Contract Review Sheet

Public Improvement Agreements **PW-5569-23 - EWA3**

Title: **ARPA - CMGC - North Santiam Canyon Sewer Project**

Contractor's Name: **Slayden Constructors, Inc.**

Department: **Public Works Department** Contact: **Alicia Jones**

Analyst: **Kathleen George** Phone #: **(503) 373-4320**

Term - Date From: **Execution** Expires: **December 31, 2026**

Original Contract Amount: **$ 375,218.00** Previous Amendments Amount: **$ 1,724,826.00**

Current Amendment: **$ 2,479,768.00** New Contract Total: **$ 4,579,812.00** Amd% **1121%**

Outgoing Funds ☑ Federal Funds ☐ Reinstatement ☐ Retroactive ☑ Amendment greater than 25%

Source Selection Method: **20-0260 Request for Proposal** RFP# **PW1258-23**

Description of Services or Grant Award

Construction Manager General Contractor (CM/GC), to engage in the following services: Construction management, constructability review, Value Engineering, CPM scheduling and schedule analysis, construction and construction procurement, bidding and administration of subcontracted work, commissioning and all related CM/GC services related to the North Santiam Canyon Sewer Project.

Early Work Amendment No. 1 adds $103,259.00 to original contract for clearing for surveying and test pits, excavation and backfill test pits.

1st Amendment to EWA No. 1 changes scope of work as stated in Early Work Amendment No. 1.

Early Work Amendment No. 2 adds $1,621,567.00 for the procurement of long lead time equipment.

Early Work Amendment No. 3 adds $2,479,768.00 to purchase essential plant equipment for the Mill City wastewater treatment plant, including a backup generator, motor control center, chemical feed pumps, submersible pumps, packaged odor control system, grit removal system, ultraviolet disinfection system and sludge dewatering press.

Desired BOC Session Date:	**1/22/2025**	Contract should be in DocuSign by:	**1/1/2025**
Agenda Planning Date	**1/9/2025**	Printed packets due in Finance:	**1/7/2025**
Management Update	**1/7/2025**	BOC upload / Board Session email:	**1/8/2025**

BOC Session Presenter(s) **Chris Einmo** Code: **Y**

REQUIRED APPROVALS

DocuSigned by: E4592AE8CAA542C...

Finance - Contracts — Date: 1/2/2025

Contract Specialist — Date:

Signed by: Scott Norris 68C98A6F708240D...

Legal Counsel — Date: 1/3/2025

Chief Administrative Officer — Date:

MARION COUNTY BOARD OF COMMISSIONERS

Board Session Agenda Review Form

Meeting date: 01/22/2025

Department: Public Works

Title: ARPA - North Santiam Canyon Sewer Project, Contract PW-5569-22, Early Work Amendment #3

Management Update/Work Session Date: 01/07/2025 **Audio/Visual aids** ☐

Time Required: 10 minutes **Contact:** Chris Einmo **Phone:** 503-566-4119

Requested Action:

Approve Early Work Amendment #3 (EWA3) to Contract PW-5569-23 with Slayden Constructors, Inc. in the amount of $2,479,768.00 to purchase essential plant equipment for the Mill City wastewater treatment plant, including a backup generator, motor control center, chemical feed pumps, submersible pumps, packaged odor control system, grit removal system, ultraviolet disinfection system and sludge dewatering press.

Issue, Description & Background:

Under Agreement SR2240, the State of Oregon awarded $50M in American Rescue Plan Act funds to Marion County for the purpose of constructing wastewater system improvements in the North Santiam Canyon. The Project is required to deliver a municipal wastewater treatment plant under aggressive funding deadlines. The Project team has identified long lead time equipment, including the equipment described above, which must be procured immediately to ensure early critical-path construction activities begin without delay. Lead times for municipal wastewater treatment equipment can be excessive and ARPA requires that all funds be expended by December 31, 2026. Therefore, the use of Early Work Amendments to procure long lead time equipment is essential to the project delivery strategy.

Financial Impacts:

EWA 3 increases the value of Contract PW-5569-23 by $2,479,768, from $2,100,044 to $4,579,812. This is a budgeted expense in the current fiscal year.

Impacts to Department & External Agencies:

Equipment will be purchased entirely using federal American Rescue Plan Act (ARPA) funds provided under SR2240 with no impacts to local funding sources. This is a budgeted expense that does not result in impacts to other county departments or external agencies.

List of attachments: Contract PW-5569-22, Early Work Amendment #3

Presenter: Chris Einmo, Marion County Public Works

Department Head Signature:

EXHIBIT E.3

MARION COUNTY
EARLY WORK AMENDMENT NO. 3 TO CONTRACT

THIS EARLY WORK AMENDMENT NO. 3 shall become effective upon execution by the Owner and CM/GC and receipt of any applicable approvals.

THIS AMENDMENT IS BETWEEN:

OWNER: Marion County, a political subdivision of the State of Oregon,

And

Slayden Constructors, Inc.
("CM/GC" and, in the Marion County
General Conditions for Public
Improvement Contracts,
September 1, 2014, Revised February 14, 2022, Edition, referred to as
"Contractor")

The Project is: North Santiam Canyon Sewer Project

The Engineer is:
Keller Associates, Inc.
245 Commercial St SE #210
Salem, OR 97301

Date of Original CM/GC Contract: September 13, 2023

Date of this Amendment: January 22, 2025

Owner and the CM/GC hereby amend the Contract as set forth below. Capitalized terms used but not defined herein shall have the meanings given in the Contract Documents. Except as amended hereby, the Contract remains in full force and effect.

1. Early Work. In accordance with Article 3.2 of the CM/GC Contract, which authorizes the CM/GC to perform Construction Phase services if an Early Work Amendment is executed, Owner and the CM/GC hereby agree that the CM/GC shall perform the Early Work generally described below and more specifically described in Attachment E.3.i. including any Early Work Plans and Specifications, which are incorporated herein by this reference.

2. Statement of Early Work. The CM/GC will provide all labor, materials, supervision, coordination, and equipment necessary to complete the following Early Work:

    a. Obtain necessary permits for structural, mechanical, plumbing, electrical, fill and grading works
    b. Procure and deliver Electrical gear, Backup generator & automatic transfer switch, Chemical feeding pump, Submersible non clog pumps, Packaged odor control system, Rotary drum screen, Grit removal equipment, Ultraviolet system and Sludge dewatering press as per specification in attachment E.3.i
    c. CM/GC shall deliver the equipment to the Project location as directed by the Engineer.
    d. The final scope of work to be as directed by the Engineer but not to exceed quoted amendment value.

3. Maximum Early Work Price. The parties agree that the cost of the Early Work described in this amendment shall not exceed $2,479,768 including the Estimated Cost of Work (ECOW) and the CM/GC fee as established in Article 6 of this Contract. CM/GC shall submit invoices for the following not to exceed amounts:

Estimated Cost of Work (Not to exceed):	$2,251,495
CM/GC Fee (7.0% of ECOW):	$157,605
Early Work Cost (Subtotal of Above):	$2,409,100
General Liability (0.8% of EWC):	$19,273
P&P Bond (0.75% of EWC)	$18,068
Builder's Risk (0.8% of EWC)	$19,273
Net Cost:	$2,465,714
Oregon CATax (0.57% of Net Cost):	$14,055
Maximum NTE (Net Cost + CATax):	**$2,479,768**

4. Plans and Specifications. The specifications for the Early Work performed under this Amendment shall be Attachment E.3.i– Early Procurement Specifications for Electrical and Process Equipment

and Exhibit A of this Contract, Marion County General Conditions for Public Improvement Contracts, rev. February 14, 2022, and may be amended by the Engineer as required.

5. Substantial Completion Date. Unless directed by the Engineer to the contrary, the required date for Substantial Completion for this Early Work package is June 30, 2026.

6. Tax Compliance Certification. The individual signing on behalf of the CM/GC hereby certifies and swears under penalty of perjury that s/he is authorized to act on behalf of the CM/GC, s/he has authority and knowledge regarding the CM/GC's payment of taxes, and to the best of her/his knowledge, the CM/GC is not in violation of any Oregon tax laws. For purposes of this certification, "Oregon tax laws" means a state tax imposed by ORS 401.792 to 401.816, ORS 320.005 to 320.150 and 403.200 to 403.250, and ORS chapters 118, 314, 316, 317, 318, 320, 321 and 323; the elderly rental assistance program under ORS 310.630 to 310.706, and local taxes administered by the Department of Revenue under ORS 305.620.

THIS AMENDMENT except as expressly amended above, all other terms and conditions of the original contract are still in full force and effect. CM/GC certifies that the representations, warranties and certifications contained in the original Contract are true and correct as of the effective date of this Amendment and with the same effect as though made at the time of this Amendment.

ATTACHMENTS

Attachment E.3.i Early Procurement Specifications for Electrical and Process Equipment

SLAYDEN CONSTRUCTORS, INC. (CM/GC)

Authorized Representative of CM/GC: _____
Date

Title_____

CCB Registration No.: _____

MARION COUNTY (OWNER)

BOARD OF COMMISSIONERS

_____
Chair Date

_____
Commissioner Date

_____
Commissioner Date

Authorized Signature: DocuSigned by: D17E8D9261374C6... 1/2/2025
Department Director or designee Date

Authorized Signature: _____
Chief Administrative Officer Date

Reviewed by Signature: Signed by: Scott Norris 60C98A6F708240B... 1/3/2025
Marion County Legal Counsel Date

Reviewed by Signature: DocuSigned by: E4592AF8CAA542C... 1/2/2025
Marion County Contracts & Procurement Date

Attachment E.3.i – Early Procurement Specifications for Electrical and Process Equipment

ADDENDUM NO. 1

to the

CONTRACT DOCUMENTS

for

CITY OF Mill City
WPCF Design

This Addendum dated November 14, 2024, is for all persons preparing bids for the above referenced project and as such shall be made a part of the Contract Documents.

All changes, corrections, deletions and/or additions to the initial bidding documents enumerated herein shall be included in the Bidder's Proposal. In case of any conflict between the drawings, specifications, and this Addendum, this Addendum shall govern.

The Bidder shall acknowledge the receipt of this Addendum in the appropriate place in the Bidder's Proposal. Failure to acknowledge the receipt of this Addendum will cause a Bid to be considered non-responsive.

BIDDING DOCUMENTS

Item	Description
4-1	**SECTION 26 24 13.21 – SWITCHBOARDS** **REVISE** Part 1.10 as follows: 1.10 MANUFACTURERS **A. Siemens** **B. Schnieder Electric** **C. ABB** D. Eaton E. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.
4-2	**SECTION 43 41 43 – POLYETHYLENE TANKS (DOUBLE WALL)** **REVISE** the file name to: **SECTION 43 41 43.02 – Polyethylene Tanks (DOUBLE WALL)**
4-3	**SECTION 46 33 33 – LIQUID POLYMER BLENDING SYSTEMS** **REVISE** Part 2.1.D, as follows:

	D. Each polymer mix/feed unit shall be sized according to the following design criteria: 1. Neat Polymer Flow Rate: ~~0.05-1.0~~ **0.25 - 5.0 gph** 2. Dilution Water Flow Rate: ~~12-120~~ **60 - 600 gph**
4-4	**SECTION 46 33 44 – PERISTALTIC METERING PUMPS** **REPLACE** this Section with the attached **"SECTION 46 33 44 - PERISTALTIC METERING PUMPS ADDENDUM #1 11-14-2024"** Document.
4-5	**SECTION 46 66 56 – OPEN-CHANNEL UV EQUIPMENT** **REVISE** PART 1.3.3.b, as follows: b. SCADA detailed tag list for all of the points outlined in ~~Section 40 61 96 – Control strategies~~ **Part 2.16.I** including functionality of each point. The intent of this submission is to provide the SCADA integrator information for integrating the UV system into the SCADA system. **REVISE** PART 2.16.A.1, as follows: 1. All controls necessary for the fully automatic operation of the ~~screen~~ **UV Disinfection System** shall be provided. ~~The control strategy shall be described in Section 40 61 96 – Control Strategies.~~ **REVISE** PART 2.16.H.1, as follows: 1. Major alarms shall be provided by the System Control Center or Local Operator Interface to indicate an extreme alarm condition in which the disinfection performance may be jeopardized. Alarms shall include the alarms listed under Section ~~F~~ **G** and the following. **ADD** the following as Part 2.16.I: I. All alarms, interlocks, indicators, and manual and automatic controls shall be contained within the UV PLC as described in Section F. The alarm, interlocks and indicators listed below are those which are to be passed through to the main plant SCADA. 2. SCADA Alarms: As a minimum, the following alarms shall be provided to the SCADA system: a. General Minor alarm (per module) b. General Major alarm (per module) c. Critical alarm (per module)

	d. PLC Fail e. UV Sensor Fail f. Channel low level 3. Interlocks: The following interlocks are required between the plant PLC and the UV disinfection system: a. Low UV Influent Flow 4. SCADA Indicators: As a minimum, the following indicators shall be provided at the main plant SCADA panel interface. a. UV power (per module) b. Reactor status c. Reactor operating hours d. UV intensity (per module) e. UV transmittance (per channel) **5.** Controls: No controls shall be provided at the plant SCADA system.
4-6	**E-601-D PROCESS BUILDING - ONE-LINE DIAGRAM** **Replace** the one-line diagram with the attached **"E-601-D PROCESS BUILDING - ONE-LINE DIAGRAM ADDENDUM #1 11-14-2024"** Document

KELLER ASSOCIATES, Inc.
245 Commercial St SE, Suite 210
Salem, OR 97301

SECTION 46 33 44 - PERISTALTIC METERING PUMPS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall assemble and install chemical peristaltic metering pumps, pump skids, and appurtenances, complete and operable, in accordance with the Contract Documents.

B. Methanol Dosing Pumps:

1. Three methanol dosing pumps to be supplied.

2. Methanol dosing pumps shall be positive displacement peristaltic type complete with spring-loaded pumphead, close coupled variable-speed gearbox, motor, and flexible extruded continuous tube.

3. The methanol dosing pumps shall be dry self-priming, capable of being run dry without damaging effects to pump or tube and shall have a maximum suction lift capability of up to 16' vertical water column.

4. Pumps shall be capable of pumping both liquids and gases without vapor locking

5. The methanol pumps shall use no check valves or diaphragms and shall require no dynamic seals in contact with the process fluid. Process fluid shall be contained within pump tubing and shall not directly contact any rotary or metallic components. Upon failure, the process fluid shall be completely contained within the pump head to prevent hazardous exposure to operators. Manufacturers that do not offer a completely contained pump head are not acceptable.

6. Methanol pumps to be the manufacturer’s standard product. Manufacturer of tubing pumps must have at least ten operating installations in the United States over a period of at least five years in the same service and size as specified. Pumps must be manufactured under ISO 90001-2000.

C. Caustic Soda Dosing Pumps:

1. Three caustic soda pumps to be supplied.

2. The caustic soda dosing pumps shall be positive displacement type with peristaltic pumphead technology cartridge-style pumphead, consisting of an eccentrically driven rotor which occludes a membrane against a track and self-contained variable speed drive.

3. The caustic soda dosing pumps shall be capable of pumping at 60 psi continuously.

4. Pumps shall be capable of pumping both liquids and gases without vapor locking

5. The caustic soda pumps shall not require the use of back pressure valves, suction foot valves, strainers, pulsation dampeners, or auto degassing valves and shall not require dynamic seals in contact with the pumped fluid. Process fluid shall be contained within pump tubing and shall not directly contact any rotary or metallic components during operation. Upon failure, the process fluid shall be completely contained within the pump head to prevent hazardous exposure to operators. Manufacturer's that do not offer a completely contained pump head are not acceptable.

6. Caustic soda pumps to be the manufacturer's standard product. Manufacturer of tubing and pumps must have at least ten operating installations in the United States over a period of at least five years in the same service and size as specified. Pumps must be manufactured under ISO 90001-2000,

1.2 SUBMITTALS

A. Submit certifications and testing consistent with Section 01 33 00 – Submittal Procedures and Section 43 05 01 – Equipment General Provisions.

