in Division 26 Section "Common Work Results for Electrical."

1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.

2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.

3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.

H. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.3 AUTOMATIC TRANSFER SWITCHES

A. Comply with Level 2 equipment according to NFPA 110.

B. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.

C. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.

D. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.

E. In-Phase Monitor: Factory-wired, internal relay controls transfer so it occurs only when the two sources are synchronized in phase. Relay compares phase relationship and frequency difference between normal and emergency sources and initiates transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer is initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.

F. Automatic Transfer-Switch Features:

1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.

2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.

3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.

4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.

5. Test Switch: Simulate normal-source failure.

6. Switch-Position Pilot Lights: Indicate source to which load is connected.

7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.

   a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."

   b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."

8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.

9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.

10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.

11. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.

12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:

    a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.

    b. Push-button programming control with digital display of settings.

    c. Integral battery operation of time switch when normal control power is not available.

2.4 SOURCE QUALITY CONTROL

A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Identify components according to Division 26 Section "Common Work Results for Electrical."

B. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as

recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

B. Ground equipment according to Division 26 Section "Common Work Results for Electrical."

C. Connect wiring according to Division 26 Section "Common Work Results for Electrical."

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installation, including connections, and to assist in testing.

2. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.

3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

a. Check for electrical continuity of circuits and for short circuits.

b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.

c. Verify that manual transfer warnings are properly placed.

d. Perform manual transfer operation.

5. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.

a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.

b. Simulate loss of phase-to-ground voltage for each phase of normal source.

c. Verify time-delay settings.

d. Verify pickup and dropout voltages by data readout or inspection of control settings.

e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.

f. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

B. Coordinate tests with tests of generator and run them concurrently.

C. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

D. Remove and replace malfunctioning units and retest as specified above.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below.

B. Coordinate this training with that for generator equipment.

C. Provide two (2) hours of automatic transfer switch training per transfer switch.

End of Section

264313
Surge Protection Devices

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data.

B. Comply with IEEE C62.41.2 and test devices according to IEEE C62.45.

C. Comply with UL 1449.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 SERVICE ENTRANCE SUPPRESSORS

A. Surge Protective Devices: Field-mounted, complying with UL 1449 Type 1.

1. Comply with IEEE C62.41 Category C, 200-kA short-circuit current rating.

2. Non-modular type with the following features and accessories:

a. Integral disconnect switch.

b. LED indicator lights for power and protection status.

B. Protection modes and UL 1449 Vpk for grounded wye circuits with 480Y/277 V and 208Y/120 V, three-phase, four-wire circuits shall be as follows:

1. Line to Neutral: 600 V for 208Y/120 V.

2. Line to Ground: 1800 V for 480Y/V; 1000 V for 208Y/120 V.

3. Line to Line: 2000 V for 480Y/V; 1000 V for 208Y/120 V.

C. Protection modes and UL 1449 Vpk for 240/120 V, single-phase, three-wire circuits shall be as follows:

1. Line to Neutral: 600 V.

2. Line to Ground: 1000 V.

3. Line to Line: 1000 V.

2.3 MOTOR CONTROL CENTER AND PANELBOARD SUPPRESSORS

A. Surge Protective Devices: Field-mounted, complying with UL 1449 Type 1.

1. Comply with IEEE C62.41 Category C, 200-kA short-circuit current rating.

2. Non-modular type with the following features and accessories:

a. Integral disconnect switch.

b. LED indicator lights for power and protection status.

B. Protection modes and UL 1449 Vpk for grounded wye circuits with 480Y/277 V and 208Y/120 V, three-phase, four-wire circuits shall be as follows:

1. Line to Neutral: 600 V for 208Y/120 V.

2. Line to Ground: 1000 V for 208Y/120 V.

3. Neutral to Ground: 600 V for 208Y/120 V.

4. Line to Line: 2000 V for 480Y/V; 1000 V for 208Y/120 V.

C. Protection modes and UL 1449 Vpk for 240/120-V, single-phase, three-wire circuits shall be as follows:

1. Line to Neutral: 600 V.

2. Line to Ground: 1000 V.

3. Neutral to Ground: 600 V.

4. Line to Line: 1000 V.

2.4 ENCLOSURES

A. Indoor Enclosures: NEMA 250, Type 12.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Do not energize or connect electrical equipment to their sources until TVSS devices are installed and connected.

End of Section

Section 264820
Variable Frequency Drives

PART 1 - GENERAL

1.1 References

A. NEMA standards publications

1. ICS 1 general standards for industrial controls and systems

2. ICS 2 standards for industrial control devices, controllers, and assemblies

3. ICS 6 enclosures for industrial controls and systems

4. MG 1 motors and generators

5. MG 2 safety standard for construction and guide for selection, installation, and use of electric motors and generators

6. MG 13 frame assignments for Alternating Current, Integral Horsepower induction motors

B. Instrument Society of America (ISA)

1. RP12.6 installation of intrinsically safe instrument systems in Class I Hazardous locations

2. RP18.1 specifications and guides for the use of general purpose Annunciator

3. S5.1 instrumentation symbols and identification

4. S51.1 standard process instrumentation terminology

PART 2 - PRODUCTS

2.1 Variable Frequency Drives (VFD's):

A. All variable frequency drives, provided under this division, must be supplied by the same manufacturer and meet all specified requirements. Contractor shall coordinate variable frequency drive manufacturer selection with all equipment manufacturers, and shall be solely responsible for ensuring that the individual variable frequency drives furnished are completely compatible with all requirements and intended functions of the driven equipment. The drive vendor shall be Allen Bradley, Square-D or approved equal.

B. The drive shall be capable of varying the speed of a standard NEMA design B induction motor from a virtual standstill to the standard speed of the motor. The

unit shall transform input power into a variable voltage, adjustable frequency three phase output of suitable capacity and waveform.

C. Input voltage shall be as indicated on the drawings and/or as specified in the equipment specification sections. Frequency shall be 60 HZ.

D. Output shall be three (3) phase voltage as indicated on the drawings and/or as specified in the equipment specification sections.

E. The drive shall be a PWM (pulse width modulated) inverter using IGBT transistors.

F. The drive manufacturer shall have not less than ten years of experience in the manufacture of drives in the United States.

G. The drives shall be rated for variable torque applications (460v - 1 hp to 150 hp)

H. Power line considerations:

1. The drive shall be designed to operate in accordance with all performance requirements of the contract documents from a power source which contains a maximum of 5% total voltage harmonic distortion, meet current distortion as defined by IEEE-519-1992.

2. Each VFD or multiple sets of VFD's shall be designed and installed such that: the total voltage harmonic distortion reflected back to the power source is a maximum of 5%.

3. When line reactors and harmonic filters are required, they shall be provided by VFD supplier and shall be rated for, and compatible with, each VFD. They shall function as a complete system. Additional harmonic filters beyond those shown on drawings may be required in order to comply with the above parameters. The line reactors and harmonic traps shall be mounted inside the respective VFD enclosures. Traps shall be fuse-protected as a minimum and shall protect internal wiring and components on each phase and shall be current limiting. Data on these items shall be included with VFD shop drawings.

4. The VFD supplier shall perform a computer simulated power system study to verify compliance with the parameters as stated herein. The results of this study shall be submitted to the engineer. At a minimum the submitted results of this study shall include:

a. A results summary sheet which briefly describes the power system configuration analyzed and which states the calculated values of total harmonic distortion.

b. Detailed list of the amplitude of harmonic currents and voltages to the 50th harmonic.

c. This report most shows if IEEE 519 is met and where on the power distribution.

5. The contractor shall supply the VFD supplier with all power system data required to perform the above described study. These data may include but are not limited to:

a. A complete one line diagram of the subject electrical distribution system.

b. Complete electrical data on all equipment shown on the one line diagram is required. At a minimum this data shall consist of:

1) Transformers - KVA, primary voltage, secondary voltage, short circuit capacity or impedance.

2) Motors - horsepower, base speed, full load RMS current (FLA).

3) Generators - short circuit capacity or Subtransient Reactance's (XD), power factor, KW, x/r ratio.

c. If the distribution system can function in more than one configuration, the configuration(s) to be analyzed shall be clearly defined. Any other information which may affect the behavior of the distribution system shall also be provided.

I. Ambient conditions:

1. Environment - indoors, NEMA 1 enclosure with fans and filters when required for drive cooling, unless located in space with different nema rating.

2. Ambient temperature - minus 10 degrees c to 40 degrees c

3. Altitude - less than 3,300 feet

4. Relative humidity - 95% maximum non-condensing

5. Vibration - less than .5g

J. Control system:

1. Input power:

a. Main circuit: 460v/60hz.

b. Control circuit 120 volts

2. Tolerance: input voltage $\pm$ 10%. Frequency $\pm$ 2 Hz.

3. Control method: sinusoidal PWM control

4. Output voltage: 3ph 0-460 volt.

5. Output frequency range: 0 Hz to 400 Hz

6. Volts/Hz characteristics:

    a. Either constant V/Hz or variable v/Hz (user selectable)

    b. Minimum frequency from 0-120 Hz

    c. Maximum frequency from 10-400 Hz

    d. Voltage boost adjustable from 0% to 30%

7. Overload current: variable torque (normal duty) applications: 110% for 60 seconds, constant torque (heavy duty) applications: 150% for 60 seconds,

8. Analog inputs: 4-20 ma or 0-10 volts

9. Analog outputs: (2) 4-20 ma (speed and motor running amps)

10. Input terminals: minimum of eight (6) programmable

11. Output contacts: three (3) programmable form c contacts rated 250v, 2 amps inductive shall be provided by interposing relays.

12. Frequency jump - 3-point settings: setting jump frequency (0 to max frequency), and width (0 to max frequency)

13. PWM carrier frequency: adjustable from 2 KHz to 10 KHz.

K. The drive shall provide a minimum displacement power factor of 0.95 throughout the speed range.

L. The efficiency of the drive at full speed shall be a minimum of 97.5 percent.

M. The drive shall be provided with a circuit breaker with through-door disconnect handle, to serve as a disconnecting means, and coordinated with the drive protective features for the motor to form a complete combination type starter/controller. Provide with current limiting fuses on the input side of the drive, sized and rated as required by UL and the drive manufacturer, so that the drive is rated for the available fault current.

N. The drive shall be provided with a motor-protecting output filter where noted in the VFD schedule or where specifically required or recommended by VFD manufacturer.

O. The drive shall be provided with an EMI/RFI filter

P. The drive shall contain relays, push buttons, timers, and all other appurtenances necessary for the specific application as specified in the equipment specification sections, and as shown on the electrical drawings.

Q. Enclosure type shall be as required for the specific application as shown on the drawings and/or as specified in the equipment specification sections.

R. Operational functions:

1. Acceleration/deceleration times: 0.1 to 600 seconds, 2 separate acceleration and deceleration times.

2. Forward or reverse run can be chosen.

3. Jogging:

a. Running - 0 to 20 Hz

b. Braking - deceleration, dc injection, or coasting

4. Multi-speed run: up to 7 preset speeds can be chosen.

5. Flying start: the drive shall be capable of determining the speed and direction of a spinning motor and adjust its output to "pick-up" the motor at the rotating speed.

6. Auto restart: in the event of power loss the drive must be able to automatically restart the drive without an external reset.

7. Soft stall: sustains a run in overload mode.

8. Overload: adjustable from 60 - 100%

9. Complete adjustment of parameters gives thousands of volt/frequency patterns.

S. Protective features:

1. Functions included:

a. Overcurrent

b. Overvoltage

c. Heatsink overheat

d. Load-side short circuit

e. Load-side ground fault

f. VFD overload

1) Overcurrent during start-up

2) EEprom error

3) Communications error

4) Auto-tuning error

5) Emergency stop

6) Undervoltage

7) Open output phase

8) Motor overload

2. Drive shall have an external fault trip input terminal.

3. Drive shall reset when a designated contact is closed on the terminal strip.

T. Monitor functions:

1. The drive shall have display scalar of monitoring frequency. (range 0.10 to 200).

2. The drive shall have an led on the front panel showing that the main dc circuit capacitor is charged.

U. Controller:

1. All parameters should be adjustable from the keypad.

2. The drive shall have a reset to factory settings.

3. The keypad shall be NEMA 12 or NEMA 1 rated and the same as the enclosure rating.

4. The keypad shall be able to extend up to 15 feet from the drive.

5. The keypad shall allow for parameters to be changed while drive is running.

V. All models shall be UL listed.

W. Drive shall be capable of communication through a standard protocol which will support rs232, rs485 as standard. The drive shall be able to communicate with at least two networks at the same time. Ethernet, Controlnet, or Devicenet are the preferred networks.

X. Drive shall be capable of PID control.

Y. Drive shall be capable of speed feedback control through an optional control board.

Z. Variable frequency drive manufacturer must have a local factory-authorized parts stocking distributor which has factory-trained service technicians and warranty authorization; shall have 24 hour service capabilities.

AA. VFD’s shall be provided in the motor control centers when indicated in the MCC schedules.

PART 3 - EXECUTION

3.1 Install drives where shown on drawings, and in compliance with the manufacturer's installation instructions.

3.2 Wire motor control power circuit through form "a" contact so that when input circuit breaker is open, control power circuit is de-energized.

3.3 Set maximum and minimum output frequencies.

3.4 Set acceleration/deceleration rate.

3.5 When a safety switch is installed between an adjustable frequency drive and motor, provide a disconnect auxiliary contact in the drive run permissive circuit to shut down the drive when the safety switch is opened. This will prevent from overloading the drive at full voltage when the safety switch is reclosed.

End of Section

265000
Lighting

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid state luminaires that use LED technology.

2. Light fixture supports.

3. Emergency lighting units.

4. Exit signs.

1.2 SECTION REQUIREMENTS

A. Submittals: Product Data for each luminaire, including lamps.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.4 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fixtures, Emergency Lighting Units, Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

A. Exterior Luminaires: Comply with UL 1598, and listed and labeled for installation in wet locations by a Nationally Recognized Testing Laboratory acceptable to authorities having jurisdiction.

B. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

C. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

2.3 LAMPS

A. With characteristics as indicated.

2.4 LUMINAIRE FIXTURE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.

D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

2.5 EXIT SIGNS

A. Internally Lighted Signs: Comply with UL 924; for sign colors and lettering size, comply with authorities having jurisdiction.

1. Lamps for AC Operation: LEDs, 70,000 hours minimum of rated lamp life.

2.6 EMERGENCY LIGHTING UNITS

A. Description: Self-contained units complying with UL 924.

1. Battery: Sealed, maintenance-free, lead-acid type.

2. Charger: Fully automatic, solid-state type with sealed transfer relay.

3. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.

4. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:

1. Sized and rated for luminaire weight.

2. Able to maintain luminaire position after cleaning and relamping.

3. Provide support for luminaire without causing deflection of ceiling or wall.

4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

E. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.

2. Do not attach luminaires directly to gypsum board.

F. Ceiling-Mounted Luminaire Support:

1. Ceiling mount with two 5/32-inch-diameter aircraft cable supports adjustable to 120 inches in length.

G. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.

2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.

3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.

4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

H. Ceiling-Mounted Luminaires:

1. Secure to any required outlet box.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

End of Section

265613
Lighting Poles and Standards

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Poles and accessories for support of luminaires.

1.3 DEFINITIONS

A. EPA: Equivalent projected area.

B. Luminaire: Complete lighting fixture.

C. Pole: Luminaire-supporting structure, including tower used for large-area illumination.

D. Standard: See "Pole."

1.4 ACTION SUBMITTALS

A. Product Data: For each pole, accessory, and luminaire-supporting and -lowering device, arranged as indicated.

1. Include data on construction details, profiles, EPA, cable entrances, materials, dimensions, weight, rated design load, and ultimate strength of individual components.

2. Include finishes for lighting poles and luminaire-supporting devices.

3. Anchor bolts.

4. Manufactured pole foundations.

B. Shop Drawings:

1. Include plans, elevations, sections, and mounting and details.

2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

3. Foundation construction details, including material descriptions, dimensions, anchor bolts, support devices, and calculations, signed and sealed by a professional engineer licensed in the state of installation.

4. Anchor bolt templates keyed to specific poles and certified by manufacturer.

5. Method and procedure of pole installation. Include manufacturer's written installations.

1.5 INFORMATIONAL SUBMITTALS

A. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements according to AASHTO LTS-6-M and that load imposed by luminaire and attachments has been included in design. The certification shall be based on design calculations signed and sealed by a professional engineer.

B. Material Test Reports:

1. For each foundation component, by a qualified testing agency.

2. For each pole, by a qualified testing agency.

C. Source quality-control reports.

D. Field quality-control reports.

E. Sample Warranty: Manufacturer's standard warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For poles to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include pole inspection and repair procedures.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Pole repair materials.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for foundation testing.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store poles on decay-resistant skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

B. Retain factory-applied pole wrappings on metal poles until right before pole installation. Handle poles with web fabric straps.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of pole(s) that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within a specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs from special warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

2. Warranty Period for Corrosion Resistance: Five years from date of Substantial Completion.

3. Warranty Period for Color Retention: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Characteristics: Comply with AASHTO LTS-6-M.

B. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied according to AASHTO LTS-6-M.

C. Live Load: Single load of 500 lbf distributed according to AASHTO LTS-6-M.

D. Ice Load: Load of 3 lbf/sq. ft., applied according to AASHTO LTS-6-M for applicable areas on the Ice Load Map.

E. Wind Load: Pressure of wind on pole and luminaire, calculated and applied according to AASHTO LTS-6-M.

1. Basic wind speed of 115 mph.

a. Minimum Design Life: 25 years.

b. Velocity Conversion Factor: 1.0.

F. Strength Analysis: For each pole, multiply the actual EPA of luminaires and brackets by a factor of 1.1 to obtain the EPA to be used in pole selection strength analysis.

G. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.

2.2 STEEL POLES

A. Source Limitations: Obtain poles from single manufacturer or producer.

B. Source Limitations: For poles, obtain each color, grade, finish, type, and variety of pole from single source with resources to provide products of consistent quality in appearance and physical properties.

C. Poles: Comply with ASTM A 500/A 500M, Grade B carbon steel with a minimum yield of 46,000 psig; one-piece construction up to 40 feet in height with access handhole in pole wall.

1. Shape: Square, straight.

2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

D. Steel Mast Arms: Single-arm type, continuously welded to pole attachment plate. Material and finish same as plate.

E. Brackets for Luminaires: Detachable, cantilever, without underbrace.

1. Adaptor fitting welded to pole, allowing the bracket to be bolted to the pole-mounted adapter, then bolted together with stainless-steel bolts.

2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire. Match pole material and finish.

F. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

G. Fasteners: Stainless steel, size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.

1. Materials: Compatible with poles and standards as well as the substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.

2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.

H. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Section 260500 "Common Work Results for Electrical," listed for attaching grounding and bonding conductors of type and size indicated, and accessible through handhole.

I. Handhole: Oval shaped, with minimum clear opening of 2-1/2 by 5 inches, with cover secured by stainless-steel captive screws.

J. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.

K. Galvanized Finish: After fabrication, hot-dip galvanize according to ASTM A 123/A 123M.

L. Powder-Coat Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces according to SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair powder coat bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.

2. Powder Coat: Comply with AAMA 2604.

a. Electrostatic-applied powder coating; single application and cured to a minimum 2.5- to 3.5-mils dry film thickness. Coat interior and exterior of pole for equal corrosion protection.

b. Color: Black.

2.3 POLE ACCESSORIES

A. Base Covers: Manufacturers' standard metal units, finished same as pole, and arranged to cover pole's mounting bolts and nuts.

2.4 MOUNTING HARDWARE

A. Anchor Bolts: Manufactured to ASTM F 1554, Grade 55, with a minimum yield strength of 55,000 psi.

1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.

2. Bent rods length per drawings.

3. Threading: Uniform National Coarse, Class 2A.

B. Nuts: ASTM A 563, Grade A, Heavy-Hex

1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.

2. Two nuts provided per anchor bolt, shipped with nuts pre-assembled to the anchor bolts.

C. Washers: ASTM F 436, Type 1.

1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.

2. One washers provided per anchor bolt.

2.5 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine poles, luminaire-mounting devices, lowering devices, and pole accessories before installation. Components that are scratched, dented, marred, wet, moisture damaged, or visibly damaged are considered defective.

C. Examine roughing-in for foundation and conduit to verify actual locations of installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 POLE FOUNDATION

A. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123 M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories.

B. Anchor Bolts: Install plumb using manufacturer-supplied steel template, uniformly spaced.

3.3 POLE INSTALLATION

A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on pole.

B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features:

1. Fire Hydrants and Water Piping: 60 inches.

2. Water, Gas, Electric, Communications, and Sewer Lines: 10 feet.

3. Trees: 15 feet from tree trunk.

C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are indicated on drawings.

D. Poles and Pole Foundations Set in Concrete-Paved Areas: Install poles with a minimum 6-inch-wide, unpaved gap between the pole or pole foundation and the edge of the adjacent concrete slab. Fill unpaved ring with pea gravel. Insert material to a level 1 inch below top of concrete slab.