B. At a minimum, shop drawings shall include complete fabrication, assembly, foundation, and installation drawings, together with detailed specifications and data covering materials used, parts, devices, supports and other accessories forming a part of the equipment. In addition, shop drawings shall include the following information:

1. Pump name, identification number, and specification section number.

2. Performance data curves showing head, capacity, horsepower demand, NPSH required, and pump efficiency over the entire operating range of the pump.

3. Assembly and installation drawings including shaft size, seal, coupling, bearings, anchor bolt plan, part nomenclature, material list, outline dimensions, and shipping weights.

4. Elevation of proposed local control panel showing panel-mounted devices, details of enclosure type, single line diagram of power distribution, and current draw of panel, and list of all terminals required to receive inputs or to transmit outputs from the local control panel.

5. Wiring diagram of field connections with identification of terminations between local control panels, junction terminal boxes, and equipment items.

6. Complete electrical schematic diagram.

C. Technical Manual: The Technical Manual shall contain the required information for each pump section as specified in Section 01 33 00 – Submittal Procedures.

D. Spare Parts List: A spare parts list shall contain the required information for each pump section.

1.3 QUALITY CONTROL

A. Factory Test Data: Signed, dated, and certified factory test data for each pump system which requires factory testing, submitted before shipment of equipment.

B. Pump shall be 24-hour continuous duty rated.

C. Manufacturer's Experience: The chemical feeding equipment shall be the product of a manufacturer who has designed and manufactured similar equipment and has a record of at least 5 years of successful operation of this type of process. The Supplier may be required to submit evidence to this effect together with a representative list of installations. The pump manufacturer shall maintain a permanent, local service department and a spare parts department.

D. Pumps shall be manufactured in compliance with ISO 9001-2008 standards and meet CE and applicable electrical standards.

E. To ensure proper function and quality, pumphead, tubing, and drive shall be manufactured by the same company. Tubing purchased by the pump manufacturer from a third party is not acceptable.

1.4 WARRANTY

A. A written manufacturer warranty shall be provided. The warranty shall be for a minimum period of three (3) years from the date of Substantial Completion. The manufacturer shall provide parts to replace all defects of materials or workmanship in the equipment during the warranty period.

PART 2 - PRODUCTS

2.1 GENERAL

A. The pumps shall be positive displacement type complete with self-contained variable speed drive as specified. Pumps shall be self-priming and shall have a maximum suction lift of up to 30 feet vertical water column for sodium hydroxide pumps, and 16 feet vertical water column for methanol pumps.Pump Schedule:

Chemical	Equipment Number	Feed Range (gph)	Continuous Operating Pressure (psi)
Methanol (100%)	PMP-C161X2	4-25	30
Sodium Hydroxide (25%)	PMP-C261X1	0-5	60

X = 1,2,3

2.2 OPERATING CONDITIONS

A. The work of this section shall be suitable for long-term operation under the conditions listed in the table below:

Equipment Number	PMP-C161X2*	PMP-C261X1*
Chemical	Methanol (100%)	Sodium Hydroxide (25%)

Ambient Environment	Outdoors	Outdoors
Ambient Temperature. (deg F)	32 to 90	32 to 90
Ambient Relative Humidity, (%)	20 to 100	20 to 100
Fluid Temperature, (deg F)	35 to 60	35 to 60
Fluid pH Range	N/A	12 - 14
Specific Gravity	0.795 @ 68 Deg F	1.27
Project Elevation, (ft)	860	860
Minimum Suction Lift, (ft)	4	4

* X = 1, 2, or 3 (Three pumps Total)

2.3 PERFORMANCE REQUIREMENTS

A. The pumps specified in this section shall satisfy the performance requirements listed in the table below:

Chemical	Methanol
Duty	Continuous
Drive	Variable
Pump Head	Closed Coupled Peristaltic Std. pump head for max performance
Continuous Operating Pressure (psi)	30
Tubing Material	Marprene

Chemical	Sodium Hydroxide
Duty	Continuous
Drive	Variable
Pump Head	Peristaltic Std. pump head for max performance
Continuous Operating Pressure (psi)	60
Tubing Material	Santoprene

2.4 CONSTRUCTION

A. For both methanol and caustic soda dosing pumps, all wetted parts to be compatible with chemical being used.

B. Methanol pumps shall consist of the following:

1. Pumphead shall consist of a fixed track, a hinged guard door, two spring-loaded tube clamp mechanisms, and spring-loaded roller rotor assembly. Pump tubing shall be in contact with the inside diameter of the track through an angle of 180 degrees and be held in place on the suction and discharge by a spring loaded self-adjusting clamp mechanism. At all times, one roller shall be fully engaged with the tubing providing complete compression and preventing back flow or siphoning. Tube occlusion and spring tension shall be factory set to accommodate 2.4mm wall thickness tubing and shall not require adjustment for accommodating tubing of 1.6mm to 8.0mm ID.
    a. Pumphead Assembly
        1) Pump Track Geometry must have a minimum 96.6mm swept diameter through a minimum track angle of 180 degrees
        2) When closed, pump door shall seal against the pump track for leak containment.
        3) Provide high corrosion/impact materials as specified
            a) Track Construction: polyphenylene sulfide (PPS)
            b) Guard Construction: hinged impact-resistant polycarbonate breakaway guard, tool un-lockable for operator safety.
            c) Rotor Construction: polyphenylene sulfide (PPS)
    b. Tube Retention
        1) Pump shall be supplied with continuous tubing , which shall be self-locating when fitted into the pumphead.
    c. Rotor Assembly
        1) Provide rotor assembly that ensures gradual tube occlusion and compensates for tube tolerance:
            a) Twin spring-loaded roller arms located 180 degrees apart, each fitted with stainless steel helical springs and compressing roller for occlusion of the tube twice per rotor revolution
                1) Compressing Rollers: 316SS with low friction stainless steel bearings and PTFE seals, minimum diameter of 18mm
            b) Provide non-compressing guide rollers constructed of corrosion resistant Nylatron
        2) Clutch: Equip rotor with a central handgrip hub and manually activated clutch to disengage the rotor from the drive for manual rotor rotation during tube loading. Clutch shall automatically reengage rotor to gearbox upon one complete revolution.
        3) Mounting: To prevent slip, the rotor assembly shall be axially secured to the dogged output shaft of the gearmotor via a slotted collet and central retaining screw.
        4) Pumpheads requiring disassembly or special tools for tube changing are not acceptable.
2. Pump shall be supplied with continuous tubing, which shall be self-locating when fitted into the pumphead and for connection of the pump to suction and discharge process lines. Pumphead shall accept tubing sizes 1.6mm, 3.2mm, 4.8mm, 6.4mm, and 8.0mm with 2.4mm wall thickness and materials including, Marprene, Bioprene, Silicone, Sta-Pure & Chem-Sure. Pumps that require tools for adjustment or changing pumpheads to accept different tubing materials or sizes are not acceptable.
3. Pump tubing shall be constructed of Marprene II, a thermoplastic elastomer with 64 Shore A durometer and minimum 2.4mm wall thickness. If required for chemical compatibility, pump manufacturer shall recommend an alternate tubing material.
4. The gearbox and motor shall be configured with UL listing. Gearing shall be double reduction helical in-line design with a housing constructed of SAE Class 30 cast iron

and fitted with a Viton seal. Gearbox output shaft and face shall accept the direct coupling of the peristaltic pumphead. Gearing shall be manufactured to AGMA Class 10 requirements with an overall rating of AGMA Class II under continuous operation and a minimum efficiency of 95%. Explosion proof variable speed motor shall include a 4-pole XPFC motor construction, Design B with Class F insulation, and 40 deg C ambient rating.

5. VFDs shall be provided by the contractor.
6. Mounting: Pump shall be mounted to epoxy-coated aluminum baseplate.
7. Paint: Pumphead shall be paint free. Gearmotor shall be painted with epoxy corrosion resistant finish.

C. Caustic soda pumps shall consist of the following:

1. Pumphead
   a. Technology: Provide tool-free ReNu cartridge-style peristaltic pumphead technology. For operator safety, pumphead shall be serviceable as a single replaceable component. Pumps that require an operator to open the pumphead for tube replacement, cleaning, or rebuilding or that require tools for maintenance are unacceptable.
   b. Housing construction: corrosion resistant and high impact resistant glass filled PPS or PPE/PS.
   c. Geometry: Pumphead shall consist of sealed track housing with in-line porting. Suction and discharge ports shall be 180 degrees apart with bottom suction and top discharge.
   d. Rotor: Pumphead rotor shall be constructed of glass filled Nylon, sealed within the track housing, and supported by its own bearings. Peristaltic occlusion level shall be factory set to ensure flow accuracy of +/- 1% and repeatability performance of +/- 0.5% and shall not require any field adjustment.
   e. Leak containment/detection: In the event of peristaltic element failure, the leak sensor shall shut the pump down immediately with all process fluid contained within the sealed pumphead.
   f. Sensor type: Utilize non-contacting optical sensor. Sensor shall not come in contact with the process fluid, shall contain no moving parts, shall not depend on the capacitance of the process fluid, shall not require fluid to leak out of the pump housing for engagement, nor shall require any sensitivity or calibration adjustment.
   g. Alarm: Sensor shall shut down the pump, give a visual indication on the drive controller, and if specified shall provide an output general alarm signal.
   h. For operator and environmental safety, pumps which do not have leak containment, leak sensor, and shutdown are not acceptable. For additional overpressure safety, sealed pumphead shall have a controlled drain-to-waste port.
2. Port connections: Pumphead shall utilize polypropylene compression fittings which shall mate to 10mm ID reinforced, transparent PVC interface hose. Provide polypropylene compression by ½" NPT adaptors for connecting interface hose to process line.

2.5 ACCESSORIES

A. Accessories shall be provided as outlined in Section 46 30 00 - Chemical Feed Equipment, General.

2.6 SPARE PARTS

A. Provide manufacturer's recommended spare parts, including at a minimum:

1. A complete set of extra compression fittings shall be furnished with each pump.

2. One box of 50' tubing for each methanol pump;

3. One pumphead for each caustic soda pump.

2.7 PUMP DRIVE

A. Mounting: Where motors or starters are an integral part of the pump, components shall be self-supporting and not require anchoring.

B. Each pump shall be provided with the following drives:

Rating	Continuous 24-hour operation, 110ºF maximum ambient temperature
Supply	120V 60 Hz; 1-Phase
Enclosure	NEMA 4X
Housing	Impact resistant engineering plastic, 20% glass filled PPE/PS. Polyester powder-coated aluminum is acceptable for the pump housing.
Drive Motor	Direct coupled pumphead with fully protected drive. Brushless DC motor with integral gearbox and closed loop tachometer feedback. Motor shall include overload protection.

2.8 PUMP CONTROLS (CAUSTIC SODA PUMPS)

A. Operator membrane keypad:

1. Increase/Decrease Speed

2. Start/Stop

3. Auto/Manual selector

4. Programmable keypad disabled to prevent changes from incidental contact.

5. Programmable automatic restarting for resumed pumping after recovery from power interruption.

6. LED display of RPM

B. Remote Features:

1. Analog input of 4-20 mA for speed control in Auto mode. Signal response may be scaled over any part of the drive speed range. Contractor to ensure analog signals being sent to the pump for automatic speed control from other devices are isolated signals. An analog input of 4-20 mA is acceptable for speed control.

2. The SCADA system will provide run and speed signals to the chemical dosing pumps based on flow meter signals from the influent pump station or according to operator dosing inputs for caustic soda dosing.

3. For methanol dosing, the SCADA system will provide run and speed signals based on flow meter signals, nitrate levels, and dissolved oxygen levels measured in the secondary effluent line, or according to operator dosing inputs.

4. Dry contact closure input for remote start/stop - functional in both the Auto and Manual modes.

5. Discrete output for running indication and alarm faulting.

6. Analog output of 4-20 mA to provide pump speed for use by SCADA to calculate flow in gph.

2.9 MANUFACTURERS OR EQUAL

A. Watson-Marlow

B. Equal must be pre-approved during bidding process.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Chemical feed systems shall be installed in accordance with accepted procedures submitted with the shop drawings and as indicated on the drawings, unless otherwise accepted.

3.2 FIELD QUALITY CONTROL

A. Manufacturer shall employ and pay for services of their field service representative(s) for one (1) trip including one (1) day to:

1. Inspect equipment covered by these Specifications.

2. Supervise pre-start adjustments and installation checks.

3. Conduct initial startup of equipment and perform operational checks.

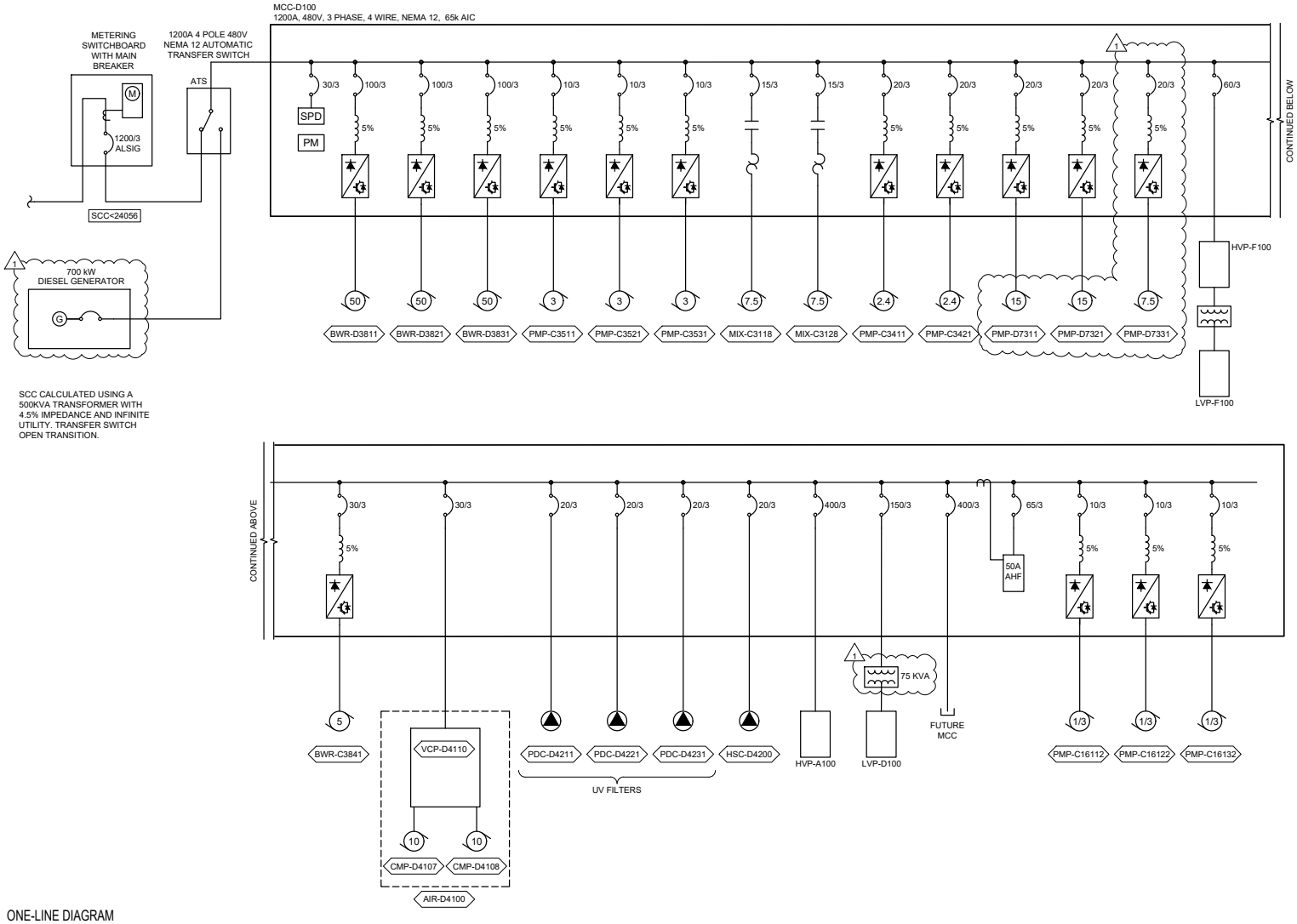
4. Provide a written statement certifying that manufacturer's equipment has been installed properly, started up and is ready for operation.

B. Instruct Owner personnel for 8 hours at the job site per Section 01 78 23 – Operation and Maintenance Data. Contractor shall video training and provide a copy on thumb drive to Owner.

END OF SECTION 46 33 44

LEGEND

NEW EQUIPMENT



A1 ONE-LINE DIAGRAM

N.T.S.

KELLER ASSOCIATES
245 Commercial St. SE, Suite 210
Salem, Oregon 97301
(503) 364-2002

50% Design Review Not For Construction

NO.	REVISIONS	DATE
1	ADDENDUM #1	11-13-24

MILL CITY WATER POLLUTION CONTROL FACILITY

PROCESS BUILDING - ONE-LINE DIAGRAM

DRAWN: TLL CHECK: DNC

VERIFY SCALE: Scales based on 22"x34" prints.

1-1/2 Inches

PROJECT NO. 222194-202

FIGURE NO. E-601-D

ADDENDUM NO. 2

to the

CONTRACT DOCUMENTS

for

CITY OF Mill City
WPCF Design

This Addendum dated November 21, 2024, is for all persons preparing bids for the above referenced project and as such shall be made a part of the Contract Documents.

All changes, corrections, deletions and/or additions to the initial bidding documents enumerated herein shall be included in the Bidder's Proposal. In case of any conflict between the drawings, specifications, and this Addendum, this Addendum shall govern.

The Bidder shall acknowledge the receipt of this Addendum in the appropriate place in the Bidder's Proposal. Failure to acknowledge the receipt of this Addendum will cause a Bid to be considered non-responsive.

BIDDING DOCUMENTS

Item	Description
2-1	**Section 46 76 26.13** **Revise** Parts 1.8.3, and 1.8.4 as follows: 3. Support structure for the Dewatering **Drums** including filtrate collection pan and outlet plumbing. ~~Support structure will include capacity to add an additional dewatering drum and increase the throughput capacity of the unit by 100% with no structural modifications.~~ All required mounting holes and brackets will be in place, drilled and tapped. 4. A self-contained electrical and control panel including control for all supplied equipment including sludge feed pump, polymer blending system and cake conveyor. ~~Control panel will also have all components included and wired for additional future dewatering drums.~~ **Revise** Part 2.7.E.1.a as follows: a. Control of all components of the Volute ~~Thickener~~ **Dewatering Press** system including the ability to set times and operating speeds for any pump installed, dewatering drums, mixers, polymer dosing system and wash-down sprays. **Revise** Part 2.9.B.1 as follows: 1. The Volute ~~Thickener~~ Dewatering Press system may be set to either Auto/Manual/Off on the control panel via a 3 position switch. This will be the "main switch" for the plant.

2-2	**Section 44 31 19** **Revise** Part 1.4.B as follows: B. ACCEPTABLE MANUFACTURERS 1. Integrity Municipal Systems, LLC (IMS) **2. Biorem** 3. Or approved equal
2-3	**Section 41 12 13.36** **Revise** Part 1.1.A as follows: A. The Work includes a ~~horizontal~~ shaftless screw conveyor for handling dewatered, Waste Activated Sludge from the volute press. Contractor shall furnish and install one (1) complete conveyor system for conveyance of dewatered sludge, including conveyor, drive motor, gear reducer, supports, anchor bolts, wiring, and all accessories and appurtenances specified or otherwise required for a complete and properly operating installation. Revise Part 1.3.8 as follows: 8. Provide design loadings to be transmitted to foundations or supports and anchoring calculations sealed by a registered Professional Engineer in the State of I~~daho~~ **Oregon**. Revise Part 3.2.B as follows: B. Operation of the conveyor system shall be coordinated with operation of the ~~screening~~ **dewatering press** equipment, to start/stop automatically.
2-4	**Section 46 23 23** **Clarifications:** - The Total Dynamic Head (TDH) for the grit pump is 20 ft, per Section 46 23 23, Part 2.2.B.4. Sheet G-007 will be updated to reflect 20 ft in the design criteria table. - The water level upstream of the Grit King will be 7” higher than the water level in the effluent pipe at peak flow, per Part 2.1.6. Sheet G-010 will be updated to show this in the hydraulic profile. - The grit pump’s suction line is 3”. The discharge line is also 3” to the classifier and connects to the classifier’s 6” inlet via a 6”x3” reducer. Sheet E-701-A will be updated to show 3” pipes. - A ball valve is missing on the fluidizing line after the solenoid valve. Sheet E-701-A will be updated to include the ball valve. - The fluidizing line is 2” down to the Grit King and connects to the 1” inlet of the fluidizing ring through a reducer. - The Grit King effluent pipe invert is at 857.00’, with a 2’-4” difference between the inlet and outlet invert elevations. Therefore, the inlet pipe invert should be at 854’-8”.

KELLER ASSOCIATES, Inc.
245 Commercial St SE, Suite 210
Salem, OR 97301

SPECS LIST | 2309 North Santiam Canyon Sewer - EWA3

SECTION NO.	SPECIFICATION TITLE	REVISION	DATE
01 33 00	SUBMITTAL PROCEDURES	EWA3	August 2024
01 42 19	REFERENCE STANDARDS	EWA3	August 2024
01 74 30	SITE PRESSURE PIPE TESTING AND DISINFECTION	EWA3	August 2024
01 75 00	EQUPIMENT TESTING AND STARTUP (WWTP)	EWA3	August 2024
01 77 00	CLOSEOUT PROCEDURES	EWA3	August 2024
01 78 23	OPERATION AND MAINTENANCE DATA	EWA3	August 2024
26 05 00	ELECTRICAL, GENERAL	EWA3	August 2024
26 24 13.21	SWITCHBOARDS	EWA3	August 2024
26 27 13.11	MICROPROCESSOR-BASED METERING EQUIPMENT	EWA3	August 2024
26 29 00	LOW VOLTAGE MOTOR CONTROL CENTERS	EWA3	August 2024
26 29 23	VARIABLE-FREQUENCY MOTOR CONTROLLERS)	EWA3	August 2024
26 32 13	ENGINE GENERATORS	EWA3	August 2024
26 36 00	TRANSFER SWITCHES	EWA3	August 2024
26 43 13.A	SURGE PROTECTIVE DEVICES (SPD) FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS	EWA3	August 2024
40 05 51	VALVES, GENERAL	EWA3	August 2024
40 05 57	ACTUATORS FOR PROCESS VALVES AND GATES	EWA3	August 2024
40 05 64	BUTTERFLY VALVES	EWA3	August 2024
40 05 65.29	DOUBLE-DISK CHECK VALVES	EWA3	August 2024
40 05 82	SOLENOID VALVES	EWA3	August 2024
40 05 93	COMMON MOTOR REQUIREMENTS FOR PROCESS EQUIPMENT	EWA3	August 2024
40 67 00	CONTROL PANELS	EWA3	August 2024
40 70 00	INSTRUMENTATION AND CONTROL, GENERAL	EWA3	August 2024
40 70 13	IN-LINE LIQUID FLOW MEASURING SYSTEMS	EWA3	August 2024
40 72 00	LEVEL MEASURING SYSTEM	EWA3	August 2024
40 74 00	TEMPERATURE MEASURING SYSTEMS	EWA3	August 2024
40 79 23	TESTING, CALIBRATION, AND COMMISSIONING	EWA3	August 2024
41 12 13.36	SCREW (SHAFTLESS) BULK MATERIAL CONVEYORS	EWA3	August 2024
43 05 01	EQUIPMENT GENERAL PROVISIONS	EWA3	August 2024
43 05 50	EQUIPMENT MOUNTING	EWA3	August 2024
43 05 60	PROCESS EQUIPMENT TESTING	EWA3	August 2024
43 20 00	PUMPS, GENERAL	EWA3	August 2024
43 23 57	PROGRESSING CAVITY SLUDGE PUMPS	EWA3	August 2024
43 25 01	SUBMERSIBLE NON-CLOG PUMPS (LIFT STATION)	EWA3	August 2024
44 31 19	PACKAGED BIOLOGICAL ODOR CONTROL SYSTEM	EWA3	August 2024
46 21 35	ROTATING DRUM IN-TANK SCREEN	EWA3	August 2024
46 23 23	GRIT REMOVAL SYSTEM	EWA3	August 2024
46 33 33	LIQUID POLYMER BLENDING SYSTEMS	EWA3	August 2024
46 33 44	PERISTALTIC METERING PUMPS	EWA3	August 2024
46 66 56	OPEN-CHANNEL LP/HI UV TREATMENT EQUIPMENT	EWA3	August 2024
46 76 26.13	VOLUTE DEWATERING PRESS	EWA3	August 2024

SECTION 01 33 00 – SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Wherever submittals are required hereunder, all such submittals by the Contractor shall be submitted to the Engineer as delineated in this Section.

B. At the Pre-Construction Conference, the Contractor shall submit the following items to the Engineer for review:

1. A preliminary construction schedule.

2. A preliminary schedule of Shop Drawings, Samples, and proposed Substitutes ("Or-Equal") submittals listed in the Bid.

1.2 ENGINEER'S REVIEW PERIOD

A. For planning purposes, the Contractor shall assume a minimum of 14 days for review by the Engineer following receipt of submittal/resubmittal. If an expedited review is requested by the Contractor, the submittal shall identify the requested expedited review. The Engineer will attempt to accommodate the expedited review.

1.3 SUBMITTAL PROCEDURES

A. Verify that the material or equipment described in each submittal conforms to all requirements of the Specifications and drawings. Where the detailed specifications require specific submittal data, submit all data at the same time. The submittals are to be accompanied by the transmittal form attached at the end of this Section. The Engineer will return for resubmittal any information not accompanied by the specified transmittal form, properly completed.

B. Indiscriminate submittal of only manufacturer's literature is unacceptable and will be rejected.

C. The submittals shall be numbered as XXXXXX-YY-z., where XXXXXX is the specification section number, YY is the sequential number of the submittal, and Z is used for re-submittal labeled a through z. For example, the first submittal of an item from Section 32 13 13 – Concrete for Exterior Improvements would be numbered "32 13 13-01"; the first re-submittal of the submittal would be numbered "32 13 13-01-A".

D. A separate transmittal form shall be used for each specific item or class of material or equipment for which a submittal is required. Transmittal of a submittal of various items using a single transmittal form will be rejected. A multiple page submittal shall be collated into sets, and each set shall be stapled or bound, as appropriate, prior to transmittal to the Engineer.

E. Identify Project, Contractor, subcontractor or supplier, pertinent Drawing sheet and detail number(s), and specifications section number, as appropriate.

F. All Contractor shop drawings submittals shall be carefully reviewed by an authorized representative of the Contractor, prior to submission to the Engineer. Each submittal shall be dated, signed, and certified by the Contractor, as being correct and in strict conformance with the Contract Documents. In the case of shop drawings, each sheet shall be so dated, signed, and certified. No consideration for review by the Engineer of any Contractor submittals will be made for any items which have not been so certified by the Contractor. All non-certified submittals will be returned to the Contractor without action taken by the Engineer, and any delays caused thereby shall be the total responsibility of the Contractor.

G. Do not mark the submittals in red. Ensure that any marks are duplicated on all copies submitted. Outline the marks on reproducible transparencies in a rectangular box.

H. Coordinate submission of related items.

I. Identify variations from Contract Documents and product or system limitation which may be detrimental to successful performance of the completed Work.

J. Provide space for Contractor and Engineer Review stamps.

K. Electronic submittals:

1. Electronic submittals shall be submitted in PDF format and combined into a single file.

2. Engineer will return comments only.

3. Contractor is responsible for distributing copies of the submittal and Engineer’s comments to concerned parties.

4. Engineer may require hard copies in lieu of an electronic submittal if, in the opinion of the Engineer, the electronic submittal is difficult to read.

L. Revise and resubmit submittals as required, identify all changes made since previous submittals.

M. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions.

1.4 DEVIATIONS FROM CONTRACT

A. If the Contractor proposes to provide material or equipment which does not conform to all of the Specifications and Drawings, the transmittal form accompanying the submittal copies shall indicate under "comments" the deviations.

1.5 SHOP DRAWINGS

A. The term "Shop Drawings" as used herein shall be understood to include detail design calculations, shop drawings, fabrication, and installation drawings, erection drawings, list, graphs, catalog sheets, data sheets, and similar items. Whenever the Contractor is required to submit design calculations as part of a submittal, such calculations shall bear the signature and seal of an engineer registered in the appropriate branch and in the state wherein the project is to be built, unless otherwise directed.

B. Except as may otherwise be indicated herein, the Engineer will return submittal to the Contractor with comments. The Contractor shall make a complete and acceptable submittal to the Engineer by the second submission of a submittal item.

C. If submittal is returned to the Contractor marked "NO EXCEPTIONS TAKEN," formal revision and resubmission of said submittal will not be required.

D. If submittal is returned to the Contractor marked "MAKE CORRECTIONS NOTED," formal revision and resubmission of said submittal will not be required.

E. If submittal is returned to the Contractor marked "AMEND-RESUBMIT," the Contractor shall revise said submittal and shall resubmit the required number of copies of said revised submittal to the Engineer.

F. If submittal is returned to the Contractor marked "REJECTED-RESUBMIT," the Contractor shall revise said submittal and shall resubmit the required number of copies of, said revised submittal to the Engineer.

G. Fabrication of an item shall be commenced only after the Engineer has reviewed the pertinent submittals and returned copies to the Contractor marked either "NO EXCEPTIONS TAKEN" or “MAKE CORRECTIONS NOTED". Corrections indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as the basis for changes to the contract requirements.

1.6 ORGANIZATION

A. A single submittal transmittal form shall be used for each technical specification section or item or class of material or equipment for which a submittal is required. A single submittal covering multiple sections will not be acceptable, unless the primary specification references other sections for components..

B. On the transmittal form, index the components of the submittal and insert tabs in the submittal to match the components. Relate the submittal components to specification paragraph and subparagraph, drawing number, detail number, schedule title, room number, or building names, as applicable.

C. Unless indicated otherwise, terminology and equipment names and numbers used in submittals shall match those used in the Contract Documents.

1.7 EFFECT OF ACCEPTANCE OF CONTRACTOR INFORMATION

A. Acceptance by the Engineer of any drawings, method of work, or any information regarding materials or equipment the Contractor proposes to provide shall not relieve the Contractor of his responsibility for any errors therein and shall not be regarded as an assumption of risk or liability by the Engineer or Owner, or by any officer or employees thereof, and the Contractor shall have no claim under the contract on account of the failure or partial failure or inefficiency of any plan or method of work or material or equipment so accepted. Such acceptance shall be considered to mean merely that the Engineer has no objection to the Contractor using, upon his own full responsibility, the plan or method of work proposed, or providing the materials or equipment proposed.

B. Approval of shop drawings by the Engineer is only for general conformance with the design concept of the project and general compliance with the information given in the contract documents. Any action shown is subject to the requirements of the Plans and Specifications. The Contractor is responsible for dimensions which shall be confirmed and correlated at the job site, fabrication process and techniques of construction, coordination of his work with that of all other trades and the satisfactory performance of his work.

1.8 PRODUCT DATA AND SAMPLES

A. Where required in the Specifications and as determined by the Engineer, test specimens or samples of materials, appliances and fittings to be used or offered for use in connection with the Work shall be submitted to the Engineer at the Contractor's expense. Specimen or sample submittals shall be made with information as to their sources, with all cartage charges prepaid, and in such quantities and sizes as may be required for proper examination and tests to establish the quality or equality thereof, as applicable.