E. Raise and set pole using web fabric slings (not chain or cable) at locations indicated by manufacturer.

3.4 CORROSION PREVENTION

A. Steel Conduits: Comply with requirements in Section 260500 "Common Work Results for Electrical." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50-percent overlap.

3.5 GROUNDING

A. Ground Metal Poles and Support Structures: Comply with requirements in Section 260500 "Common Work Results for Electrical."

1. Install grounding electrode for each pole.

2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

3.6 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260500 "Common Work Results for Electrical."

3.7 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Inspect poles for nicks, mars, dents, scratches, and other damage.

2. System function tests.

End of Section

265619
LED Exterior Lighting

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.

2. Luminaire supports.

B. Related Requirements:

1. Section 265613 "Lighting Poles and Standards" for poles and standards used to support exterior lighting equipment.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color rendering index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of luminaire.

1. Arrange in order of luminaire designation.

2. Include data on features, accessories, and finishes.

3. Include physical description and dimensions of luminaire.

4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.

5. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project.

    a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.

    b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

6. Wiring diagrams for power, control, and signal wiring.

7. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.

B. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

C. Delegated-Design Submittal: For luminaire supports.

1. Include design calculations for luminaire supports.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of the following:

1. Luminaire.

B. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.

C. Source quality-control reports.

D. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and photoelectric relays to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.

2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: Two for each type and rating installed.

2. Glass, Acrylic, and Plastic Lenses, Covers, and Other Optical Parts: Two for f each type and rating installed.

3. Diffusers and Lenses: Two of each type and rating installed.

4. Globes and Guards: Two of each type and rating installed.

1.8 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products and complying with applicable IES testing standards.

C. Provide luminaires from a single manufacturer for each luminaire type.

D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

E. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.10 FIELD CONDITIONS

A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.

1.11 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Structural failures, including luminaire support components.

    b. Faulty operation of luminaires and accessories.

    c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: 5 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. UL Compliance: Comply with UL 1598 and listed for wet location.

C. Lamp base complying with ANSI C81.61.

D. Bulb shape complying with ANSI C79.1.

E. CRI of 70. CCT of 4100 K.

F. L70 lamp life of 35,000 hours.

G. Lamps dimmable from 100 percent to 0 percent of maximum light output.

H. Internal driver.

I. Nominal Operating Voltage: 240 V ac.

J. In-line Fusing: On the primary for each luminaire.

K. Lamp Rating: Lamp marked for outdoor use.

L. Source Limitations: Obtain luminaires from single source from a single manufacturer.

M. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.2 LUMINAIRE TYPES

A. Area and Site:

1. 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:

    a. Architectural Area Lighting.

    b. Atlas Lighting Products.

    c. Cooper Lighting, an Eaton business.

    d. Deco Lighting.

    e. Gallium Lighting, LLC.

    f. GE Lighting Solutions.

    g. H.E. Williams.

    h. Howard Lighting Products.

    i. Juno Lighting Group by Schneider Electric.

    j. KIM Lighting.

    k. Lightolier; a Philips group brand.

    l. Lithonia Lighting; Acuity Brands Lighting, Inc.

    m. Luraline Lighting.

    n. OSRAM SYLVANIA.

    o. RAB Lighting.

    p. Or Approved Equal.

2. Luminaire Shape: Square.

3. Mounting: Pole with extruded-aluminum rectangular arm, 11 inchesin length.

4. Luminaire-Mounting Height: 25 feet.

5. Distribution: Per schedule.

6. Housings:

    a. Extruded-aluminum housing and heat sink.

    b. Anodized finish.

2.3 MATERIALS

A. Metal Parts: Free of burrs and sharp corners and edges.

B. Sheet Metal Components: Corrosion-resistant aluminum. Form and support to prevent warping and sagging.

C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.

D. Diffusers and Globes:

1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

2. Glass: Annealed crystal glass unless otherwise indicated.

3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

F. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:

1. White Surfaces: 85 percent.

2. Specular Surfaces: 83 percent.

3. Diffusing Specular Surfaces: 75 percent.

G. Housings:

1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.

2. Provide filter/breather for enclosed luminaires.

H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:

a. "USE ONLY" and include specific lamp type.

b. Lamp diameter, shape, size, wattage and coating.

c. CCT and CRI for all luminaires.

2.4 FINISHES

A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electronically deposited color coating 0.018 mm or thicker), complying with AAMA 611.

a. Color: Black.

2.5 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Comply with NECA 1.

B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Install lamps in each luminaire.

D. Fasten luminaire to structural support.

E. Supports:

1. Sized and rated for luminaire weight.

2. Able to maintain luminaire position after cleaning and relamping.

3. Support luminaires without causing deflection of finished surface.

4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

F. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.

G. Wiring Method: Install cables in raceways. Conceal raceways and cables.

H. Install luminaires level, plumb, and square with finished grade unless otherwise indicated. Install luminaires at height indicated on Drawings.

I. Coordinate layout and installation of luminaires with other construction.

J. Comply with requirements in Section 260500 “Common Work Results for Electrical” wiring connections and wiring methods.

3.3 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Section 260500 “Common Work Results for Electrical” in concrete foundations, wrap conduit with 0.010-inch thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260500 “Common Work Results for Electrical.”

3.5 FIELD QUALITY CONTROL

A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

B. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

2. Verify operation of photoelectric controls.

C. Illumination Tests:

1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s):

a. IES LM-5.

b. IES LM-50.

c. IES LM-52.

d. IES LM-64.

e. IES LM-72.

2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

D. Luminaire will be considered defective if it does not pass tests and inspections.

E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

End of Section

APPENDIX A

Alfa Laval Centrifuge Specification

Part 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all materials, equipment, appurtenances and delivery as required to provide a complete centrifuge for processing wastewater sludge.

B. Each centrifuge shall be a complete unit.

C. The centrifuge unit shall be the product of suppliers regularly engaged in the design and manufacture of centrifuges and shall be specifically designed for the intended conditions of service. Appurtenant equipment shall be new and shall be designed, fabricated and assembled in accordance with the best engineering and shop practices. Individual parts shall be manufactured to standard sizes and gauges. Components of the centrifuge shall be designed for the stresses that may occur during fabrication, shipping, erection, operation, or maintenance. Materials shall be suitable for service conditions and as described herein.

1. The centrifuge manufacturer will be responsible for providing a complete centrifuge system, as described herein, and for delivering the equipment to the job site.

2. The centrifuge and the controls shall each be tested prior to shipment.

3. The equipment will be shipped in a minimum number of components; and they will typically be comprised of the centrifuge assembly with drive and back drive, control panel, and other parts.

1.02 SYSTEM DESCRIPTION

A. General

1. The centrifuge specified herein are of the counter-current design, horizontal, solid bowl type. The bowl of the centrifuge must be removed vertically from the frame and casing.

2. Each centrifuge shall be continuously fed sludge conditioned with polymer by individual progressive cavity type feed pumps. The sludge shall be fed into the center of the equipment where the solids are thrown against the wall of the bowl, which is rotating at high speeds thus generating high centrifugal forces. An internal screw conveyor shall continuously move the solids deposited against the bowl wall to one end of the machine where they are plowed up and discharged out a solids discharge chute. The cake shall discharge freely into a cake chute and the clarified liquid shall continuously flow over adjustable weirs at the other end of the machine where it discharges into a centrate chute. The centrifuges shall be provided with back drives to infinitely vary the speed of the conveyor to optimize sludge processing.

1.03 WARRANTY

A. Warranty

1. Each unit shall be warranted to be free from defects in materials and workmanship for a period of twelve months after successful completion of Acceptance Testing, beneficial use, or for a period not to exceed eighteen months from shipment, whichever occurs first. The warranty shall cover all repairs for all systems furnished by the manufacturer. Manufacturer shall repair or replace, at its option, any such equipment found to be defective, provided written notice of the alleged defect

is received within twelve months after successful completion of Acceptance Testing, beneficial use, or for a period not to exceed eighteen months from shipment.

1.05 CENTRIFUGE SELECTION

A. Alfa-Laval Series **ALDEC** model High Performance Decanter.

B. Alternate manufacturers will be considered as alternate bidders.

Part 2 PRODUCTS

2.01 GENERAL

A. The centrifuge shall be a solid bowl, horizontal, scroll type unit and shall be specifically designed to handle the sludge specified above. The centrifuge shall be capable of continuous (or intermittent) operations with minimum of maintenance and operation supervision.

B. The centrifuge shall be equipped with:

1. Rotating Assembly with Gearbox
2. Casing and frame
3. Feed tube
4. Vibration isolators
5. Main Drive motor
6. Back drive assembly
7. Cover switch
8. Vibration switch
9. Operating controls

2.02 MATERIALS

A. All wetted parts of the centrifuge rotating assembly shall be 316, or Duplex stainless steel, except for the O-rings, seals, and abrasion-resistant material. O-rings shall be Nitrile rubber (NBR); lip seals shall be Nitrile rubber (NBR).

B. The feed tube will be constructed of AISI 316 stainless steel.

C. The frame will be fabricated from box beam profile in mild steel and shall contain no weighted aggregate.

D. The upper casing will be AISI 304, AISI 316 or Duplex stainless steel with 316 stainless protecting the wetted parts of the lower casing. Fiber glass covers should not be considered as they may be unsafe.

B. The belt guards are integrated into the upper casing.

2.03 CENTRIFUGE

A. Bowl

1. The bowl shall be manufactured from centrifugal spun castings of duplex stainless steel and designed to operate at a maximum of 3,550 x G at the inside bowl wall diameter for maximum process flexibility and reliability and to withstand all centrifugal forces encountered at design

operating speeds with adequate safety factors. Rolled and welded or static cast bowls shall not be allowed. The bowl shall be inspected for cracks, shrinkage, porosity, or other defects and independently balanced.

2. The centrifuge bowl shall be supported by bearings mounted in pillow blocks and fitted for convenient lubrication. Main bearings shall have a calculated life of at least 100,000 hours at standard operating speeds in accordance with DIN ISO 281 requirements or SKF New Life bearing calculations.

3. Flow through the centrifuge shall be counter-current such that there are no centrate tubes to maintain. Pond depth shall be readily adjustable via weirs located at the large diameter end of the bowl without removing the rotating assembly from the frame.

B. Scroll Conveyor

1. The centrifuge shall include an AISI 316 stainless steel hub for the horizontal conical-cylindrical scroll conveyor. The conveyor shall be equipped with solid helical flights independently mounted concentrically within the bowl. The scroll shall utilize a differential speed to convey solids from the cylindrical section to the conical section and out of the bowl with a minimum disturbance to the pool, and to the maximum advantage of the variable speed back drive described in this section. The scroll conveyor shall be supported on grease lubricated anti-friction ball or roller bearings sealed from process contamination. The scroll assembly shall be independently balanced.