B. All samples and test specimens are to be submitted in ample time to enable the Engineer to make any tests or examinations necessary, without delay to the Work. The Contractor will be held responsible for any loss of time due to the neglect or failure to deliver the required samples to the Engineer as specified.

C. Samples are also to be taken during the course of the Work, as required by the Engineer.

D. Laboratory tests and examinations that the Owner elects to make will be made at no cost to the Contractor, except that, if a sample of any material or equipment proposed for use by the Contractor fails to meet the Specifications, the cost of testing subsequent samples will be borne by the Contractor.

E. All tests required by the Specifications to be performed by an independent laboratory are to be made, and the samples therefore furnished shall be at the sole expense of the Contractor.

F. Material used in the Work is to conform to the submitted samples and test certificates as approved by the Engineer.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF SECTION 01 33 00

STANDARD SUBMITTAL FORM

Transmittal of Shop Drawing or Submittal

CONTRACTOR: <CONTRACTOR NAME>

Tracking No. XXXXXX

Item covered by this submittal

Refer to the following attachment(s) for a detailed description of the item.

Applicable specification section(s)

☐ First Submittal OR ☐ Resubmittal No. _____

☐ This item is as specified OR ☐ This item is a substitution/or equal

☐ Supplier/Subcontractor certifies:

- ☐ Conforms to contract
- ☐ Minor deviations as specifically noted
- ☐ Major deviations as specifically noted

Review Priority: ☐ 1 ☐ 2 ☐ 3

Due Date: XX-XX-XX (Engineer's standard review period is 14 days)

Notes to Engineer:

Date Received by Contractor: _____ Date Returned to Subcontractor/Supplier _____

Contractor Comments:

Deviations Specifically Noted

SECTION 01 42 19 - REFERENCE STANDARDS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Titles of Sections and Paragraphs: Captions accompanying specification sections and paragraphs are for convenience of reference only, and do not form a part of the Specifications.

B. Applicable Publications: Whenever Specification references are made to published specifications, codes, standards, or other requirements, it shall be understood that wherever no date is specified, only the latest specifications, standards, or requirements of the respective issuing agencies which have been published as of the date that the Work is advertised for bids shall apply. No requirements set forth herein or shown on the Drawings shall be waived because of any provision of, or omission from, said standards or requirements.

C. Specialists' Assignments: In certain instances, specification text requires specific work be assigned to specialists or expert entities who must be engaged for the performance of that work. Such assignments shall be recognized as special requirements over which the Contractor has no choice or option. These requirements shall not be interpreted so as to conflict with the enforcement of building codes and similar regulations governing the Work. In addition, these requirements are not intended to interfere with local union jurisdiction settlements and similar conventions. Such assignments are intended to establish which party or entity involved in a specific unit of work is recognized as "expert" for the indicated construction processes or operations. Nevertheless, the final responsibility for fulfillment of the entire set of contract requirements remains with the Contractor.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of other requirements of the Specifications, all work specified herein shall conform to or exceed the requirements of applicable codes and the applicable requirements of the following documents:

1. References herein to "Building Code" shall mean current International Building Code (IBC).

2. References to "Mechanical Code" or "Uniform Mechanical Code," "Plumbing Code" or "Uniform Plumbing Code," "Fire Code" or "Uniform Fire Code," shall mean International Mechanical Code, Uniform Plumbing Code and International Fire Code of the International Conference of the Building Officials (ICBO).

3. "Electric Code" or "National Electric Code (NEC)" shall mean the National Electric Code of the National Fire Protection Association (NFPA).

4. The latest edition of the codes as approved by the Municipal Code and used by the local agency as of the date that the Work is advertised for bids, as adopted by the agency having jurisdiction, shall apply to the Work herein, including all addenda, modifications, amendments, or other lawful changes thereto.

B. In case of conflict between codes, reference standards, drawings, and the other Contract Documents, the most stringent requirements shall govern. All conflicts shall be brought to the attention of the Engineer for clarification and directions prior to ordering or providing any materials or furnishing labor. The Contractor shall bid for the most stringent requirements.

C. The Contractor shall construct the Work specified herein in accordance with the requirements of the Contract Documents and the referenced portions of those referenced codes, standards, and specifications listed herein.

D. References herein to "OSHA Regulations for Construction" shall mean Title 29, Part 1926, Construction Safety and Health Regulations, Code of Federal Regulations (OSHA), including all changes and amendments thereto.

E. References herein to "OSHA Standards" shall mean Title 29, Part 1910, Occupational Safety and Health Standards, Code of Federal Regulations (OSHA), including all changes and amendments thereto.

1.3 REGULATIONS RELATED TO HAZARDOUS MATERIALS

A. The Contractor shall be responsible that all work included in the Contract Documents, regardless if shown or not, shall comply with all EPA, OSHA, RCRA, NFPA, and any other Federal, State, and Local Regulations governing the storage and conveyance of - hazardous materials, including petroleum products.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF SECTION 01 42 19

SECTION 01 74 30 - SITE PRESSURE PIPE TESTING AND DISINFECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall test all potable water pipelines, utility water, pressure sewer pipe and appurtenant piping, fittings, valves, and meters.

B. The Contractor shall be responsible for obtaining permits for discharging excess testing and disinfection water and dichlorination of such water if required to satisfy permit limits.

1.2 SUBMITTALS

A. The Contractor shall furnish the following information:

1. A testing plan and schedule, including method for conveyance, control, disposal, de-chlorination, and disinfection shall be submitted in writing for approval.

2. Name of certified bacteriological testing laboratory for potable water testing.

3. Provide to the Project Engineer a record of test duration calculations for each segment tested.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All test equipment, chemicals for chlorination, temporary valves, bulkheads, and other water control equipment, and choice of disinfectant shall be as determined by the Contractor.

B. Chlorine for disinfection may be in one of the following forms:

1. Sodium hypochlorite liquid containing approximately 5 to 15% available chlorine, per ANSI/AWWA B 300.

2. Calcium hypochlorite, granular or in 5g tablets containing approximately 65% available chlorine by weight, per ANSI/AWWA B 301.

3. Liquid chlorine: Only with written authorization of Engineer, in accordance with the requirements of ANSI/AWWA B301 - Liquid Chlorine and only by trained personnel using appropriate safety practices.

C. Dechlorinate water prior to discharge. Dechlorination agents may be sodium bisulfite, calcium bisulfite, sodium sulfite, or sodium thiosulfate.

PART 3 - EXECUTION

3.1 GENERAL

A. Water for testing pipelines will be furnished by the Owner; however, the Contractor shall convey the water from the Owner-designated source to the points of use.

B. All pressure pipelines shall be pressure tested; those for potable water shall be disinfected. All chlorinating and testing operations shall be performed in the presence of the Engineer.

C. Disposal of flushing water and water containing chlorine shall be by methods acceptable to the Oregon Department of Environmental Quality.

D. Disinfection operations shall be scheduled as late as possible during the Contract Time to maximize the degree of sterility of the facilities at the time the Work is accepted by the Owner. Bacteriological testing shall be performed by a certified testing laboratory and paid by the Contractor.

3.2 HYDROSTATIC TESTING OF PIPELINES

A. Prior to hydrostatic testing, pipelines shall be flushed or blown out as appropriate. Flushing pipe velocity shall be 2.5 ft/second minimum.

B. The Contractor shall test pipelines either in sections or as a unit. No section of the pipeline shall be tested until the trench has been properly backfilled and all field-placed concrete or mortar has attained an age of 7 days, or until adequately cured. The test shall be made by closing valves when available or by placing temporary bulkheads in the pipe and filling the line slowly with water. The Contractor shall be responsible for ascertaining that all test bulkheads are suitably restrained to resist the thrust of the test pressure without damage to or movement of the adjacent pipe. Unharnessed sleeve-type couplings, expansion joints, or other sliding joints shall be restrained or suitably anchored prior to the test to avoid movement and damage to piping and equipment. Remove or protect any pipeline-mounted devices that may be damaged by the test pressure. The Contractor shall provide sufficient temporary tapping’s in the pipelines to allow for all entrapped air to exit. After completion of the tests, such taps shall be permanently plugged. Open all air relief valves during filling.

C. The pipeline shall be filled at a rate which will not cause any surges or exceed the rate at which the air can be released through the release valves at a reasonable velocity. All the air within the pipeline shall be allowed to escape. The differential pressure across the orifices in the air release valves shall not be allowed to exceed 5 psi at any time during filling.

D. Verify that, in a minimum two-hour test, the pipe does not leak in excess of the allowable leakage as defined by the following formula in which L is the allowable leakage in gallons per hour. Leakage is only allowed for buried piping.

$$Q = \frac{LD(P)^{1/2}}{148{,}000}$$

Where Q = Allowable Leakage (gallons/hour)

L = Length of pipe section being tested (feet)

D = Nominal Pipe Diameter (inches)

P = Tested Pressure (psi, gauge)

E. See plans for planned testing pressures of various pipelines.

F. Pressure test pipe per ASTM F 2164-02 Field Leaking Testing of Polyethylene (PE) Pressure Piping Systems using Hydrostatic Pressure.

3.3 DISINFECTING PIPELINES – TABLET OR GRANULE METHOD

A. Solution Strength: 25 mg/L minimum.

B. Use: Only if the pipes and appurtenances are kept clean and dry during construction. Do not use on solvent welded plastic or screwed joint steel pipe.

C. Placement When Using Granules: During construction, place calcium hypochlorite granules at the upstream end of the first section of pipe, at the upstream end of each branch main, and at 500-foot intervals.

D. Granular Quantity:

Ounces of Granules	
Pipe Diameter (inches)	Amount (ounces)
4	1.7
6	3.8
8	6.7
10	10.5
12	15.1
16	26.8
18	34.0
20	41.9
24	60.4

E. Placement When Using Tablets: During construction, place 5g calcium hypochlorite tablets in each section of pipe as noted in Table 2, and also place one tablet in each hydrant, hydrant branch and other appurtenances. Attach tablets to the inside of the pipe using an adhesive such as Permatex No. 2 or approved substitution. Assure no adhesive is on the tablet except on the broad side attached to the surface of the pipe. Attach all the tablets at the inside top of the main, with approximately equal numbers of tablets at each end of a given pipe length. If the tablets are attached before the pipe section is placed in the trench, mark their position on the section so it can be readily determined that the pipe is installed with the tablets at the top.

Number of Tablets [1]	
Pipe Diameter (inches)	No. of 5g Tablets [2]
4	1
6	1
8	2
10	3
12	4
16	6
18	7
20	9
24	13

[1] Adjust for pipe length other than 18 feet.

[2] Based on 3.25g available chlorine per tablet.

F. Filling Procedure: When granule or tablet installation has been completed, fill the main with clean water at a velocity not exceeding 1 fps. Take precautions to assure that air pockets are eliminated. Leave this water in the pipe for at least 24 hours. If the water temperature is less than 41°F, leave the water in the pipe for at least 48 hours. Position valve so that the chlorine solution in the main being treated will not flow into water mains in active service.

3.4 DISINFECTING PIPELINES – CONTINUOUS FEED METHOD

A. Solution Strength: Dose at 25 mg/L for 4 hours

B. Residual: 10 mg/L at 24 hours.

C. Dosing Methods:

1. Liquid Chlorine: Solution feed vacuum-operated chlorinator in combination with a booster pump. Direct feed is not allowed.

2. Hypochlorite Solution: Chemical feed pump designed for feeding chlorine solutions.

3. Calcium Hypochlorite Granules: Refer to previous section.

D. Filling Procedure: Use approved source to flow clean water at a constant, measured rate into the newly laid water main. Fill at a point not more than 10 feet downstream from the beginning of the new main. Measure concentration at regular intervals to ensure a 25 mg/L dose. Position valves so that the chlorine solution in the main being treated does not flow into water mains in active service. Do not stop chlorine application until the entire main is filled with chlorinated water. Retain the chlorinated water in the main for at least 4 hours, operating all valves and hydrants in the section treated. At the end of the 24-hour period, verify the treated water in all portions of the main has a residual of 10 mg/L free chlorine.

3.5 DISINFECTING PIPELINES – SLUG METHOD

A. Solution Strength: 100 mg/L.

B. Dosing Methods: Per Engineer's direction

C. Filling Procedure: Use approved source to flow clean water at a constant, measured rate into the newly laid water main. Fill at a point not more than 10 feet downstream from the beginning of the new main. Measure concentration at regular intervals to ensure 100 mg/L dose. Apply the chlorine continuously and for the time required to develop a solid column or "slug" of chlorinated water that will expose all interior surfaces to a 100 mg/L for at least 3 hours. Measure the chlorine residual in the slug as it moves through the main. If at any time it drops below 50 mg/L, stop flow and relocate chlorination equipment at the head of the slug, and as flow is resumed, add chlorine to restore the free chlorine in the slug to not less than 100 mg/L. As the chlorinated water flows past fittings and valves, operate valves and hydrants to disinfect appurtenances and pipe branches.

3.6 DISINFECTING PIPELINES – FINAL FLUSHING

A. After the retention period, flush the chlorinated water from the main until chlorine measurements show that the concentration in the water leaving the main is no higher than that in the system, or is acceptable for domestic use.

B. Dispose of flushing water to a location approved by the Engineer.

3.7 DISINFECTING PIPELINES – BACTERIOLOGICAL TESTS

A. After final flushing and before the water main is placed in service, test samples collected from the main(s) for coliform bacteria. Take 2 samples from each location at least 24 hours apart.

B. If the initial disinfection fails to produce approved bacteriological samples, reflush and resample the main. If check samples show bacterial contamination, re-chlorinate the main until approved results are obtained.

3.8 DISINFECTING PIPELINES – SWABBING

A. If connections are not disinfected along with the newly installed main, swab or spray the interior of all pipe and fittings used in making the connections with a 1% hypochlorite solution before installation.

END OF SECTION 01 74 30

SECTION 01 75 00 – EQUIPMENT TESTING AND STARTUP (WWTP)

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Equipment testing and startup are requisite to satisfactory completion of the contract and, therefore, shall be completed within the contract time.

B. The Contractor shall coordinate with the Owner all work necessary for the successful operation of all equipment, including owner furnished equipment.

C. During all equipment testing plant/facility startup period and acceptance test periods, the Owner shall ensure that experienced, trained, and qualified personnel are onsite at all times to oversee and safeguard such testing and operations.

1.2 SUBMITTALS

A. Testing and Startup Plan: Not less than 60 days prior to startup, the Contractor shall submit for review a detailed Testing and Startup Plan. The Plan shall include schedules for equipment certifications, submittal of final Owner's Manuals, training of the Owner's personnel, electrical testing, and a detailed schedule of operations to achieve successful equipment plant testing, startup, performance and acceptance testing and activities to implement the 7-day and 30-day tests. The Plan shall include test checklists and data forms for each item of equipment and shall address coordination with the Owner's staff. The Contractor and Owner shall revise the Plan as necessary based on review comments.

B. System Outage Requests: Request for shutdown of on-line systems as necessary to test or start up the plant and equipment. Shutdown requests must be submitted at least two weeks prior to shutdown.

C. Records and Documentation:

1. Submit documentation that the equipment has been properly installed, is in accurate alignment, is free from undue stresses from connecting piping and anchoring, and has operated satisfactorily under full load conditions.

2. Testing and Startup Records as specified in Section 3.8.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION

3.1 GENERAL

A. Prior to scheduling any operations testing, the Contractor shall have previously furnished the Owner's Manuals required under Section 01 78 23 – Operation and Maintenance Data.

B. The Contractor shall coordinate the scheduling of all operations testing. The Contractor is advised that the Engineer and the Owner's operating personnel will witness operations testing and that the equipment supplier's representative shall be required to instruct the Owner's operating personnel in correct operation and maintenance procedures.

C. The Contractor shall notify the Engineer at least 7 days in advance for testing installed equipment.

3.2 FACTORY ACCEPTANCE TESTING

A. The Contractor shall be responsible for conducting a factory acceptance test and achieving Engineer approval as to the outcome of the test prior to the field installation of the equipment, if required by the specifications for the equipment.

B. The Contractor is advised that the Engineer and the Owner’s operating personnel may witness factory testing.

C. The Contractor shall be responsible for scheduling all factory acceptance testing. The Contractor shall coordinate the factory acceptance testing schedule with the Engineer at least 1 week in advance.

D. Factory acceptance testing shall be conducted per the requirements in the equipment specifications.

E. Factory acceptance testing shall involve the bench setup of RTU/PLC panels with interconnecting network connections when needed. This will be followed by a demonstration of OIT navigation menus, process data displays, alarm/status indication, and PLC implementation of control strategies described in Division 40. In addition, the Contractor shall demonstrate operation of RTU/PLCs for a minimum of eight continuous hours. Factory acceptance testing for SCADA computers requires that all software for the system be installed, configured, and operating with no errors or faults for 24 hours. The system will remain active throughout this test period. In addition, automatic windows updates must be disabled.

3.3 EQUIPMENT INSTALLATION AND TESTING

A. The Contractor shall coordinate directly with the Equipment Vendor to provide the services of an experienced and authorized representative of the manufacturer, who shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation.

B. The Contractor shall arrange to have the manufacturer's representative revisit the job site as often as necessary until any and all trouble is corrected and the equipment installation and operation are satisfactory to the Vendor and Engineer.

C. The Contractor shall require that each manufacturer's representative furnish to the Engineer a written certification addressed to the Owner certifying that the equipment has been properly installed and lubricated, is in accurate alignment, is free from any undue stress imposed by connecting piping or anchor bolts, and has been operated satisfactorily and tested under full-load conditions.

3.4 PROCESS SYSTEM TESTING

A. In addition to individual equipment and subsystem testing, the Contractor shall perform testing of all process control, electrical and other systems, as listed below and/or in the Contract Documents, to demonstrate proper operation with equipment operating over full operating ranges and under actual operating conditions, in all of the automatic and manual modes as specified in the control strategies and descriptions in the equipment specifications and Division 40.

B. The Contractor shall repeat the system tests as necessary to demonstrate proper operation to the satisfaction of the Engineer. The Contractor shall be back charged the cost of Owner's personnel and Engineer's personnel for all tests beyond the second test.

C. Prior to initiating the system testing, the Contractor shall submit the testing procedures to the Engineer for approval. Systems that are included in a 7-day test shall be tested and accepted prior to commencement of the 30-day startup test. The systems that shall be included in the 7-day and 30-day tests include the following and other systems as indicated in the Contract Documents:

1. Headworks systems including screening and lift station.

2. Grit removal system including grit chamber, grit classifier and grit pump.

3. SBR treatment basins, aeration system, and all associated components including but not limited to process blowers, DO probes, fine bubble diffusers, flow meters, electrically actuated valves, pressure sensors, and master dissolved oxygen control system.

4. Other mechanical equipment including mixers, ORP/temperature sensors, pH sensors, decanters, TSS sensors, ammonia sensors, and mixed liquor, WAS and EQ pumps.

5. UV disinfection system.

6. Power distribution, switchgear, standby generator and motor control equipment.

7. SCADA system.

8. Denitrifying sand filters and associated components.

9. Solids handling equipment including gravity belt thickener (if ABI 2 is added to contract), screw press, feed pumps, and polymer feed equipment.

10. Other systems as specified in the Contract Documents.

D. Systems that do not need a 7-day clean water test include:

1. Utility water system.

2. Generator.

E. System testing in general shall involve demonstration that all controls, instrumentation loops, alarm/status indication, and all controls described in Division 40 function properly. In addition, the Contractor shall demonstrate sustained equipment operation for a minimum of eight continuous hours when operated in conjunction with other system components. The Contractor shall schedule, provide, and coordinate the services of all manufacturers, suppliers, subcontractors, the Engineer, and the Owner for successful system testing.

F. All system testing activities shall follow detailed test procedures, check lists, etc., previously developed and submitted by the Contractor which have been reviewed by the Engineer. Completion of all system testing activities shall be documented by a certified report. Successful completion of the system testing is required prior to commencement of the 7-day test and 30-day test specified below.

G. The Contractor shall test and fully demonstrate proper operation of the utility, safety equipment, and other support systems before commencing the process system testing.

H. The Contractor shall give the Engineer written notice confirming the date of any system test at least (3) working days before the time the system is scheduled to be tested. The Owner’s staff will observe system's testing.

I. Operational instruction for the controls and instrumentation shall occur before the test.

3.5 7-DAY CLEAN WATER TEST

A. The startup of the wastewater treatment process is a complex operation requiring the combined technical expertise of the Contractor, Owner, and the Engineer. The Owner shall provide the effective coordination of all parties necessary for a successful 7-day test.

B. The Owner and Contractor shall provide operating personnel for the duration of the 7-day test.

C. The 7-day test shall not commence until all required equipment tests have been completed to the satisfaction of the Engineer.

D. All defects in materials or workmanship which appear during this test period shall be immediately corrected by the Contractor.

E. During the 7-day test, the Owner and Contractor shall provide the services of authorized representative, in addition to those services required under operations testing, as necessary, to correct faulty equipment operation.

F. 7-Day Test: The Contractor shall be required to conduct the 7-day test, operate facilities being tested, and pass a 7-day test. All equipment must properly run continuously 24 hours per day for the test period at test flow rates. If any item malfunctions during the test, the item shall be repaired and the test restarted at day zero with no credit given for the operating time before the aforementioned malfunction.

1. The Owner shall lubricate and maintain the equipment in accordance with the manufacturer’s recommendations.

2. Prerequisites: The following shall be completed before the 7-day testing begins.

a. All Owner's manuals information required by the Contract Documents has been furnished.

b. Provide all safety equipment, fire extinguishers, protective guards and shields, handrails, grating, safety signs, and valve and piping identification required by the Contract Documents. Devices and equipment shall be fully functional, adjusted and tested.

c. Manufacturer's certification of proper installation has been accepted.

d. Leakage tests, electrical tests, and adjustments have been completed.

e. Training of Owner's personnel on all equipment included in the 7-day test has been completed and copy of training on DVD and/or digitally provided to Owner.

f. The Engineer has approved the 7-day testing and startup Plan. The Plan shall include a check list documenting that all the prerequisites have been provided and/or completed.

g. Functional verification of the individual instrumentation loops (analog, status, alarm, and control).

h. Adjustment of the pressure switches, timing relays, level switches, temperature switches, HMI monitors, and all other control devices to the settings determined by the Engineer or the equipment manufacturer.

i. Functional verification of the individual interlocks between the field-mounted control devices and the motor control circuits, control circuits of variable-speed controllers, and packaged system controls.

3.6 30-DAY TEST AND PLANT STARTUP

A. The Contractor shall be required to incorporate the Plant improvements into the plant operation, operate it, and pass a 30-day test prior to acceptance. The new plant improvements shall be started up together after each has completed the 7-day test. All process equipment must properly run continuously 24 hours per day for the 30-day test period. If any item malfunctions during the test, the item shall be repaired and the test restarted at day zero with no credit given for the operating time before the aforementioned malfunction.

1. Prerequisites: The following shall be completed before plant testing and startup begins.

a. The 7-day clean water test shall be completed and accepted.

b. Clean water from the 7-day clean water test has been pumped out of the system. Contractor is responsible for emptying the system of clean water. Coordinate with the Owner for proper disposal of the water. It is expected that the clean water will be discharged from the treatment plant to the rapid infiltration basins.

c. The Engineer has approved the 30-day Testing and Startup Plan.

B. The startup of the wastewater treatment process is a complex operation requiring the combined technical expertise of the Contractor, Owner, and the Engineer. The Owner and/or Engineer shall provide the effective coordination of all parties necessary for successful 30-day test.

C. After approval of the 30-day Startup Plan and coordination with the Owner, the Contractor shall start the 30-day test by diverting the influent flow to the new headworks and fully treated effluent to the rapid infiltration disposal basins.

D. Throughout the 30-day test, all plant flow shall run through the new facilities.

E. All defects in material or workmanship which appear during the tests shall be immediately corrected by the Contractor.

F. The Owner and Contractor shall provide operating personnel for the duration of the 30-day test.

G. The Owner shall lubricate and maintain the equipment in accordance with the manufacturer's recommendations.

H. During the 30-day test, the Contractor shall provide the services of authorized representative, in addition to those services required under operations testing, as necessary, to correct faulty equipment operation.

I. Testing and startup records per Section 3.8.

J. After successful completion and acceptance of the 30-day test, the Contractor shall:

1. Complete closeout of the project per Section 01 77 00 – Closeout Procedures.

3.7 SUPPLIES

A. The Owner shall furnish all wastewater, treated wastewater chemicals, and all other necessary equipment, facilities, and services required for conducting the tests.

B. If the 7-day clean water test uses dewater, well water, or irrigation water, Contractor shall make arrangements and provide water.

3.8 RECORDS OF TESTING AND STARTUP

A. The Contractor shall maintain the following during the 7-day and 30-day testing and startup and submit originals to Engineer prior to acceptance of tests:

1. Lubrication and service records for each mechanical and electrical equipment item.

2. Hours of daily operation for each mechanical and electrical equipment item.

3. Equipment alignment and vibration measurement records.

4. Logs of electrical measurements and tests.

5. Instrumentation calibration and testing logs.

6. Testing and validation of status indications and alarms.

7. Factory and field equipment settings.

8. Log of problems encountered and adjustments made.

9. Other records, logs, and checklists as required by the Contract Documents.

10. Influent and effluent flow for each 24-hour period from midnight to midnight during the test.

11. Backwash flow for each 24-hour period from midnight to midnight during the test.

3.9 TRAINING

A. The Contractor shall coordinate the training periods with the Owner and manufacturer's representatives and shall submit a training schedule and detailed agenda for each piece of equipment or system for which training is to be provided. Said training schedule and agenda shall be submitted not less than 14 calendar days prior to the time that the associated training is to be provided. The Contractor shall confirm each training period a minimum of two days prior to scheduled time.

END OF SECTION 01 75 00

SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Comply with requirements stated in conditions of the contract and in Specifications for administrative procedures in closing out the Work.

B. Furnish lien waivers, bond extensions, and other required data.

C. Satisfy conditions of the contract, fiscal provisions, legal submittals and additional administrative requirements.

1.2 SUBSTANTIAL COMPLETION

A. Substantial Completion of a facility with operating systems (e.g., mechanical, electrical, HVAC) shall be that degree of completion that it may be used or occupied for its intended purpose and performance and acceptance testing has been successfully demonstrated to the Owner's Authorized Representative. All equipment contained in the Work, plus all other components necessary to enable the Owner to operate and maintain the facility in the manner it was intended, shall be complete on the Substantial Completion date. The contractor may request that a punch list be prepared by the Owner's Authorized Representative with submission of the request for the Substantial Completion notice.

B. When substantially complete, the Contractor shall submit to the Owner:

1. A written notice that the Work, or designated portion thereof, is substantially complete.

2. A list of items to be completed or corrected.

C. Within a reasonable time after receipt of such notice, Engineer will perform an inspection to determine the status of completion. If the Work is not deemed substantially complete, the following will occur:

1. Owner will promptly notify the Contractor in writing, giving the reasons therefore.

2. The Contractor shall remedy the deficiencies in the Work, and send a second written notice of Substantial Completion to the Owner.

3. Owner will request the Engineer to re-inspect the Work.

4. Once the Work is deemed substantially complete and after review and approval, the Engineer will execute and deliver to the Owner and the Contractor, the Certificate of Substantial Completion with a final list of items to be completed or corrected prior to release of final payment.

1.3 PROJECT RECORD DOCUMENTS

A. Maintain at Project site, available to Owner and Engineer, one copy of the Contract Documents, shop drawings and other submittals, in good order.

1. Mark and record field changes and detailed information contained in submittals and change orders.

2. Record actual depths, horizontal and vertical location of underground pipes, duct banks and other buried utilities. Reference dimensions to permanent surface features.

3. Identify specific details of pipe connections, location of existing buried features located during excavation, and the final locations of piping, equipment, electrical conduits, manholes, and pull boxes.

4. Identify location of spare conduits including beginning, ending, and routing through pull boxes and manholes. Record spare conductors, including number and size, within spare conduits, and filled conduits.

5. Provide schedules, lists, layout drawings, and wiring diagrams.

6. Make annotations with erasable colored pencil conforming to the following color code:

a. Additions - Red

b. Deletions - Green

c. Comments - Blue

d. Dimensions - Graphite

7. Make all annotations on one set of drawings.

B. Maintain documents separate from those used for construction.

1. Label documents “RECORD DRAWINGS.”

C. Keep documents current.

1. Record required information at the time the material and equipment is installed and before permanently concealing.

2. During progress meetings, record documents will be reviewed to ascertain that changes have been recorded.

D. Submit record documents for review. Submittal shall be in accordance with Section 01 33 00 – Submittal Procedures.

1.4 FINAL SUBMITTALS

A. The Contractor, prior to requesting final payment, shall obtain and submit the following items to the Engineer for transmittal to the Owner:

1. Written guarantees, where required.

2. Technical Manuals and instructions.

3. New permanent cylinders and key blanks for all locks.

4. Maintenance stock items; spare parts; special tools.

5. Completed record drawings.

6. Bonds for roofing, maintenance, etc., as required.

7. Certificates of inspection and acceptance by local governing agencies having jurisdiction.

8. Releases from all parties who are entitled to claims against the subject project, property, or improvement pursuant to the provisions of law.

9. Letter from bonding company stating that bonds will be extended for one year after substantial completion.

B. Owner will prepare a final Change Order, reflecting approved adjustments to the contract sum which were not previously made by Change Orders.

1.5 FINAL CLEANUP

A. The Contractor shall promptly remove from the vicinity of the completed Work, all rubbish, unused materials, concrete forms, construction equipment, and temporary structures and facilities used during construction. Final acceptance of the Work by the Owner will be withheld until the Contractor has satisfactorily performed the final cleanup of the Site.

1.6 MAINTENANCE AND GUARANTEE

A. The Contractor shall comply with the maintenance and guarantee requirements contained in the General Conditions.

B. The Contractor shall make all repairs and replacements promptly upon receipt of written order from the Owner. If the Contractor fails to make such repairs or replacements promptly, the Owner reserves the right to do the Work and the Contractor and its surety shall be liable to the Owner for the cost thereof.

1.7 FINAL PAY ESTIMATE

A. Submit final pay estimate and supporting data to Owner.

B. Final estimates shall reflect all adjustments to the contract sum:

1. The original contract sum
2. Additions and deductions resulting from:
    a. Previous Change Orders
    b. Allowances
    c. Unit prices
    d. Deductions for uncorrected work
    e. Penalties and bonuses
    f. Deductions for liquidated damages
3. Total contract sum, as adjusted
4. Previous payments
5. Sum remaining due

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF SECTION 01 77 00

SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall submit technical operation and maintenance information for each item of mechanical and electrical equipment in an organized manner in the Owner's Manual. It shall be written so that it can be used and understood by the Owner's operation and maintenance staff. The Owner's Manual information shall also be submitted in electronic format using a USB flash drive.

B. All manuals supplied to the Owner by suppliers of Owner-furnished equipment, shall be inserted into the Owner's Manual by the Contractor. The Contractor shall be responsible for providing all other information.

1.2 OWNER'S MANUAL

A. The Owner's Manual shall include the following for each item of mechanical and electrical equipment (as applicable):

1. Equipment Summary: A summary table shall include the equipment name and equipment number, the manufacturer's model number, serial number, and other nameplate information specific to the equipment provided.