2. The edge and the face of the conveyor flights shall be protected from wear as described in the abrasion protection section, paragraph 2.03.H.

3. The scroll conveyor shall be designed such that the feed leaving the feed tube is accelerated in a feed zone. The feed material leaving the conveyor hub will pass through hard surfaced feed ports. The feed shall be evenly discharged into the bowl. The flights on the conveyor shall be solid, designed with flow equalization windows to allow axial flow of centrate for minimum disturbance to the pool and maximum settling of fine particles. Ribbon flights should not be considered as they are weaker and may bend due to the scroll torques the process sludge will generate.

C. Gear Box

1. The centrifuge shall be equipped with a multistage planetary gearbox to provide control of the differential speed between the centrifuge bowl and conveyor.

2. Lubricating oil is self-contained and shall be high performance gear oil.

3. The gearbox shall be independently balanced from the centrifuge, and interchangeable. Each gear unit should be protected from damage due to high torque overload

4. A thermal overload protection device shall not be considered as providing for sufficient protection for the gear unit.

5. Hydraulic drive units or externally cooled gearboxes will not be acceptable.

D. Frame and Casings

1. The rotating assembly and bearings of the centrifuge will rest on a steel frame.

2. The frame and casing shall be supplied on a modular frame and shall be fabricated from structural tubular steel. The modular frame shall support both the drive motor and back drive motor and shall provide a minimum clearance as specified in the general dimension drawing from floor to the casing solids and liquid discharge openings.

3. The bottom of the casing shall be fitted with a flexible connector and a solids outlet funnel for cake discharge. The liquid (centrate) discharge shall be fitted with a flexible connection and an 8-inch hose connection liquid outlet funnel. The lower casing shall be fabricated from carbon steel with stainless steel cladding on the wetted parts.

4. The casing assembly will be provided with a stainless steel upper casing, specifically designed for rigidity and noise reduction. The case shall be designed to act as a protective guard and to provide a complete enclosure for odor containment. The casing top shall be gasketed. A cover switch shall be provided so that the centrifuge cannot be started when the cover is open.

5. Vibration isolators for the drive motor and back drive shall be supplied as required. Junction boxes for all centrifuge mounted switches, except those specifically related to the main drive motor, shall be mounted on the base.

E. Feed Tube

1. Sludge shall be fed to the centrifuge by means of a positive displacement pump, supplied by others, suitable to minimize turbulence and pulsation. The minimum inlet pressure to the centrifuge shall be 5 psig (when used on water with viscosity of 1 Centipoise).

2. The feed connection to the centrifuge shall be a 150 lb. flange connection. The feed tube shall also include a three-quarter inch NPT (3/4”) connection for polymer.

F. Drive System

1. The bowl drive system shall consist of an electric motor and a belt drive system. The belt drive system shall consist of multiple belts as required to provide full capacity and to withstand the full starting torque of the system.

2. The drive system shall use one motor for the bowl drive and a separate back drive motor for differential adjustment.

G. Back Drive System

1. The centrifuge shall be furnished with a complete direct coupled back drive system to control differential speed between the conveyor and the bowl. The back drive shall provide an adjustable differential speed variation over its range of operation.

2. Each back-drive system shall be furnished with all the required instrumentation and electrical controls to meet the operating requirements of this specification.

3. Back drives utilizing hydraulic drive, or water-cooled units will not be acceptable.

H. Abrasion Protection

1. To minimize wear due to abrasive materials in the feed, replaceable hard surfacing shall be provided at all points where the abrasive action of the sludge will cause wear on the metal parts of the centrifuge. The following shall be considered a minimum degree of hard surfacing required.

   a. Bowl Wall: The bowl wall and conical extensions shall be protected with minimum of eight (8) welded ribs of stainless steel or Stellite designed to trap a protective layer of solids between the bowl wall and the conveyor.

   b. Conveyor Feed Zone: The conveyor feed ports shall be protected from abrasion by field replaceable solid sintered tungsten carbide wear liners. These pieces take the wear due to the acceleration in the feed zone.

   c. Solids Discharge Ports: The solids discharge ports shall be protected from abrasion by field replaceable tungsten carbide wear saddles.

   d. Solids Discharge Casing: a replaceable stainless steel or urethane insert shall protect the solids discharge casing.

   e. Scroll Conveyor Flights: The edge and face of the conveyor flights shall be protected against abrasion from the solids by a series of welded-on sintered tungsten carbide tile assemblies from two wraps beyond the feed zone through the solids discharge end. Each tile assembly shall be weight correct and consist of a solid sintered tungsten carbide wear part brazed to a stainless steel or Stellite back-up plate. Each assembly shall be individually replaceable and shall include the ability to monitor wear by means of visual inspection. Spray hard surfacing applied to a back-up plate will not be allowed. The tile assemblies must extend 0.5 inches beyond the radial edge of the conveyor flight. The remaining scroll conveyor edge and face shall be protected from abrasion by flame sprayed hard surfacing containing a minimum of 40% tungsten carbide particles. Stellite or ceramic hard surfaced tiles are not acceptable.

2.04 NOISE AND VIBRATION

A. The centrifuge shall be equipped with noise suppression devices of an energy efficient design, such that the average noise level measured at three (3) feet around the periphery of the complete centrifuge assembly shall not exceed the 81 dB(A) when tested at the manufacturing facility without feed and with the inlet and discharge closed.

B. The centrifuge, when running without feed, shall be measured for vibration at the manufacturing facility. The vibration shall be less than or equal to 6.5 mm/s RMS when measured at the pillow blocks under dry shop conditions.

C. The centrifuge shall be equipped a device to monitor against excessive vibration. The monitor shall be interlocked with the controls to shut down the centrifuge if excessive vibration is detected. The vibration monitor shall provide an output to the PLC for display and monitoring on the HMI.

2.05 LUBRICATION

A. The gearbox lubrication shall be self-contained and consist of high performance gear oil.

B. All bearings on the centrifuge shall be grease lubricated through suitably located fittings. As an option, main bearings can be grease lubricated by means of an automatic grease lubrication system.

2.06 VIBRATION ISOLATORS

A. The centrifuge shall be mounted on rubber-type vibration isolators. The number and vibration constant of the isolator shall be as recommended by the manufacturer for the load and impact resulting from the operation of the centrifuge provided. The vibration isolators do not use built-in leveling bolts. The centrifuge is shimmed to level during its installation.

2.07 ANCHOR BOLTS

A. Anchor bolts shall be recommended by the centrifuge manufacturer and shall be supplied by the installing contractor. Anchor bolts shall be 304 stainless steel.

2.08 FLEXIBLE CONNECTORS

A. There shall be no rigid connections to the centrifuge.

B. To insure a quiet installation, flexible connectors shall be provided to isolate the centrifuge from the building structure. Flexible connectors include the solids discharge splashguard, flexible feed connections, flexible centrate connection, and flexible polymer connection for the feed tube. These items are to be supplied by the centrifuge manufacturer:

1. The flexible solids splashguard shall be 12 inches long and constructed of 1/8-inch black neoprene. All hardware shall be constructed of 304 stainless steel.

2. The flexible feed connection shall be 23 inches long and constructed of black neoprene hose with a 3-inch Ø hose clamp fitting mounted on a 4-inch 150 lb. flange connection.

3. The flexible centrate connection shall be 8 inches long and constructed of black neoprene with a 1/ 8 inch 150 lb. flange connection.

4. The flexible polymer connection shall be a 12 inches long hose with a custom connector on the centrifuge feed tube side and a three-quarter inch NPT polymer connection to process piping.

C. The installing contractor shall furnish all electrical flexible connectors including: drive motor, back drive motor and centrifuge junction boxes. The installing contractor shall insure that all electrical codes are met.

2.09 STANDARD TOOLS AND SPARE PARTS

A. One set of the following standard tools to be provided to assemble and disassemble the centrifuge as required by the owner. The following tools shall be supplied as a minimum:

1. 1 set of Special tools including bowl lifter and conveyor lifter.
2. 1 set of lubricants for start-up
3. 1 set spare drive belts
4. 1 complete set of main and conveyor bearings, including O-rings

2.10 PAINT SYSTEM

A. Paint system shall be manufactures standard system consisting of a catalyzed epoxy primer and a top coating of aliphatic acrylic urethane. All carbon steel and cast iron shall be properly prepared and cleaned in accordance with standard practice. A total of seven mils for primer and finish coat shall be applied.

2.11 CONTROLS & MOTORS

A. General

The control system shall be complete with a NEMA 4X centrifuge operator control panel capable of being mounted on a stand or wall, and a NEMA 4X free standing starter/back drive panel.

B. Operator Control Panel

The centrifuge operator control panel shall contain a minimum 10" graphic color operator interface. Indication for running, off, and fault indication of all major components, elapsed time meter, and alarm acknowledge/lamp reset push-button shall be included in the screen. An emergency stop-push-button and an alarm horn shall also be provided.

1. All components in the control panel shall be completely factory wired. All external control connection points shall terminate on terminal blocks with ferrules on wire ends to prevent fraying of wires during connection and servicing. There shall be a minimum of 10% spare terminal connection points supplied.

2. The enclosure shall be 304 stainless steel.

3. The centrifuge is monitored, and the back drive is controlled by the Allen Bradley PLC located in the centrifuge starter panel. The PLC controls differential rpm in the speed control mode and scroll torque in the automatic control mode. The Human Machine Interface (HMI) provides digital display of bowl speed, pinion speed, delta rpm, vibration, bearing temperature, and torque. Applicable set point values are entered via the HMI.

4. Logic is by the PLC and the associated Allen Bradley HMI. The HMI consists of a color display. All operator functions described below will be provided through menus and keys on the HMI.

5. The HMI shall be capable of automatic or manual start/stop operations, as well as provide display readings of the following:

    a. Centrifuge drive motor amps,
    b. sludge and polymer actual flow rates,
    c. sludge and polymer desired flow rates,
    d. bearing temperature if specified,
    e. vibration,
    f. fault monitoring, and pre-set and actual timing operations,
    g. local/remote control status, and auto/manual control status,
    h. back drive torque,
    i. back drive speed,
    j. differential speed,
    k. and bowl speed

6. The HMI shall be supplied with selector keys to allow the operator to toggle between feed pump 1 or feed pump 2 and polymer pump 1 or polymer pump 2, and up to two cake conveyors which are supplied by others.

7. Control wire shall be #16 AWG minimum, shall conform to UL standards, and shall be type THHN, THW or MTW.

8. Nameplates shall agree with the wiring diagram and shall be made of 1/16" thick laminated acrylic. Letters shall be black on a white background to prevent obscuring text with dirt build-up and shall be 1/8" in height.