2. Operational Procedures: Manufacturer-recommended procedures on the following shall be included:

   a. Installation

   b. Adjustment

   c. Startup

   d. Location of controls, special tools, equipment required, or related instrumentation needed for operation

   e. Operation procedures

   f. Load changes, Calibration, Shutdown

3. Troubleshooting, Disassembly, Reassembly

   a. Realignment

   b. Testing to determine performance efficiency

   c. Tabulation of proper settings for all pressure relief valves, low and high pressure switches, and other protection devices

d. List of all electrical relay settings including alarm and contact settings

4. Preventive Maintenance Procedures:

a. Procedures: Preventive maintenance procedures shall include all manufacturer-recommended procedures to be performed on a periodic basis, both by removing and replacing the equipment or component, and by leaving the equipment in place.

b. Schedules: Recommended frequency of preventive maintenance procedures shall be included. Lubrication schedules, including lubricant SAE grade, type, and temperature ranges, shall be covered.

5. Parts List and Drawings:

a. Parts List: A complete parts list shall be furnished, including a generic description and manufacturer's identification number for each part. Addresses and telephone numbers of the nearest supplier and parts warehouse shall be included.

b. Drawings: Cross-sectional or exploded view drawings shall accompany the part list.

6. Wiring Diagrams: Include complete internal and connection wiring diagrams for electrical equipment items.

7. Shop Drawings: Include approved shop or fabrication drawings, complete with dimensions. Include performance curves for pumps furnished.

8. Safety: This part describes the safety precautions to be taken when operating and maintaining the equipment or working near it.

9. Documentation: All equipment warranties, affidavits, and certifications required by the Technical Specifications shall be placed in this part.

10. Spare Parts: This part shall contain spare parts information for all mechanical, electrical, and instrumentation equipment. The spare parts list shall include the current list price of each spare part. The spare parts list shall be limited to those spare parts which each manufacturer recommends be maintained by the Owner in inventory at the plant site. Each manufacturer or supplier shall indicate the name, address, and telephone number of its nearest outlet of spare parts to facilitate the Owner in ordering. The Contractor shall cross-reference all spare parts lists to the equipment numbers designated in the Contract Documents.

B. If manufacturer’s standard brochures and manuals are used to describe operating and maintenance procedures, modify such brochures and manuals **to reflect only the model or series of equipment used on this project and features provided**. Cross out neatly or remove extraneous material, or otherwise annotate or eliminate.

1.3 TRANSMITTAL PROCEDURE

A. Provide three (3) original paper copies and one (1) electronic copy in PDF format of all operating and maintenance information. For ease of identification, label each manufacturer's brochure and manual with the equipment name. Organize the information in 3-ring binders and use an indexing feature within the PDF submission, in numerical order, per specification section number. Include in the manuals a table of contents and tab sheets to permit easy location of desired information. Each binder shall include a cover sheet and spine label giving the project name, Engineer's project number, Contractor name and contact information, applicable subcontractor name and contact information, and supplier name and contact information.

B. The Contractor shall submit to the Engineer three identical Owner's Manuals a minimum of 90 calendar days prior to the scheduled startup of the equipment.

C. The Engineer will review the Owner's Manuals within 30 days following their receipt by the Engineer. The Contractor shall then make any corrections and changes noted and compile all the corrected Owner's Manuals for final submittal to the Engineer.

1.4 PAYMENT

A. Acceptable operating and maintenance information for the project must be delivered to the Engineer prior to the project being 75 percent complete or at least two weeks prior to startup of any equipment. Progress payments for work in excess of 80 percent completion or 2 weeks prior to startup will not be made until the specified acceptable operating and maintenance information has been delivered to the Engineer.

1.5 FIELD CHANGES

A. Following the acceptable installation and operation of an equipment item, the item's instructions and procedures are to be modified and supplemented to reflect any field changes or information requiring field data.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF SECTION 01 78 23

SECTION 26 05 00 – ELECTRICAL, GENERAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to all of Division 26 Specifications. This Specification section applies to all Division 26 Specifications and Electrical Drawings.

B. Division 26 contractor shall review all other division specifications and drawings for additional requirements.

1.2 QUALITY ASSURANCE

A. Comply with latest NEC, NFPA, UBC, UFC, UL and applicable Local and State Codes. Also comply with Utility Company regulations and industry standards and these Drawings.

B. Work shall be done by only trained, licensed and experienced workmen familiar with the requirements.

C. All microprocessor-based equipment and software with equipment shall utilize 4 digits for the year part of all dates. A two-digit date shall be an option for printing at Owner’s preference.

D. Hazardous Location Rating of Equipment: Equipment manufacturer shall reference the hazardous-area classification drawing in the Contract Documents and provide equipment in compliance with the defined NEC- classification requirements. It will be the manufacturer's sole responsibility to submit equipment in compliance with the Contract Documents, NFPA 820, and NEC requirements.

1.3 EXTENT OF DRAWINGS / SPECIFICATION

A. Drawings indicate intent and general layout of electrical systems for the Project. Drawings are partly diagrammatic and do not indicate all fittings and accessories which may be required. Provide such fittings and accessories as required to form a complete and operating system in general conformance with Specifications and Drawings.

1.4 PRIOR APPROVALS

A. Unless directed otherwise by Division 1, all products submitted for prior approval shall be received by the Engineer 10 business days prior to Bid. Supply technical data, photometrics and dimensional Drawings showing that substitutes are equal to product specified. Faxed prior approvals will not be accepted.

1.5 DISCREPANCIES

A. Prior to submitting Bid, Contractor shall refer any apparent discrepancies or omissions to Engineer for clarification. The more stringent provisions shall take precedence where codes, Specifications and Drawings differ with one another. The Contractor shall Bid the more expensive requirement, unless discrepancy is addressed by Addendum prior to Bid.

1.6 TEMPORARY LIGHTING/POWER

A. Provide temporary electrical power and lighting for all trades that require service during the course of this Project. Provide temporary service and distribution as required. Provide temporary power for all electrical equipment that will need to be installed due to the phased construction of this project. Comply with the NEC and OSHA requirements. Energy Costs by General Contractor.

1.7 SHOP DRAWING SUBMITTALS

A. General: Follow the procedures specified in Section 01 33 00 – Submittal Procedures. Submit for final and official approval through the General Contractor.

1.8 SEQUENCING AND SCHEDULING

A. Coordinate electrical equipment installation with other building components.

B. Arrange for chases, slots, and openings in building structure during progress of construction to allow for electrical installations.

C. Coordinate installing required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

D. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning prior to closing in the building.

E. Coordinate connecting electrical service to components furnished under other Sections.

F. Coordinate connecting electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Coordinate requirements for access panels and doors where electrical items requiring access are concealed by finished surfaces.

1.9 SUBSTANTIAL COMPLETION

A. At Substantial Completion of Project, be ready to demonstrate the following list of items below. If this is not possible, inform the General Contractor and Engineer no less than 1 week prior to Engineer’s visitation of the site for Substantial Completion.

B. Demonstrate the operation and test of the emergency lighting system.

C. Demonstrate the main service ground, bonding to neutral and resistance readings obtained at time of installation. This will involve having some covers removed from the main panels at the time of the Engineer's visitation.

D. All electrical systems and items specified shall be installed and operational.

E. Demonstrate exterior lighting controls.

F. Demonstrate the operation of all emergency power systems including generators, uninterruptible power supplies and inverter systems.

G. Demonstrate compliance with IEEE 519 for harmonic distortion within “Pacific Power’s” distortion limit requirement of “8%”. Distortion limits apply to the entire plant load measured at the primary meter. This point in the system shall be defined as the point of common coupling (PCC). Meeting these requirements is a condition of service and a requirement of this project. Refer to Section 26 29 23 – Variable-Frequency Motor Controllers (VFCs/VFDs), Part 2.3.I.

1.10 RECORD DOCUMENTS

A. Prepare Record Documents in accordance with the requirements in Section 01 77 00 – Closeout Procedures. In addition to the requirements specified in Division 1, indicate the following installed conditions:

B. Actual location of all electrical service gear/feeders, panel/motor/special equipment feeders, all major underground or under slab conduits, all conduit stubs for future use, any change in branch circuitry from Drawings, key junction boxes and pull boxes not indicated on Drawings, any control locations or indicator lights not shown on Drawings.

C. Addendum items, Change Order items and all changes made to Drawings from Bidding phase through to Project completion.

D. Actual equipment and materials installed. Where manufacturer and catalog number are indicated on Drawings, generally or in fixture or equipment schedules, change to reflect actual products installed.

E. Change service panel and branch panel breaker locations and schedules to reflect actual installed conditions.

1.11 MAINTENANCE MANUALS

A. Prepare maintenance manuals in accordance with Section 01 77 00 – Closeout Procedures. In addition to the requirements specified in Division 1 assemble O & M Manuals as follows:

1. Compile Operating and Maintenance Manuals for the electrical systems and equipment. The manuals shall be provided to the Engineer for approval complete and at one time, prior to requesting final payment. Partial or separate data will be returned for completion.

2. Manuals shall be assembled in three-ring binders. Binders shall be 3 inch thick or less and have slip sleeve jacket on binder side and front. More than one binder shall be used for each set of data if required to prevent overfilling of one binder. All information shall be arranged in Sections and each Section shall have a blank buff colored, heavy paper divider with a protruding tab clearly labeled. Sections shall be arranged in the same order that the equipment is listed in the Specification and each Specification section shall have a separate tab. Shop Drawings which are larger than 8-1/2-inch by 11 inch shall be individually folded so they are 8-1/2-inch by 11 inch or less and inserted behind the appropriate tab.

3. Tabs shall be labeled and arranged as follows:

   a. Index: Furnish under the first tab an index of Sections listing name of Section and Specification numbers.

   b. Equipment Manufacturers: Furnish under the second tab a complete typed list of equipment suppliers and manufacturer's representative including type of equipment, name, address, and phone number. The company listed here should be the one which could furnish replacement parts and offer technical information about the equipment.

   c. Product Literature: Each tab, starting with the third shall contain the name of a Specification Section. Behind each tab shall be the previously submitted and approved Shop Drawing, factory published operation and maintenance instructions and parts lists. Also include description of function, normal operating characteristics and limitations, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions. Servicing instructions and lubrication charts and schedules.

4. Upon completion and approval of the booklets, one copy shall be given to the Architect, and two to the Owner. Using the booklet, the Electrical Contractor shall explain in detail and instruct the Owner's operating personnel in the correct operation and maintenance of the equipment.

PART 2 - PRODUCTS

2.1 SUPPORTING DEVICES

A. Channel and angle support systems, hangers, anchors, sleeves, brackets, fabricated items, and fasteners are designed to provide secure support from the building structure for electrical components.

1. Material: Steel, except as otherwise indicated, protected from corrosion with zinc coating or with treatment of equivalent corrosion resistance using approved alternative finish or inherent material characteristics.

2. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel, except as otherwise indicated.

B. Steel channel supports have 9/16-inch diameter holes at a maximum of 8 inches o.c., in at least 1 surface.

1. Fittings and accessories mate and match with channels and are from the same manufacturer.

C. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps or "click"- type hangers.

D. Sheet-Metal Sleeves: 0.0276-inch or heavier galvanized sheet steel, round tube, closed with welded longitudinal joint.

E. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.

F. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Plugs have number and size of conductor gripping holes as required to suit individual risers. Body constructed of malleable iron casting with hot-dip galvanized finish.

G. Expansion Anchors: Carbon-steel wedge or sleeve type.

H. Toggle Bolts: All-steel springhead type.

I. Powder-Driven Threaded Studs: Heat-treated steel.

2.2 CONCRETE EQUIPMENT BASES

A. Concrete: 3000 psi, 28-day compressive strength as specified

B. RACEWAY AND CABLE LABELS

C. Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

1. Color: Black letters on orange field.

2. Legend: Indicates voltage.

D. Adhesive Labels: Preprinted, flexible, self-adhesive vinyl with legend overlaminated with a clear, weather- and chemical-resistant coating.

E. Pretensioned, Wraparound Plastic Sleeves: Flexible, preprinted, color-coded, acrylic band sized to suit the diameter of the line it identifies and arranged to stay in place by pretensioned gripping action when placed in position.

F. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

G. Underground-Line Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape.

1. Not less than 6 inches wide by 4 mils thick.

2. Compounded for permanent direct-burial service.

3. Embedded continuous metallic strip or core.

4. Printed legend indicating type of underground line.

H. Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

2.3 NAMEPLATES

A. Engraved Plastic Nameplates: Engraving stock, melamine plastic laminate, minimum 1/16-inch thick for signs up to 20 sq. in. and 1/8-inch thick for larger sizes.

1. Engraved legend with white letters on black face.

2. Punched or drilled for mechanical fasteners.

2.4 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.

1. Minimum Width: 3/16-inch.

2. Tensile Strength: 50 lb minimum.

3. Temperature Range: Minus 40 to plus 185 deg F.

4. Color: According to color-coding.

B. Paint: Formulated for the type of surface and intended use.

1. Primer for Galvanized Metal: Single-component acrylic vehicle formulated for galvanized surfaces.

2. Primer for Concrete Masonry Units: Heavy-duty-resin block filler.

3. Primer for Concrete: Clear, alkali-resistant, binder-type sealer.

4. Enamel: Silicone-alkyd or alkyd urethane as recommended by primer manufacturer.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION REQUIREMENTS

A. Install components and equipment to provide the maximum possible headroom where mounting heights or other location criteria are not indicated.

B. Install items level, plumb, and parallel and perpendicular to other building systems and components, except where otherwise indicated.

C. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

D. Give right of way to raceways and piping systems installed at a required slope.

3.2 ELECTRICAL SUPPORTING METHODS

A. Damp Locations and Outdoors: Hot-dip galvanized materials, U-channel system components.

B. Dry Locations: Steel materials.

C. Support Clamps for PVC Raceways: Click-type clamp system.

D. Conform to manufacturer's recommendations for selecting supports.

E. Strength of Supports: Adequate to carry all present and future loads, times a safety factor of at least 4; 200 lb minimum design load.

3.3 GENERAL INSTALLATION OF MATERIALS

A. Install wires according to manufacturer's written instructions and NECA's "Standard of Installation."

B. Conductor Splices: Keep to the minimum and comply with the following:

1. Install splices and taps that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

2. Use splice and tap connectors that are compatible with conductor material.

C. Connect outlets and components to wiring systems and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening requirements specified in UL 486A.

D. Install devices to securely and permanently fasten and support electrical components.

E. Raceway Supports: Comply with NFPA 70 and the following requirements:

1. Conform to manufacturer's recommendations for selecting and installing supports.

2. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.

3. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.

4. Spare Capacity: Size supports for multiple conduits so capacity can be increased by a 25 percent minimum in the future.

5. Support individual horizontal raceways with separate, malleable iron pipe hangers or clamps.

6. Hanger Rods: 1/4-inch diameter or larger threaded steel, except as otherwise indicated.

7. Spring Steel Fasteners: Specifically designed for supporting single conduits or tubing. May be used in lieu of malleable iron hangers for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to channel and slotted angle supports in accordance with NEC.

8. In vertical runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports, with no weight load on raceway terminals.

F. Vertical Conductor Supports: Install simultaneously with conductors.

G. Miscellaneous Supports: Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices except where components are mounted directly to structural features of adequate strength.

H. Sleeves: Install for cable and raceway penetrations of concrete slabs and walls, except where core-drilled holes are used. Install for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.

I. Fastening: Unless otherwise indicated, securely fasten electrical items and their supporting hardware to the building structure. Perform fastening according to the following:

1. Fasten by means of wood screws or screw-type nails on wood; toggle bolts on hollow masonry units; concrete inserts or expansion bolts on concrete or solid masonry; and by machine screws, welded threaded studs, or spring-tension clamps on steel.

2. Threaded studs driven by a powder charge and provided with lock washers and nuts may be used instead of expansion bolts, machine screws, or wood screws.

3. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or any other items.

4. In partitions of light steel construction use sheet-metal screws.

5. Drill holes in concrete beams so holes more than 1-1/2 inches deep do not cut main reinforcing bars.

6. Drill holes in concrete so holes more than 3/4-inch deep do not cut main reinforcing bars.

7. Fill and seal holes drilled in concrete and not used.

8. Select fasteners so the load applied to any fastener does not exceed 25 percent of the proof-test load.

J. Install concrete pads and bases where indicated.

K. Install utility-metering equipment according to utility company's written requirements. Provide grounding and empty conduits as required by company.

3.4 LABEL INSTALLATION

A. Identification Materials and Devices: Install at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations in the Contract Documents or with those required by codes and standards. Use consistent designations throughout Project.

C. Sequence of Work: If identification is applied to surfaces that require finish, install identification after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before applying.

E. Install painted identification according to manufacturer's written instructions and as follows:

1. Clean surfaces of dust, loose material, and oily films before painting.

2. Prime surfaces using type of primer specified for surface.

3. Apply one intermediate and one finish coat of enamel.

F. Caution Labels for Indoor Boxes and Enclosures for Power and Lighting: Install pressure-sensitive, self-adhesive labels identifying system voltage with black letters on orange background. Install on exterior of door or cover.

G. Circuit Identification Labels on Boxes: Install labels externally.

1. Exposed Boxes: Permanent black marker indicating panel and circuit designation.

2. Concealed Boxes: Permanent black marker indicating panel and circuit designation.

H. Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communication lines, install continuous underground plastic line marker located directly above line at 6 to 8 inches below finished grade. Where width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches overall, use a single line marker. Install line marker for underground wiring, both direct-buried cables and cables in raceway.

I. Color-Coding of Secondary Phase Conductors: Use the following colors for service, feeder and branch-circuit phase conductors:

1. 208/120-V Conductors:

a. Phase A: Black.

b. Phase B: Red.

c. Phase C: Blue.

d. Neutral: White.

e. Ground: Green.

2. 480/277-V Conductors:

a. Phase A: Brown.

b. Phase B: Orange

c. Phase C: Yellow.

d. Neutral: Gray.

e. Ground: Green.

3. Factory apply color the entire length of conductors, except the following field-applied, color-coding methods may be used instead of factory-coded wire for sizes larger than No. 10 AWG:

a. Colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Use 1 inch wide tape in colors specified. Adjust tape bands to avoid obscuring cable identification markings.

J. Power-Circuit Identification: Metal tags or aluminum, wraparound marker bands for cables, feeders, and power circuits in vaults, pull and junction boxes, manholes, and switchboard rooms.

1. Legend: 1/4-inch steel letter and number stamping or embossing with legend corresponding to indicated circuit designations.

2. Tag Fasteners: Nylon cable ties.

3. Band Fasteners: Integral ears.

K. Apply identification to conductors as follows:

1. Conductors to Be Extended in the Future: Indicate source and circuit numbers.

2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color-coding to identify circuits' voltage and phase.

3. Multiple Control and Communication Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color-coding, or cable marking tape.

L. Apply warning, caution, and instruction signs as follows:

1. Warnings, Cautions, and Instructions: Install to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.

2. Emergency Operation: Install engraved laminated signs with white legend on red background with minimum 3/8-inch high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.

M. Equipment Identification Labels: Engraved plastic laminate. Install on each unit of equipment, including central or master unit of each system. This includes power, lighting, communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Unless otherwise indicated, provide a single line of text with 1/2-inch high lettering on 1-1/2 inch high label; where two lines of text are required, use labels 2 inches high. Use white lettering on black field. Apply labels for each unit of the following categories of equipment using mechanical fasteners:

1. Panelboards, electrical cabinets, and enclosures.

2. Access doors and panels for concealed electrical items.

3. Electrical switchgear and switchboards.

4. Emergency system boxes and enclosures.

5. Disconnect switches.

6. Enclosed circuit breakers.

7. Motor starters.

8. Push-button stations.

9. Power transfer equipment.

10. Contactors.

11. Remote-controlled switches.

12. Control devices.

13. Transformers.

14. Battery racks.

15. Power-generating units.

N. For panelboards, provide framed type circuit schedules with identification of items controlled by each breaker. Indicate room numbers of items controlled or room name where appropriate for Owners convenience. Final schedules shall be typed or printed for clarity. Hand written schedules are not acceptable. Schedules shall be posted inside each panel door mounted in transparent card holder upon project completion.

END OF SECTION 26 05 00

SECTION 26 24 13.21 - SWITCHBOARDS

PART 1 - GENERAL

1.1 SCOPE

1. Furnish and install, where indicated, a free-standing, dead-front type low-voltage distribution switchboard, utilizing group mounted circuit protective devices, integrated panelboards, and other equipment as specified herein, and as shown on the contract drawings.

1.2 REFERENCES

A. The low-voltage distribution switchboards and all components shall be designed, manufactured, and tested in accordance with the latest applicable following standards:

1. NEMA PB-2
2. UL Standard 891

1.3 SUBMITTALS – FOR REVIEW/APPROVAL

A. The following information shall be submitted to the Engineer:

1. Master drawing index
2. Front view elevation
3. Floor plan
4. Top view
5. Single line
6. Schematic diagram
7. Nameplate schedule
8. Component list
9. Conduit entry/exit locations
10. Assembly ratings including:
11. Short-circuit rating.
12. Voltage
13. Continuous current

14. Major component ratings including:

15. Voltage

16. Continuous current

17. Interrupting ratings

18. Cable terminal sizes

19. Product data sheets

B. Where applicable, the following additional information shall be submitted to the Engineer:

1. Busway connection

2. Connection details between close-coupled assemblies

3. Composite floor plan of close-coupled assemblies

1.4 SUBMITTALS – FOR CONSTRUCTION

A. The following information shall be submitted for record purposes:

1. Final as-built drawings and information for items listed in Paragraph 1.04 and shall incorporate all changes made during the manufacturing process.

2. Wiring diagrams

3. Certified production test reports

4. Installation information

5. Seismic certification and equipment anchorage details as specified.

1.5 QUALIFICATIONS

A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

D. Provide Seismic tested equipment as follows:

1. The equipment and major components shall be suitable for and certified by actual seismic testing to meet all applicable seismic requirements of the latest International Building Code (IBC).

2. The Project Structural Engineer will provide site specific ground motion criteria for use by the manufacturer to establish SDS values required.

3. The IP rating of the equipment shall be 1.5.

4. The Structural Engineer for the Site will evaluate the SDS values published on the Manufacturer’s website to ascertain that they are "equal to" or "greater than" those required for the Project Site.

5. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.

6. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared, and stamped by a licensed civil engineer in the state. Mounting recommendations shall be provided by the manufacturer based upon the above criteria to verify the seismic design of the equipment.

7. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.

8. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

    a. The manufacturer shall maintain a minimum of twelve (12) domestic, regional, switchboard manufacturing plants within the United States of America to provide parts and service. These facilities shall have the ability to replace and/or modify equipment as deemed necessary. A list of these plants, phone numbers and contacts shall be provided at the request of the owner.

1.6 REGULATORY REQUIREMENTS

A. The low-voltage switchboard shall be UL labeled.

1.7 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer’s instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.8 OPERATION AND MAINTENANCE MANUALS

A. Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewal parts lists where applicable, for the complete assembly and each major component.

1.9 PRODUCTS

1.10 MANUFACTURERS

A. Eaton

B. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

1.11 RATINGS

A. The assembly shall be rated to withstand mechanical forces exerted during short-circuit conditions when connected directly to a power source having available fault current as shown on the drawings. Main Switchboard Section shall be fully rated for 65,000amperes symmetrical at rated voltage. Sub-panels shall be fully rated to meet requirements shown on drawings. Copies of series combinations shall be submitted with approval drawings. These series combinations are required to be tested by UL and values predicted by the use of let-through curves are not acceptable.

B. Voltage rating to be as indicated on the drawings.

1.12 CONSTRUCTION

A. Switchboard shall consist of the required number of vertical sections bolted together to form a rigid assembly. The sides and rear shall be covered with removable bolt-on covers. All edges of front covers or hinged front panels shall be formed. Provide adequate ventilation within the enclosure.

B. All sections of the switchboard shall be rear aligned with depth as shown on the drawings. All protective devices shall be group mounted. Devices shall be front removable and load connections front accessible enabling switchboard to be mounted against a wall.

C. The assembly shall be provided with adequate lifting means.

D. The switchboard shall be equal to Eaton type Pow-R-Line C utilizing the components herein specified and as shown on the drawings.

E. The switchboard shall be suitable for use as service entrance equipment and be labeled in accordance with UL requirements.

1.13 BUS

A. All bus bars shall be silver-plated copper. Main horizontal bus bars, if applicable, shall be mounted with all three phases arranged in the same vertical plane. Bus sizing shall be based on NEMA standard temperature rise criteria of 65 degrees C over a 40 degrees C ambient (outside the enclosure).

B. Provide a full capacity neutral bus where a neutral bus is indicated on the drawings.

C. A copper ground bus (minimum 1/4 x 2 inch) shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the switchboard.

D. All hardware used on conductors shall be high-tensile strength and zinc-plated. All bus joints shall be provided with conical spring-type washers.

1.14 WIRING/TERMINATIONS

A. Small wiring, necessary fuse blocks and terminal blocks within the switchboard shall be furnished as required. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.

B. Mechanical-type terminals shall be provided for all line and load terminations suitable for copper or aluminum cable rated for 75 degrees C of the size as indicated on the drawings.

C. Lugs shall be provided in the incoming line section for connection of the main grounding conductor. Additional lugs for connection of other grounding conductors shall be provided as indicated on the drawings.

D. All control wire shall be type SIS, bundled and secured with nylon ties. Insulated locking spade terminals shall be provided for all control connections, except where saddle type terminals are provided integral to a device. All current transformer secondary leads shall first be connected to conveniently accessible short-circuit terminal blocks before connecting to any other device. All groups of control wires leaving the switchboard shall be provided with terminal blocks with suitable numbering strips. Provide wire markers at each end of all control wiring.

E. Where there is a main switchboard section in the lineup, the switchboard manufacturer shall wire from the associated feeder breaker to the respective panelboard, dry type distribution transformer, automatic transfer switch, UPS, etc… as noted on drawings. Feeders shall be copper, and conductor sized as noted on the drawings. This wiring shall be installed in the factory and shall not be installed in the field. All factory installed power wiring shall be provided with phase color tape as follows:

1. 480/277-Volt WYE Systems

   a. Phase-A = Brown

   b. Phase-B = Orange

   c. Phase-C = Yellow

   d. Neutral = Gray

2. 208/120-Volt WYE Systems

   a. Phase-A = Black

b. Phase-B = Red

c. Phase-C = Blue

d. Neutral = White

1.15 MAIN SWITCHBOARD SECTION

A. Main protective devices

B. Trip units – Main and Tie devices

C. Feeder protective devices

D. Trip units – Feeder devices

E. Accessories

1. Provide shunt trips, bell alarms and auxiliary switches as shown on the contract drawings.

1.16 METERING

A. Where indicated on the drawings, provide a separate metering compartment with front hinged door, and include the following:

B. Current transformers for meter. Current transformers shall be wired to shorting-type terminal blocks.

C. Metering shall meet the requirements of EUSERC No. 322.

1.17 ENCLOSURES

A. NEMA 3R Enclosure

1.18 NAMEPLATES

A. Engraved nameplates, mounted on the face of the assembly, shall be furnished for all main and feeder circuits as indicated on the drawings. Nameplates shall be laminated plastic, black characters on white background. Characters shall be 3/16-inch high, minimum. Nameplates shall give item designation and circuit number as well as frame ampere size and appropriate trip rating. Furnish master nameplate giving switchboard designation, voltage ampere rating, short-circuit rating, manufacturer’s name, general order number, and item number.

1.19 FINISH

A. All exterior and interior steel surfaces of the switchboard shall be properly cleaned and provided with a rust-inhibiting phosphatized coating. Color and finish of the switchboard shall be ANSI 61 light gray.

1.20 SURGE PROTECTIVE DEVICES

A. Provide surge protective devices as specified in Section 16671A.

PART 2 - - EXECUTION

2.1 FACTORY TESTING

A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.

1. The switchboard shall be completely assembled, wired, adjusted, and tested at the factory. After assembly, the complete switchboard will be tested for operation under simulated service conditions to assure the accuracy of the wiring and the functioning of all equipment. The main circuits shall be given a dielectric test of 2200 volts for one (1) minute between live parts and ground, and between opposite polarities. The wiring and control circuits shall be given a dielectric test of 1500 volts for one (1) minute between live parts and ground.

B. The manufacturer shall provide three (3) certified copies of factory test reports.

2.2 MANUFACTURER’S CERTIFICATION

A. A certified test report of all standard production tests shall be available to the Engineer upon request.

2.3 INSTALLATION

A. The Contractors shall install all equipment per the manufacturer’s instructions, contract drawings and National Electrical Code.

B. The assembly shall be provided with adequate lifting means and shall be capable of being moved into installation position and bolted directly to the floor without the use of floor sills provided the floor is level to 1/8 inch per 3-foot distance in any direction. All necessary hardware to secure the assembly in place shall be provided by the Contractor.

2.4 FIELD ADJUSTMENTS

1. The Contractor shall perform field adjustments of the protective devices as required to place the equipment in final operating condition. The settings shall be in accordance with the approved short-circuit study, protective device evaluation study and protective device coordination study.

2. Necessary field settings of devices and adjustments and minor modifications to equipment to accomplish conformance with an approved short circuit and protective device coordination study shall be carried out by the Contractor at no additional cost to the owner.

END OF SECTION 26 24 13.21

SECTION 26 27 13.11 - MICROPROCESSOR-BASED METERING EQUIPMENT

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 power monitoring equipment

1.3 SUBMITTALS

A. Furnish in accordance with Section 01 33 00 – Submittal Procedures.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Eaton products.

1. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

2.2 THE MICROPROCESSOR-BASED METERING EQUIPMENT.

A. The Power Xpert Meter 3000 series**:**

1. Where indicated on the drawings, provide a microprocessor-based line of multifunction, power and energy meters, designated (MM3000) device equal to Eaton type PXM3000 series. The meter device shall be UL listed. All meters shall have the following ratings, features, and functions, unless a specific meter type is designated.

B. Metering

1. Meter shall be designed for multifunction electrical measurement on 3 phase power systems. The meter shall support 3-element wye, 2 element delta and single-phase systems.

2. The meter shall be user programmable for voltage range to any PT ratio.

3. Meter shall be programmable for current to any CT ratio. The use of DIP switches for selecting fixed ratios shall not be acceptable

4. The meter shall have an accuracy of +/- 0.2% or better for volts and amps, and 0.2% for power and energy functions. The meter shall meet the accuracy requirements of IEC62053-22 (class 0.2S) and ANSI C 12.20 (Class 0.2).

5. The meter shall sample the current and voltage inputs at 512 samples per cycle for high accuracy metering.

6. The MM3000 series shall provide the following features:

    a. Calculation of harmonic magnitudes for each phase voltage and current through the 63rd harmonic.

    b. Minimum and maximum values and the date/time of occurrence for the following parameters:

        1) Voltage L-L and L-N

        2) Current per phase

        3) Apparent power factor

        4) Real, reactive, and apparent total power

        5) %THD voltage L-N

        6) %THD current per phase

        7) Frequency

        8) Voltage and Current unbalance factors

7. Type MM3000 meters shall provide the following measurements with a 100ms update rate:

    a. Volts (phase to phase and phase to neutral; per phase and average)

    b. Amps (per phase, neutral, and average)

    c. KW (per phase, and total)

    d. KVAR (per phase and total)

    e. KVA (per phase and total)

    f. PF (apparent power factor)

    g. Frequency

8. Type MM3000 meters shall provide the following measurements with a 10 second update rate:

    a. kWh (forward, reverse, total, net)

    b. kVARh, (forward, reverse, total, net)

    c. kVAh (total)

    d. kWh per phase (forward, reverse)

    e. kVARh per phase (forward, reverse)

    f. kVAh per phase (total)

    g. % THD (Total Harmonic Distortion) monitoring to the 63rd harmonic order for currents and L-N voltage in 4 wire wye and L-L voltage in 3 Wire delta

9. The MM3000 shall include the last 5-minute interval MIN, MAX, and AVERAGE readings for 56 parameters in MODBUS TCP and in BACNET.