9. The centrifuge shall be equipped with vibration monitoring. The monitor shall be interlocked with the controls to shut down the centrifuge if excessive vibration is sensed. The monitors shall provide a signal proportional to the vibration magnitude for display and monitoring at the HMI. The centrifuge shall be equipped with a cover switch so the centrifuge cannot be started when the cover is open.

10. Field mounting of the control panel and interconnecting wiring between the centrifuge, control panel, and starter panel shall be provided by the installing contractor.

C. Centrifuge Starter/Back Drive Panel

1. The centrifuge starter/back drive panel shall be a free standing ventilated enclosure, containing a main circuit breaker with a through the door handle, a common buss variable frequency drive (VFD) system for the centrifuge back drive motor and drive motor, and a back-drive motor blower starter (if applicable). The VFD system shall be sized in accordance with the centrifuge manufacturer's design requirements and shall be as specified in the Variable Frequency Drive section of this specification. The drive system shall be capable of a flying restart after shutdown including power outage. The main circuit breaker shall be a 22,000-symmetrical amp thermal magnetic breaker sized in accordance with centrifuge system requirements. A duplex 120 VAC receptacle for customer use up to 3 amps, non-inductive loads shall be mounted internal to the enclosure.

2. The enclosure is to be painted with enclosure manufacturers standard paint system.

3. A 24 V D.C. internal power supply and U.P.S. for the PLC and associated HMI shall be provided. All +24 VDC power supplies must provide short circuit fold back protection.

4. The control system shall have the capability to be hardwired to ancillary equipment supplied by others such as conveyors, feed pumps, diverter gates, etc.

5. The control system shall interface directly with a plant SCADA or DCS system via an Ethernet communication cable.

6. In the event of a power outage the control system shall have the ability to provide protection that will allow the centrifuge to run through a short duration power blip, generally defined as 3-5 seconds before starting a shutdown sequence. If power is restored during this time the feed pump and polymer pump will not have shut down and production will continue.

   Should the power not be restored during this interval, the control system must allow the centrifuge to be brought to a stop in a normal shutdown mode (as if it had power); maintaining the differential speed during the coast down period. This system will allow the centrifuge to scroll the solids out and be available for an immediate restart, once power is restored.

7. Control wire shall be #16 AWG minimum, shall conform to UL standards, and shall be type THHN, THW or MTW.

8. A ground lug shall be supplied on the panel. All customer interface contacts are provided through isolated 10 amp interposing relays. Contacts shall be suitable for 24 VDC or 120 VAC control. The control system shall provide 24 V DC control voltage for all external inputs.

9. The PLC shall be supplied so all programs and settings are retained if a power supply failure occurs. Digital and analogue I/O units shall be supplied.

10. Each wire segment shall be numbered at each end using tubular heat shrinkable markers with permanent mechanically stamped. The wire numbers shall correspond to those on the wiring diagram. Wrap around or clip type numbers are not acceptable.

11. Nameplates shall agree with the wiring diagram and shall be made of 1/16" thick laminated acrylic. Letters shall be black on a white background to prevent obscuring text with dirt build-up and shall be 1/8" in height.

D. Drive Motor

1. The motor shall be a squirrel cage induction motor suitable for VFD starting, TEFC, continuous duty, with a non-hydroscopic class F insulation system limited to a B temperature rise, 1.0 service factor on sine wave, NEMA design B, standard long shaft for v-belt drive, and terminal box rotatable in 180-degree increments. The motor shall be provided with thermal protection using a bi-metal thermal switch or thermistor. The motor shall have copper windings and be of high thermal capacity design for operation on 460/3/60 power. Fluid coupling/clutch starting systems shall not be allowed due to maintenance concerns.

2. With the motor at ambient temperature, it shall be capable of making (2) complete starts in succession with coasting to rest between starts. The motor shall be capable of one (1) immediate restart after of any shutdown except motor overload. The motor shall not take longer than five minutes (each start) to accelerate to full rated rpm on at 90% nameplate voltage while maintaining operation below name plated full load amps. The motor shall be rated by the motor manufacturer as having a noise level not exceeding 85 dB(A) (sound pressure) when measured at three (3) feet from the motor in any direction. The motor bearings shall be grease lubricated ball or roller anti-friction type of standard manufacture. The bearings shall be conservatively designed to withstand all stresses of the service specified. Motor bearings shall have a minimum life rating of 40,000 hours of operation.

3. Motor shall be Baldor or approved equal.

E. Back Drive Motor

1. The motor shall be a premium efficiency squirrel cage induction motor for VFD duty, TEBC - blower cooled or TEFC, continuous duty, 1.0 service factor, NEMA design B, with class F insulation and class B rise, and a pinion pickup sensor for pinion speed feedback control. The motor shall have copper windings and be designed for operation on 460/3/60 power and balanced for centrifuge operation. Thermal protection in the motor shall be bi-metallic thermostat. The VFD system shall be sized in accordance with Centrifuge Manufacturer's design requirements and shall be as specified in the Variable Frequency Drive section of this specification. The motor shall be capable of delivering full load torque across a 20:1 turn down ratio. The drive system shall be capable of a flying restart. Hydraulic back drive systems shall not be allowed.

2. Motor shall be Baldor or approved equal.

F. Main Drive & Back Drive – Variable Frequency Drive

1. The Main Drive VFD and Back Drive VFD shall be housed in the Centrifuge Starter/Back Drive Panel, containing both AC (VFD) motor controllers and a backdrive motor blower starter (if applicable). The main drive and back drive AC motor (VFD) controller shall be a flux vector controlled, sine coded, PWM drive.

a. Output contactors must be provided for each VFD to ensure positive power disconnect on over speed, emergency stop fault, and at reset conditions. A positive speed measurement device must be provided for over speed protection.

b. The drive shall include the following minimum features:

1) IGBT (Insulated Gate Bipolar Transistor) power module.
2) On-board alphanumeric digital display for programming and indication of set-up operating, circuit analysis, and diagnostic data.
3) Set-up parameters shall be stored in EPROM memory that does not require battery back-up.
4) UL, Canadian UL, or CSA Labels.
5) Product of ISO 9001 certified production facility.
6) Designed to provide 100,000 hours mean time between failures with specified preventative maintenance.
7) Inner loop torque control strategy with mathematical torque and flux calculation updates every 25 microseconds (40,000 times per second).
8) Operation from 3-phase power rated 380 to 480 VAC +/- 10% and 48 to 63 Hz.
9) The drive shall employ a Full Wave rectifier to prevent input line notching and operate at fundamental power factor of 0.98 at all speeds and loads.
10) Drive efficiency shall be 97% or higher at full speed and load.
11) An internally mounted line reactor shall be provided to reduce input current harmonic content, provide protection from power line transients such as utility power factor correction capacitor switching transients and reduce RFI emission.
12) An automatic motor parameter ID function shall define the motor equivalent circuit in the VFD.
13) Flux optimization to limit the audible noise produced by the motor and to maximize the efficiency by providing the optimum magnetic flux for any given speed/torque operating point.
14) VFD drives shall be equipped with communication module to allow communication with control system.

c. As a minimum the drive will include the following adjustable parameters and indication.

1) Adjustable Parameters

a) Torque Limit Level
b) Minimum/Maximum RPM
c) Output signal selection and scaling
d) Input signal scaling
e) Preset speeds
f) Motor full load current
g) Motor Base RPM

2) Indication

a) Motor torque
b) Motor Current
c) Motor Speed

d) Motor Speed Set-point
e) Motor Power
f) External Torque Reference
g) DC Buss Voltage
h) Motor Temperature
i) Run Time Hours

d. Cables

1) Cables between the VD's and Motors shall be symmetrical shielded cable with three phase conductors and a concentric PE conductor as a shield. The shield must meet the requirements of IEC 61439-1. Also acceptable is a symmetrical shielded cable with three phase conductors and symmetrically constructed PE conductor and a shield – PE conductor must meet the requirements of IEC 61439-1.
2) If the motor cable shield is used as the sole protective earth conductor of the motor, ensure that the conductivity of the shield is sufficient (see IEC 61439-1). To effectively suppress radiated and conducted radio-frequency emissions, the cable shield conductivity must be at least 1/10 of the phase conductor conductivity.

2. Main Drive System Performance

a. Speed regulation of 0.4% or better
b. 100% Torque output in all Four Quadrant Control when required
c. Torque signal accuracy of +/- 5%
d. Torque limiting of motor torque, 0 – 200%

3. VFD drives shall be ABB or Allen Bradley.

4. Centrifuge VFD requirements are unique to centrifugation equipment. Centrifuge VFD requirements in this section shall take precedent over general VFD requirements for other equipment listed in the general equipment requirements or general electrical requirements.

G. Control System Operation

1. The centrifuge shall be able to be started automatically or manually. To automatically start the centrifuge, press "Start" key on the operator interface unit.

2. The control system will issue a "run" command to the centrifuge main drive motor and the bowl will begin to accelerate. The polymer and feed systems (by others) shall be interlocked with the centrifuge controls to prevent their operation at this time. During acceleration of the centrifuge, the system shall issue a "run" command to the back drive and a "start-up speed" command. This will make the back drive run at a pre-programmed start-up speed as set in the system to provide the maximum scrolling of residual solids from the bowl. After a pre-set, timed interval, during which the bowl has reached full operating speed and entered production mode, the feed and polymer pumps will then start automatically. As process requirements vary, the back drive speed shall be adjustable via the control system which shall maintain the set speed or torque utilizing a closed loop, feedback.

3. Automatic torque mode may also be selected at any time. In this mode the back-drive torque shall be maintained while the speed is allowed to vary, within pre-set limits, in order to maximize residence time. If torque begins to rise above the set point, the differential speed shall be increased to scroll solids out of the bowl at a faster rate, thereby lowering the torque back to the set point. The

system shall be equipped with a feature that will allow for manual adjustment of the PID Proportional, Integral and Derivative values from the operator interface. Separate software, computers, and communication cables shall not be required to activate this feature.

4. Upon stopping the centrifuge by pressing the " Stop" key on the operator interface unit, or via a fault condition, the feed and polymer system interlock contact shall open thereby insuring feed to the centrifuge is stopped. An auto flush valve will also be opened for a pre-determined time during shutdown.

5. A Clean-In-Place (CIP) function is also provided. This function is used for optimal cleaning of the centrifuge. The CIP run cycle can be started anytime the main drive motor is at rest as determined by the shutdown timer. Before initiation of the CIP start sequence, all faults must be cleared. A "CIP" key is pressed to begin the CIP cycle. The back drive will be energized and begin to rotate in the normal direction at a low speed for a predetermined time. At the same time, the main drive will accelerate the bowl to a low speed in the forward direction. At the end of the set time, the main drive will then toggle direction, causing a water "sloshing" effect within the centrifuge bowl and conveyor. The process will continue until the predetermined overall time ends, a "CIP" key is depressed, or a fault occurs. Any shutdown fault will terminate the CIP cycle.

H. Control System Fault Detection

1. In the event that a fault condition occurs, the sounding of an alarm horn will take place, and an alarm text fault message will be displayed on the operator interface unit to facilitate trouble shooting. An Alarm "Acknowledge" push-button, on the HMI interface, will flash when a fault condition occurs. When pressed, the horn will be silenced, and the flashing will turn solid. When the alarm fault is corrected, and reset, the solid light will be turned off.

2. The following faults shall be provided as alert conditions and shall shut off the feed pump, polymer system, and grinder as required:

   a. Feed pump fault
   b. Polymer system fault
   c. Grinder fault
   d. Cake conveyor fault
   e. Torque alert
   f. Low differential
   g. High Vibration
   h. Main or back drive motor shutdown
   i. Temperature
   j. Feed and polymer flow deviation (flow meter provided by others)

3. The following faults shall be provided as alarms and will cause shutdown of the Main Drive and Back drive motors:

   a. Main motor overheat
   b. Main drive malfunction
   c. Excessive vibration
   d. Back drive motor overheated
   e. Back drive malfunction
   f. Centrifuge cover open
   g. Torque alarm
   h. Centrifuge bowl over speed
   i. High bearing temperature

2.12 CONTROL – AUXILIARY EQUIPMENT INTERFACES

A. The following auxiliary control must be provided within the centrifuge control panel for use with currently installed equipment and future installed options. These features must be able to be enabled or disabled as required from the Operator Interface Unit. Centrifuge supplier to enable actual configuration at start-up.

B. Installing contractor is required to coordinate and ensure proper interface between the centrifuge control panel and auxiliary equipment supplied in other sections.

1. Positive Displacement Sludge Feed Pump Interface. The existing sludge feed pump is VFD controlled for speed adjustment and a hand-off-auto switch. In hand, the pump speed shall be controlled locally from the VFD, but still interlocked with the centrifuge feed permissive or a bypass valve position switch feedback signal. In the auto position, the pump shall accept a run command and a 4-20mA speed control signal from the centrifuge control system. In the off position, the pump shall be locked out of operation. The pump shall also be provided with on/off status contacts.

2. Positive Displacement Polymer Feed Pump Interface. The polymer feed pump shall be provided with a VFD for speed control and a hand-off-auto switch. In hand, the pump speed shall be controlled locally from the VFD, but still interlocked with the centrifuge polymer permissive or a bypass valve position switch feedback signal. In the auto position, the pump shall accept a run command and a 4-20 mA speed control signal from the centrifuge DMS. In the off position, the pump shall be locked out of operation. The pump shall also be provided with on/off status contacts.

3. Flow meter

   An existing flow meter signal shall be utilized to monitor/measure the sludge feed to the centrifuge prior to polymer addition. The existing flow meter shall provide a 4-20 mA output signal to the centrifuge DMS for indication and closed loop PID control of flow rate. The signal shall be scaled in accordance with the actual gpm range of the meter.

4. Packaged Polymer System Control Interface

   The packaged polymer system as specified in the RFP will have a self-contained local control panel with a hand-off-auto switch, a dilution water flow control valve, dilution water flow meter, and logic system to maintain constant dilute polymer concentration.

   In the off position, the polymer system shall be locked out of operation. In hand, the polymer system shall be controlled locally from the polymer system local control panel. The system shall accept a run command from the centrifuge. In the auto position, the dilution water control valve shall accept a 4-20 mA control signal from the centrifuge control system. The flow meter shall send a 4-20 mA output signal to the system for indication and display of the actual polymer flow rate.

5. Solenoid valves shall be provided by others for the CIP, Diverter Gate/Screw Conveyor Flush, and Centrifuge Flush water control. Please note that these are separate valves as the flow rate required for CIP, Diverter Gate/Screw Conveyor Flush, and Flush are different. If these valves are powered by the centrifuge control they need to be 24 VDC, if they are not powered by the centrifuge control panel a set of dry contacts shall be provided.

***The follow options shall be provided as part of the base bid centrifuge system*:**

Upper Casing Hinges

2.03.D.4 The centrifuge cover shall be supplied with spring loaded hinges to allow for ease of opening during maintenance or inspection (spring loading prevents cover from closing on its own). These hinges can be located on the left or right side.

Feed Zone

2.03.H.1.b For extreme wear or grit conditions the unit shall be provided with a feed zone of solid sintered tungsten carbide components.

Lubrication

2.05.C An automatic greasing system shall be provided for the main bearings. System shall consist of a frame mounted grease pump and tubing. Pump will allow for separate greasing levels for each of the main bearings and provide a low-level grease alarm. Control of the pump; duration between greasing and length of grease cycle, is from the decanter control panel.

2.05.D. Bearing temperature monitors shall be provided on each main bearing pillow block with an output signal sent to the PLC for display and monitoring at the HMI operator interface.

Controls and Motors

2.11.B.9 Bearing temperature sensors shall be provided on each pillow block, with an output signal sent to the HMI.

END OF SECTION

APPENDIX B

Alfa Laval Centrifuge Equipment Proposal

July 12, 2021

Town of Culpeper, Virginia
RFP Solicitation # DES-21-48001

July 12, 2021

To: Town of Culpeper
Town Operations Center
15038 Service Lane
Culpeper, VA 22701

Alfa Laval Inc.
5400 International Trade Drive
Richmond, VA 23231
Tel: 804-236-1265

Subject: Town of Culpeper – RFP Solicitation # DES-21-48001
Wastewater Sludge Dewatering Unit Replacement – Equipment Procurement and installation labor.
Alfa Laval Reference No: 0103981 Rev. 2

To whom it concerns:

On behalf of Alfa Laval and our local representative Sherwood-Logan & Associates, we are pleased to present this Proposal for Alfa Laval Centrifuge for dewatering of sludge based on the RFP Solicitation # DES-21-48001 Wastewater Sludge Dewatering Unit Replacement – Equipment Procurement and Add. #1.

One (1) ALDEC 75 Centrifuge will come complete and include the following scope of supply:

- Modular frame with process-contact areas in 316 stainless steel
- Vibration isolators
- Singular cover in 316 SS (covers belts, rotating assembly and gearbox)
- Abrasion protection (Tungsten Carbide on wear surfaces)
- Rotating assembly complete with 8 kNm DD gearbox and pillow block bearings
- All bearings grease lubricated
- Vibration and temperature sensors in main bearing housings
- Main drive Motor: 50 Hp AC VFD – Premium Efficiency Motors - Baldor
- Back drive Motor: 10 Hp AC VFD - Baldor
- Control of centrifuge during power loss or outage
- Factory Paint System

One (1) Centrifuge Starter Panel, **and Operator Panel**, complete assembled, prewired and shop tested including:

- Allen Bradley CompactLogix 5069-L320ER PLC
- 10 inch Allen Bradley PV7+ Performance HMI
- AnyBus Bolt WAP (WiFi Access Point) for control on iOS and Android devices
- ABB ACS 880 VFDs: Main Drive 60 HP, Back Drive 10 HP

- 1734 Point I/O Modules
- Dual Bearing Vibration Monitoring
- Configured for Direct Drive Gearbox
- 1Panel Configuration: NEMA 4X 24" x 24" HMI AND NEMA 4X 72" x 60" x 18" MCC
- Panel Input Power 380-480 VAC 3ph, 50/60 Hz
- 24 VDC Control with UPS
- UL-508A Standards with UL Label & Certificate
- SCADA Integration to Allen Bradley/ Rockwell System using TC/IP
- Gateway Dell E3002- Remote Support and Monitoring w/1 year Data Subscription
- Configured to support Auto Bearing Greasing System Control
- No AutoLube/Grease System
- No Feed Control Configured
- No Diverter or Conveyor Control Configured

One (1) lot of the following:

- 1-Feed Flexible Connection, 316SS/SBR 2-1/2" 150# Flange x 2-1/2" Suction/Discharge Hose x 26" Long, with 316SS Fasteners
- 1-Polymer Flexible Connection, 316SS/PTFE, 3/4" BSP x 3/4" NPT x 24" Long PTFE Lined Braided Hose
- 1-Solids Flexible Connection, 2-Ply CI Neoprene x 4" Tall EJ with 316SS Backer bars
- 1-Solids Support / Taber Chute, 316SS Floor Support Plate, 4" Solids Sample Port with 316SS Fasteners
- 1-Centrate Funnel, 316SS Funnel with 8" 125# Plate Flange and 8" Discharge Hose (Flexible Connection). Vent is not included.

One (1) Polymer Feed System: VeloBlend Model VM-30P-2400-Rp-1-A-2

Polymer Flow Range: 1.5 to 30 GPH
Dilution Water Flow: 4 to 40 GPM

Each unit shall include the following unless otherwise indicated:

Polymer Mixing Chamber:

A. Series: VeloBlend VM
B. Type: Staged Hydro-Mechanical
C. Mixer Motor: ½ HP, 90 VDC, 1750 RPM, wash-down duty
D. Mixer Shaft Seal: Mechanical with seal flushing assembly
E. VeloCheckTM Neat Polymer Check Valve with Quick Release Pin
F. Construction:
    1. Body: Stainless steel
    2. Impeller: Stainless steel
    3. Mechanical Seal: Ceramic, Carbon, Stainless steel, Viton
    4. Cover: Clear polycarbonate with stainless steel reinforced flange & discharge
G. Pressure Rating: 100 psi
H. Pressure Relief Valve: Brass

Neat Polymer Metering Pump Assembly:

A. PVC FNPT union style polymer inlet
B. Type: Progressive Cavity type

I. Motor: ½ HP, 1750 RPM, 90 VDC, Wash-down duty motor
J. Loss of polymer flow sensor
C. Metering pump calibration assembly with isolation valves
D. Plumbing: SCH. 80 PVC

Dilution Water Inlet Assembly shall be provided, including the following:
A. Stainless steel FNPT water inlet connection
B. Dilution water ON/OFF solenoid valve
C. Control Valve: Linear Actuated Automatic Flow Control Valve
D. Primary dilution water flow meter type: Paddle Meter
E. 0-160 psi inlet water pressure gauge (stainless steel, liquid filled)
F. Plumbing – SCH. 80 PVC

Solution Discharge Assembly:
A. Stainless steel FNPT solution discharge connection
B. 0-160 psi solution discharge pressure gauge (stainless steel, liquid filled)
C. Plumbing – SCH. 80 PVC

Control Panel:
A. Enclosure: NEMA 4X, FRP
B. Power:
1. Required: 120 VAC, 60 Hz., 1 Ph
2. Disconnect: 10′ power cord with 120VAC plug
C. Controller: VeloDyne
D. Operator Interface: 6″ Color TFT
E. Motor controllers:
1. Mixing Chamber
2. Neat polymer metering pump
F. Miscellaneous:
1. Control circuit protection
2. Control relays
3. Power supplies
4. Grounding blocks
5. Numbers terminal blocks
6. Wire labels, shrink-tube type
7. Cabling
G. Description:
1. The control system shall be designed to precisely control dilution water flow in proportion to polymer flow (polymer master) based on an operator input of desired solution concentration. The controller shall have two (2) modes of operation:
a. Manual Mode: Operator sets pump rate and water rate manually by increase and decrease push buttons on controller face.
b. Proportional Auto Mode: Operator sets desired solution concentration. Metering pump follows 4-20mA pump pacing input signal. Water rate is controlled to maintained desired solution concentration (i.e. for inline

applications where process flow fluctuates).

H. Operator Interface Functions:
1. System ON/OFF
2. Mode (change mode, select mode):
    a. Manual Mode
    b. Proportional Auto Mode
3. Set % Solution (proportional modes only)
4. Set Poly Rate (manual mode only)
5. Set Water Rate (manual and remote auto modes)
6. Polymer Pump Calibrated Value Input

I. Operator Interface Display:
1. Pump Rate
2. Water Rate
3. Solution Concentration
4. Status / Alarm Indicators:
    a. Low Water Flow Alarm
    b. Low Polymer Flow Alarm
5. Mode Select
6. Calibration Mode

J. Inputs (signals by others):
1. Remote Start / Stop (discrete dry contact)
2. Pacing Signal Based on Process Flow (4-20mA)

K. Outputs:
1. System Running (discrete dry contact)
2. Remote Mode (discrete dry contact)
3. Common Alarm (discrete dry contact)
4. Polymer Pump Rate (4-20mA)

L. Special Functions / Features:
1. Proportional control of water to polymer flow (ratio control) as outlined above
2. Programmable auto flush – keeps water control valve open for programmable amount of time when unit is shut-off.
3. Polymer pump rate input for calibration.

System Skid:

A. Frame: 304 stainless steel, open frame design for access to all components
B. Fasteners: 304 SS
C. Designed for bolt-down

Also included with pricing:

- Factory Paint System
- Freight to jobsite, DDP Incoterms 2020 (unloaded by others)
- One (1) year warranty against defects in materials and workmanship
- Service time as follows:
    - One trip and three days for inspection during installation
    - One trip and five days for start-up and performance testing
    - One trip and one day for operations and maintenance training

- One (1) set of tools and spare parts
    - One set of special tools including bowl lifter and conveyor lifter
    - One set of lubricants for start-up
    - One set of spare drive belts
    - One set of main and conveyor bearings including O-rings

Not included in pricing:

- Feed Inlet Manifold
- Field wiring, conduit, flexible connections
- Piping, Venting & Valves
- Anchor bolts
- Flow meters and Pressure gauges
- Conveyor
- Feed pump and Grinder/Macerator
- Polymer for startup or testing
- Lab fees for testing
- Unloading at jobsite
- Installation at the job-site
- Storage and Handling fees
- Taxes and bonds

The water supply available at each unit shall be as follows:

Bowl Flushing:	50 gpm @ 22- 45 psi
CIP Flushing	22 gpm @ 22- 45 psi
Temperature:	Ambient (40 - 90 F)

Cake capacity during a power loss condition for each centrifuge: 6.4 cu ft/0.24 cu yd

Control of centrifuge during power loss or outage:

The control of centrifuge during power loss or outage will allow the centrifuge to run through a short duration power blip, generally defined as 3-5 seconds. If the power outage extends past the 3-5 seconds the system will shut down the feed pump and polymer pump and put the centrifuge into the production standby mode for a programmed set time. If power is restored during this time the feed pump and polymer pump will automatically restart and production will resume.

Should the power not be restored, the control system will allow the centrifuge to be brought to a stop in a normal shutdown mode (as if it had power) maintaining the differential speed during the coast down period. This system will allow the centrifuge to scroll the solids out and be available for an immediate restart, once power is restored.

ONE (1) ALDEC 75 CENTRIFUGE, AS DESCRIBED ABOVE;	**$247,800.00**
Optional Adders:	**$ 27,000.00**

1. ADDER FOR FEED ZONE, LUBRICATION AND CONTROLS & MOTORS AS LISTED ON PAGE 14 OF THE ALFA LAVAL CENTRIFUGE SPEC. **2. Optional Polymer System:** **A. Additional Velodyne Simplex Skid (two stand alone systems for redundancy).** **Total sell price……**	 **$34,740.00** **$309,540.00**
PRICE VALIDITY	60 days
PAYMENT TERMS	10% upon Submittal Approval, NET 30 days 75% upon Delivery, NET 30 days 10% upon Substantial Completion, NET 30 days 5% Retainage
DELIVERY	**Submittals**: Estimated 8-12 weeks after executed PO **Equipment**: Estimated 21-22 (plus freight) weeks after submittal approval or release for manufacture. Please note, current ocean freight is 8-10 weeks for delivery.

Notes of Clarification / Exception

Exceptions:

1. The items listed on Page 14 of the Alfa Laval Centrifuge Specification Section (i.e. Feed Zone, Lubrication and Controls and Motors) are not included in our base offer. They are offered as optional items. Per conversation with Robert Mangrum with Mangrum Consulting (email dated Jan. 15), it was decided to offer these items as optional adders since our competitors' specification did not require them to include these items.

2. In the "Town of Culpeper Standard Contract for Goods, Services, Construction and Insurance" Section V) Item B) Hold Harmless: We require the following changes – add the word "reasonable" between "including" and "attorney's" in the first sentence. Also add "for personal injury, death, and third-party property damage" between "fees," and "arising" in the first sentence. Finally a "Limitation of Liability" needs to be added to this contract. The overall limitation of liability will be capped at 100% of the contract value.

Clarifications:

1. Warranty covers defects in materials and workmanship for twelve (12) months after startup or beneficial use or eighteen months (18) months after shipment, whichever comes sooner. Alfa Laval reserves the right to review operating and maintenance records to ensure compliance.

2. Service time for start-up assistance is included with this price. Any additional service time resulting from non-warranty delays will be charged at the rate in effect at the time of service.

3. Alfa Laval will size anchor bolts. Anchor bolts are to be supplied by the installing contractor.

4. Contractor shall remain responsible for meeting all relevant electrical codes.

5. The process performance (cake solids, loading, hydraulic throughput, etc.) achieved by the centrifuges can be guaranteed after confirmation of the quality of the feed sludge through the analysis of a representative sample.

6. Anything not explicitly stated in this proposal is not included. Alfa Laval scope excludes all equipment specifications except the Alfa Laval Centrifuge Specification.

Again, we thank you for the opportunity to offer this proposal. Should you have any questions, please feel free to contact us, or our representative noted below.

Sincerely,

Mark Schlitzkus

Mark Schlitzkus
Regional Sales Manager
Food and Water Division

cc: Jon Casarotti – Sherwood-Logan

TERMS AND CONDITIONS OF SALE

These Terms and Conditions of Sale ("Terms and Conditions") apply to all quotations, orders, and contracts for Alfa Laval Inc. products (hereafter "Equipment") and associated services ("Services") As used in these Terms and Conditions, the word "Equipment" includes all hardware, parts, components, software and options.

1. **ACCEPTANCE**: Our sale to you is limited to and expressly made conditional on your assent to these Terms and Conditions and, if applicable, on the attendant quotation, both of which form a part of the contract between us and which supersede and reject all prior agreements, representations, discussions or negotiations, whether written or oral, with respect to this sale and any conflicting terms and conditions of yours, whether or not signed by you. Any terms and conditions contained in your purchase order or request for quotation or other form which are different from, in addition to, or vary from these Terms and Conditions are expressly rejected, shall not be binding upon us, and are void and of no force or effect. These Terms and Conditions may not be changed except by the written agreement of both parties.

2. **PRICES**: Unless otherwise specified in writing, all quoted prices are in U.S. Dollars and are firm for thirty (30) days from the date of offer. Prices quoted are exclusive of taxes, freight and insurance, and you agree to pay any and all sales, revenue, excise or other taxes (exclusive of taxes based on our net income) applicable to the purchase of Equipment. If you claim an exemption from any such taxes you shall provide us with a tax exemption certificate acceptable to the taxing authorities.

3. **DELIVERY; FORCE MAJEURE**: Dates for the furnishing of Services and/or delivery or shipment of Equipment are approximate only and are subject to change. Quoted lead times are figured from the date of receipt of complete technical data and approved drawings as such may be necessary. We shall not be liable, directly or indirectly, for any delay in delivery or failure to deliver caused by carriers or by labor difficulties, shortages, strikes or stoppages of any sort, or difficulties in obtaining materials from ordinary sources and suppliers. In addition, we shall not be liable for any such delays or for any failure to perform our obligations under an order or contract due to any one

or more of the following events, whether foreseeable or not: war, hostilities, military operations, terrorism, riots, disorder, accidents, floods, storms, natural disasters, fires, acts of God, epidemics and/or pandemics (and specifically in relation hereto and notwithstanding anything else stated herein, whether or not outbreak of such epidemic or pandemic has occurred prior to acceptance of this order or execution of a contract for the Services), governmental, judicial or administrative decisions, decrees or orders, embargoes or blockades, or any causes beyond our reasonable control. Unless otherwise specifically agreed in writing by us, in no event shall we be liable for any damages or penalties whatsoever, or however designated, resulting from our failure to perform or delay in performing due to any of the causes specified in this paragraph 3.

4. **SHIPMENT, RISK OF LOSS, TITLE**: All sales are made F.O.B. Alfa Laval shipping point, unless otherwise noted. Duty, brokerage fees, insurance, packing and handling as applicable are not included unless otherwise noted. Our liability for delivery ceases upon making delivery of Equipment to the carrier at the shipping point in good condition. The carrier shall be your agent. Risk of loss shall pass to you upon such delivery. Regardless of the delivery term specified, we shall retain title to the Equipment until final payment thereof has been made.

5. **CREDIT AND PAYMENT**: Payment terms are (30) days net, unless agreed otherwise by us in writing. *Pro rata* payments shall become due with partial shipments. Any discount period which may be granted by us begins on the invoice date and all payments are due 30 days after the invoice date. All payments shall be made without deduction, deferment, set-off, lien or counterclaim of any nature. All amounts due not paid within 30 days after the date such amounts are due and payable shall bear interest at the lesser of 1.5 percent per month or the maximum rate of interest allowed by law. We reserve the right at any time to suspend credit or to change credit terms provided herein, when, in our sole opinion, your financial condition so warrants. Failure to pay invoices when such invoices are due and payable, at our election, shall make all subsequent invoices immediately due and payable irrespective of terms, and we may withhold all subsequent deliveries until the full account is settled. We shall not, in such event, be liable for delay of performance or nonperformance of contract in whole or in part subsequent to such event.

6. **SECURITY AGREEMENT:** You hereby grant us a security interest in the Equipment, including a purchase money security interest, and in such materials, proceeds and accessories thereof, to secure payment of the purchase price of the Equipment. You authorize us to file or record a purchase order or copy thereof or any UCC financing statement showing our interest in the Equipment in all jurisdictions where we may determine filing to be appropriate, and you agree to sign all such documents reasonably related thereto promptly following our request. You will not encumber the Equipment with any mortgage, lien, pledge or other attachment prior to payment in full of the price therefor.

7. **CANCELLATIONS AND CHANGES**: Orders which have been accepted by us are not subject to cancellation or changes in specification except upon prior written agreement by us and upon terms that will indemnify us against all losses resulting from or arising out of such cancellation or change in specifications. In the absence of such indemnification, we shall be entitled to recover all damages and costs of whatever nature permitted by the Uniform Commercial Code.

8. **DEFERRED SHIPMENT**: If shipment is deferred at your request, payment of the contract price shall become due when you are notified that the Equipment is ready for shipment. If you fail to make payment or furnish shipping instructions, we may either extend the time for so doing or cancel the contract. In case of deferred shipment at your request, storage and other reasonable expenses attributable to such delay shall be payable by you.

9. **EQUIPMENT WARRANTY AND REMEDY**:

(a) For new Equipment only, we warrant to you that the Equipment that is the subject of this sale is free from defects in design (provided that we have design responsibility), material and workmanship. The duration of this warranty is twelve (12) months from start-up or eighteen (18) months from delivery to you, whichever occurs first (the "Warranty Period"). If you discover within the Warranty

Period a defect in design, material or workmanship, you must promptly notify us in writing. Within a reasonable time after such notification, we shall repair, replace, or, at our option, refund you the price of the defective Equipment or part thereof.

(b) For repairs, parts and Services provided by us, we warrant to you that the repairs, parts and Services we provide to you will be free from defects in material and workmanship. The duration of this warranty is ninety (90) days from as applicable (i) the date the Equipment which required the repairs, parts or Services is returned to you by us, (ii) the date of your receipt of the part, or (iii) the date of completion of the repair or other Services, if performed at your facility. If during this ninety-day period you discover a defect in the repairs, parts or Services you must promptly notify us in writing, and we shall correct such defect with either new or used replacement parts or reperform the Services as applicable. If we are unable to correct the defect after a reasonable number of attempts, we will provide a refund of the price paid for the defective repair, parts or Services.

(c) All warranty service is subject to our prior examination and approval and will be performed by us at your facility or at service centers designated by us. All transportation to and from the designated service center will be at our expense. The remedies set forth above are your exclusive remedies for breach of warranty. Unless otherwise agreed in writing by us, our warranty extends only to you and is not assignable to or assumable by any subsequent purchaser, in whole or in part, and any such attempted transfer shall render all warranties provided hereunder null and void and of no further force or effect.

(d) The warranties set forth above are inapplicable to and exclude any product, components or parts not manufactured by us or covered by the warranty of another manufacturer. We shall have no responsibility for defects, loss or damage to the extent caused by (i) normal wear and tear, (ii) your failure to follow all installation and operation instructions or manuals or to provide normal maintenance, (iii) repairs or modifications by you or by others not under our direct supervision, or (iv) a product or component part which we did not design, manufacture, supply or repair.

(e) **DISCLAIMER OF IMPLIED WARRANTIES**. THE WARRANTIES SET FORTH ABOVE AND IN SECTION 12 BELOW ARE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

10. **LIMITATION OF LIABILITY**: In no event shall we be liable, and you hereby waive any claims against us and release us from liability to you, for any indirect, special, punitive, incidental, or consequential damages whatsoever based upon breach of warranty, breach of contract, negligence, strict tort, or any other legal theory. In no circumstance, shall we be liable for, however such damages are characterized, loss of profits, loss of savings or revenue, loss of use of the Equipment or any associated equipment, cost of capital, cost of any substitute Equipment, facilities or services, downtime, or loss of prospective economic advantage. OUR AGGREGATE LIABILITY FOR FAILURE TO PERFORM, BREACH OF WARRANTY OR BREACH OF OTHER CONTRACTUAL OBLIGATIONS SHALL NOT EXCEED THE TOTAL PRICE PAID TO US FOR THE EQUIPMENT AND SERVICES THAT ARE THE SUBJECT OF ANY CLAIM BY YOU.

11. **OWNERSHIP:** All drawings, designs, specifications, data and other proprietary rights supplied by us (including without limitation in connection with the Equipment) have been prepared or assembled by us and are (and shall remain) exclusively our property, and upon our request you agree to execute any additional documents needed to give effect to the foregoing. Such drawings, designs and specifications have been furnished in order to provide full documentation and on the condition that they shall not be disclosed, reproduced or copied in any manner whatsoever, in whole or in part, except for your internal use as necessary, and upon the further condition that, as our sole property, they shall not be used for furnishing information and/or disclosed, in whole or in part, to others or otherwise for any purpose not specifically authorized in a writing signed by one of our corporate officers.

12. **PATENT INFRINGEMENT**

(a) We make no express or implied warranties of non-infringement with respect to the Equipment. We will, however, defend, indemnify and hold you harmless from any third party apparatus claims based upon an issued U.S. patent to the extent such claim relates to

the Equipment supplied and sold to you; provided, however, that we undertake no indemnification in respect of third-party rights (i) where the alleged patent infringement is based upon or related to any method, process or design claims in third-party U.S. patents, any combination of the Equipment with other equipment not supplied by us, or any modifications of the Equipment made by you and not approved by us, or (ii) to the extent the alleged infringement is directly attributable to the negligence or intentional misconduct of you or otherwise for which you are obligated to indemnify us for under paragraph 12(c).

(b) We shall assume defense of a claim at our expense in accordance with these Terms and Conditions, provided you shall notify us within 30 days of your receipt of notice of an alleged third-party claim that you believe would entitle you to patent infringement indemnification pursuant to paragraph 12(a). You acknowledge and agree that we shall have the sole right to settle or otherwise compromise such a third-party claim, including but not limited to the right to either (i) modify the Equipment to avoid infringement if you are agreeable to the modification, (ii) repurchase the Equipment from you at a price equal to the then-current fair market value of the Equipment, or (iii) secure rights by assignment or license to permit continued use of the Equipment.

(c) If a third party charges us with patent infringement relating to Equipment sold by us to you, we shall have the right to either (i) modify the Equipment to avoid infringement if you are agreeable to the modification, (ii) repurchase the Equipment from you at a price equal to the then-current fair market value of the Equipment, or (iii) secure rights by assignment or license to permit continued use of the Equipment. If a third party charges us with patent infringement on the bases set forth in paragraph 12(a)(i) or (ii), you shall indemnify and hold us harmless for all expenses as well as any awards of damage assessed against us, and, without limiting any of our other rights and remedies available at law or in equity, we shall also have the right to modify or repurchase the Equipment or to secure rights for continued use by way of assignment or license as set forth in this paragraph.

13. **INSPECTION**: Upon prior written notice, you may make reasonable inspections of Equipment at our facility. We reserve the right to determine the reasonableness of the request and to select an appropriate time and location for such inspection. You agree to execute appropriate confidentiality provisions upon our request prior to visiting our facility. All costs of inspection shall be solely determined by us and shall be payable by you. No inspection or expediting by you at the facilities of our suppliers is authorized.

14. **SOFTWARE PROVISIONS**: If software is provided hereunder (whether such is integrated into the Equipment or otherwise operates alongside the same), you are hereby granted a non-exclusive, non-sublicensable, non-transferable, royalty free license to access and use such software as provided and as intended with our Equipment. Without limiting the foregoing, under the foregoing license you may specifically: (i) use our software in machine readable object code only and only with the Equipment provided; (ii) copy our software into any machine readable object code form solely for back up purposes in support of your use of our software on the Equipment provided in accordance with these Terms and Conditions; and (iii) create one additional copy of the software for archival purposes only. This license may only be assigned, sublicensed or otherwise transferred by you with our prior written consent. You hereby recognize and acknowledge that the software provided to you hereunder comprises valuable trade secret and/or copyright property of Alfa Laval (or its licensors) and you covenant that you will take adequate precautions against access to the software by, or disclosure of the software to, anyone not authorized hereunder to use or have access to the software as contemplated herein. The software is subject to the confidentiality obligations set forth below in paragraph 15.

15. **CONFIDENTIALITY:** Subject to any non-disclosure or confidentiality agreement already in effect between us, any drawings, data, software or other information exchanged between us is proprietary or confidential to us and shall not be used or disclosed by you without our prior written consent. Confidential information shall not be any information that (i) is known previously to you under no obligation of secrecy; (ii) becomes known to the public through no breach of an obligation of secrecy by you; or (iii) is independently developed by you without use or reference to any of the confidential information or materials provided to you by us.

16. **INAPPLICABILITY OF CISG:** The parties specifically agree that the United Nations Convention on Contracts for the International Sale of Goods shall not apply to any sale or order or the contract between us.

17. **GOVERNING LAW & VENUE**: These Terms and Conditions and any dispute or claim arising out of or related to an order or the contract between us shall be finally decided in accordance with the laws of the Commonwealth of Virginia, without giving effect to the provisions thereof relating to conflict of laws. You agree that the venue for any such dispute shall lie in the United States District Court for the Eastern District of Virginia, Richmond Division. In the event that federal jurisdiction cannot be established pursuant to 28 U.S.C. §§ 1331 or 1332, the venue for any such dispute shall lie in the Circuit Court of Henrico County, Virginia. You expressly submit and waive any objection to the sole and exclusive jurisdiction of such courts.

18. **GENERAL:** All previous agreements or understandings between us, either oral or written, with regard to the subject order, with the exception of a pre-existing non-disclosure agreement between us, are void and these Terms and Conditions constitute the entire agreement between us with respect to the matters addressed herein. Neither of us shall assign an order or contract to which these Terms and Conditions apply without the prior written consent of the other party, which consent shall not be unreasonably withheld. If any provision of these Terms and Conditions is held to be invalid or unenforceable, such holding shall not affect the validity or enforceability of any other provision herein. No waiver by either of us of any default or breach by the other party will operate as or be deemed a waiver of any subsequent default or breach.