10. The MM3000 shall provide user configured fixed window or sliding window demand.

11. Demand Readings shall be available for kW, kVAR and kVA.

12. Type MM3000 shall support time of use metering. The meter shall support 4 tariffs, 12 seasons and 14 schedules.

13. The meter shall fit in both DIN 92mm and ANSI C39.1 round cut-out.

14. The meter must display a % of Load indication on the front panel to provide an analog feel. The % load bar shall have not less than 10 segments.

15. The meter shall be available in transducer only version, which shall not include a display. The transducer version shall mount directly to a DIN rail.

C. Advanced Power Quality

1. Type MM3000 WEB server shall support sag/swell voltage quality event logging including waveform capture and 1.5 Gigabytes for data logging, and waveform captures.

2. Type MM3000 meters shall provide a simultaneous voltage and current waveform recording displayable in the Meter's WEB server. The MM3000 shall record voltage and current waveform data at a sample rate of 128 samples per cycle including the ability to capture sags and swells.

3. Waveform data shall be exportable from the WEB server.

4. The MM3000 meter shall provide triggered 20 cycle recordings with 10 cycles of pre- and post-trigger recording capability.

5. COMTRADE – Waveform file shall be available in industry standard COMTRADE format and shall be downloadable from SFTP directory on-board the meter.

6. The MM3000 meter shall support 3 user configurable data logs. Each data log can contain up to 117 parameters and can be configured from 1 minute to 1440 minutes.

D. Advanced WEB Server

1. The MM3000 shall include the following WEB server features using only an internet browser and no separate software. The WEB server shall provide the user with remote WEB access to metered information including basic metering data, energy, harmonics, sequence components, max/min, alarm log, I/O status. Capabilities shall include:

a. Full device configuration

b. 20 cycle sag/swell waveform viewing including 10 cycles before and 10 cycles after trigger point with click and drag zoom

c. Manual triggering and viewing of steady state waveform

d. Waveform viewing shall include 3 currents and 3 voltages simultaneously with the ability to select/de-select individual channels

e. Graphical demand comparison between 2 different days, 2 different weeks or 2 different months for benchmarking of energy consumption

f. Graphical trending of 44 metering parameters including click and drag zoom window capability

g. Key parameter trends to include true 100ms min/max readings representing short term variations of data

h. Overview page with statistical analysis of key parameters including mean value and +/- 3 sigma deviation

i. Phasor diagram of current and voltage metered inputs to assist in validation and troubleshooting of meter wiring issues.

j. TLS 1.2 encrypted WEB pages

k. Support for importing custom security certificates

E. Ratings

1. The meter shall accept a direct metering voltage input range of up to 400 Volts line to neutral, and a range of up to 690 Volts line to line.

2. Meter shall accept standard 5A or 1A current transformer inputs.

3. Current inputs shall support ring tongue type terminals

4. Meter overrange shall support 2X primary rating

5. Pickup current shall be 0.1% of nominal for 1A and 5A CT's or

6. Meter current input withstand shall be rated for 20A continuous. Fault current withstand shall be 100 Amps for 1 second.

7. Power meter shall be able to be stored in (-40 to +85) degrees C.

8. Operating temperature shall be (-25 to +70) degrees C.

9. A NEMA 12 faceplate rating shall be available for the meter.

10. Digital and relay outputs shall be isolated to 2500 Volts AC.

11. Analog inputs and outputs shall be isolated to 500 Volts DC.

12. The meter power supply shall be rated for operation from 100 to 300V AC and 100 to 300V DC with a power supply burden of 10W.

F. Triggers

1. The meter shall provide on board meter alarms and control capability as follows:

2. Alarm limit ranges can be set for V, I, P, Q, S, PF, V_THD, and I_THD, unbalance factor, demand current, demand power, reverse phase sequence and input status.

3. Up to 16 limit ranges can be set.

4. Limit alarms can be programmed to operate relays. Relays can be set to either latched mode or pulse (momentary) mode.

5. The meter shall support up to 8 “AND” logic relationships for alarming

G. Communications

1. The meter shall include a full function embedded WEB server capable of meter configuration without the use of separate software.

2. The meter shall include independent communication protocol support for both serial and ethernet communications

a. Serial communications

1) Connection type: RS-485

2) Protocols: Modbus RTU, DNP 3.0

3) Baud rates shall be from 1200 to 115,200 baud

b. Network communication

1) Connection type: RJ-45 10/100 Base-T Ethernet network port

2) Protocols: Ethernet TCP/IP, Modbus TCP, BACnet/IP, SMTP (email), HTTP, HTTPS, NTP, SFTP

3) HTTP push connection to optional remote cloud software

3. The meter’s real-time clock shall have the capability to synchronize with a network time server to maintain time accuracy.

4. Manual relay control shall be available using Modbus RTU command when used with optional relay card

5. Ethernet IP address shall be configurable using the Meter's front panel display

H. Modular I/O

1. The meter shall have I/O expandability through the addition of option modules on the back of the meter

a. The Modules shall be capable of being installed in the field, without removing the meter from installation. The meter shall support up to 3 I/O option modules, with no more of 2 of the same type of module.

b. The meter shall auto-detect the presence of any I/O option module.

c. Inputs and Outputs shall support user definable names.

d. The following 3 module types shall be supported.:

1) Module type 1:

a) Six digital inputs (DI) - Each DI can be used to detect remote signals or be used as an input pulse counter. When it is used to detect remote signals, it also can enable sequence of events (SOE), recording the event and time of the event.

b) Two relay outputs (RO) - Can be used for remote control or alarm indication. Each of the ROs work in the same mode. In control mode, both latching and pulse output shall be supported. In alarm mode, latching output shall be supported.24 V isolated power supply - Used as an auxiliary power supply for digital inputs.

2. Module type 2:

a. Four digital inputs (DI) - Each DI can be used to detect remote signals, or be used as an input pulse counter. When it is used to detect remote signals, it can also enable a sequence of events (SOE), recording the events and time of the events.

b. Two analog outputs (AO) - Can output analog voltage or analog current. When it outputs analog voltage, the range of voltage is from 0 to 5 V or from 1 to 5 V. When it outputs analog current, the range of current is from 0 to 20 mA or from 4 to 20 mA.

c. Two digital outputs (DO) - Can be used in alarm mode or energy pulse output mode. Both of the DOs work in the same mode.

3. Module Type 3:

a. Four digital inputs (DI) - Each DI can be used to detect remote signals or be used as an input pulse counter. When a DI is used to detect remote signals, it can also enable a sequence of events (SOE), recording the events and time of the events.

b. Two relay outputs (RO) - Can be used for remote control or alarm indication. Each o THE MICROPROCESSOR-BASED METERING EQUIPMENT.

PART 3 - EXECUTION

3.1 WIRING

A. Provide and install all wiring per manufacturer’s instructions.

3.2 INSTALLATION

A. General: Install electrical cables, wires, and connectors in compliance with NEC.

B. Install CTs compatible with unit and with adequate ratings for the system to be monitored.

C. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values.

D. Mount level and square with adequate clearance for ease of access at normal standing height.

3.3 FIELD QUALITY CONTROL

A. Prior to energizing, test wires and cables for electrical continuity and for short-circuits.

B. Verify unit is functioning properly. Replace any faulty or malfunctioning parts as needed and re-test.

END OF SECTION 26 27 13.11

SECTION 26 29 00 - LOW VOLTAGE MOTOR CONTROL CENTERS

PART 1 - GENERAL

1.1 SUMMARY

A. The Contractor shall provide motor control centers (MCC's), complete and operable, in accordance with the Contract Documents. The Contractor shall be responsible for providing MCC's for all equipment relating to the contracted Scope of Supply.

B. In the event that motors sized and provided by the equipment vendor are delivered to the site with larger horsepower than motors indicated on approved shop drawings, raceways, conductors, starters, overload elements, and branch circuit protectors shall be revised as necessary to control and protect the increased motor horsepower according to applicable Sections of Division 26. This work shall be performed by the Contractor at no additional cost to Owner.

1.2 RELATED SECTIONS

A. Section 26 05 00 – Electrical, General

B. Section 26 22 00 – Low Voltage Transformers

C. Section 26 24 16 – Panelboards

D. Section 26 27 13.11 – Microprocessor-Based Metering Equipment

E. Section 26 28 00 – Overcurrent Protective Devices

F. 26 29 13.13 – Across-the-Line Motor Controllers

G. 26 29 13.16 – Reduced-Voltage Motor Controllers

H. 26 29 23 – Variable-Frequency Motor Controllers

I. 26 35 26 – Active Harmonic Filters

J. 26 43 16.A – Surge Protective Devices (SPD) for Low-Voltage Electrical Power Circuits

1.3 REFERENCES

A. The Motor Control Centers and all components shall be designed, manufactured, and tested in accordance with the latest applicable standards of NEMA, ANSI and UL 485.

1.4 SUBMITTALS – FOR REVIEW/APPROVAL

A. Submittals shall be in accordance with Section 01 33 00 – Submittal Procedures and include the following:

1. Mater drawing index

2. Front view elevation

3. Floor plan

4. Top View

5. Unit wiring diagrams

6. Nameplate schedule

7. Starter and component schedule

8. Conduit entry/exit locations

9. Assembly ratings including:

    a. Short-circuit rating

    b. Voltage

    c. Continuous current

10. Major component ratings including:

    a. Voltage

    b. Continuous current

    c. Interrupting ratings

11. Cable terminal sizes

12. Product data sheets

B. Where applicable the following information shall be submitted to the engineer:

1. Busway connections

2. Connection details between close-coupled assemblies

3. Key interlock scheme drawing and sequence of operations

1.5 SUBMITTALS – FOR CONSTRUCTION

A. The following shall be submitted for record purpose:

1. Seismic design certification of the anchoring system in accordance with Section 26 05 00 – Electric, General.

2. Time-current curves for all protective devices

3. Final as-built drawings and information for items listed in paragraph 1.4, and shall incorporate all changes made during the manufacturing process.

4. Unit wiring diagram

5. Certified product test reports

6. Installation information

1.6 QUALIFICATINS

A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

B. For equipment specified herein, the manufacture shall be ISO 9001 or 9002 certified

C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.7 REGULATORY REQUIREMENTS

A. Motor control centers shall bear a label from a certified testing agency.

1.8 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be handled and stored in accordance with the manufacturer’s instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.9 OPERATION AND MAINTENANCE MANUALS

A. For motor-control centers, all installed devices, and components to include in maintenance manuals specified in Section 26 05 00 – Electrical, General. In addition to requirements specified elsewhere, include the following:

1. Routine maintenance requirements for motor-control centers and all installed components.

2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

1.10 COORDINATION

A. Coordinate layout and installation of motor-control centers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate features of motor-control centers, installed units, and accessory devices with pilot devices and control circuits to which they connect.

C. Coordinate features, accessories, and functions of each motor-control center, each controller, and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Eaton

B. Schnieder Electric

C. ABB

D. Allen-Bradley, Rockwell Automation

E. Seimens

2.2 RATINGS

A. The Motor Control Center(s) shall be 600-volt class suitable for operation on a 3-phase, 60 Hz system. The system operating voltage and number of wires shall be as indicated on the drawings.

2.3 CONSTRUCTION

A. Motor Control Center(s) shall be equal to Eaton F2100 design

B. Structures shall be totally enclosed, dead-front, free-standing assemblies. They shall be 90 inches high and 21 inches deep for front mounted units and 21 inches deep for back-to-back mounted units. Structures shall contain a horizontal wireway at the top 9 inches tall, isolated from the horizontal bus via metal barrier and shall be readily accessible through a hinged cover. Structures shall also contain a horizontal wireway at the bottom 9 inches tall that is open to the full rear of the structure. Adequate space for conduit and wiring to enter the top or bottom shall be provided without structural interference.

C. Compartments for mounting control units shall be incrementally arranged such that not more than twelve (12) size 1 or size 2 starters for front-mounted only can be mounted within each vertical structure. Guide rails shall be provided.

D. A vertical wireway with minimum of 35 square inches of cross-sectional area shall be adjacent to each vertical unit and shall be covered by a hinged door. Wireways shall contain steel rod cable supports.

E. All full voltage tarter units through NEMA size 5 and all feeder breakers through 400 amp shall be of the draw-out type. Draw-out provisions shall include a positive guide rail system and stab shrouds to absolutely ensure alignment of the stabs with the vertical bus. Draw-out units shall have a tin-plated stab assembly for connection to the vertical bus. No wiring to these stabs shall extend outside of the draw-out unit. Interior of all units shall be painted white for increased visibility. Units shall be equipped with side-mounted, positive latch pull-apart type control terminal blocks rated 600 volts. Knockouts shall be provided for the addition of future terminal blocks. In addition, a master terminal block, when type C wiring is specified, shall be draw-out and shall be located in the top wireway, readily accessible through a hinged cover. All control wiring to be 14 gauge minimum.

F. All draw-out units shall be secured by a spring-loaded, quarter turn, indicating type fastening device located at the top front of the unit. With the exception of the dual-mounted units, each unit compartment shall be provided with an individual front door.

G. An operating mechanism shall be mounted on the primary disconnect of each starter unit. It shall be mechanically interlocked with the unit door to prevent access, unless the disconnect is in the “OFF” position. A defeater shall be provided to bypass this interlock. With the door open, an interlock shall be provided to prevent inadvertent closing of the disconnect. A second interlock shall be provided to prevent removal or reinsertion of the unit while in the “ON” position. Padlocking facilities shall be provided to positively lock the disconnect in the “OFF” position with up to three (3) padlocks with the door open or closed. In addition, means shall be provided to padlock the unit in a partially withdrawn position with the stabs free of the vertical bus.

2.4 BUS

A. Each structure shall contain a main horizontal tin-plated copper bus, with minimum ampacity of 1200 amperes or as shown on the drawings. The horizontal bus shall be rated at 50 degrees C temperature rise over a 40 degrees C ambient in compliance with UL standards. Vertical bus feeding unit compartments shall be tin-plated copper and shall be securely bolted to the horizontal main bus. All joints shall be front-accessible for ease of maintenance. The vertical bus shall have a minimum rating of 600 amperes or as shown on the drawings. Both vertical and horizontal bus shall be fully rated; but shall not be tapered. Tapering of vertical bus via a center feed is not acceptable. Both top and bottom of this type bus must be individually fully rated.

B. Isolation of the vertical bus compartment from the unit compartment shall be by means of a full height insulating barrier. This barrier shall be a single sheet of glass-reinforced polyester with cutouts to allow the unit stabs to engage the vertical bus every 6 inches. Provide snap-in covers for all unused openings.

C. Buses shall be braced for 65,000 amperes RMS symmetrical.

D. A tin-plated copper ground bus shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the motor control center. The ground bus shall be located in the bottom horizontal wireway.

E. Each structure shall contain tin-plated vertical ground bus rated 300 amperes. The vertical ground bus shall be directly connected to the horizontal ground bus via a tin-plated copper connector. Units shall connect to the vertical bus via a tin-plated copper stab.

2.5 WIRING/TERMINATIONS

A. Wiring shall be NEMA Class II, Type C.

2.6 CABINET:

A. Structural members shall be fabricated of not less than 12-gauge steel and side and top panels and doors shall be not less than 14 gauge steel.

B. Spaces designated as “SPACE” or “BLANK” shall include blank hinged doors and vertical bus bars.

C. Control units inside compartments shall be clearly identified with tags or stencil markings.

D. Each control unit including spares, spaces and blanks, lights, and devices shall be identified by an engraved nameplate.

E. Each motor control center shall be fitted with the manufacturer’s nameplate which shall include the NEMA Standard electric rating and other pertinent data, including manufacturer, sales order number, date of manufacturer, and place of manufacture.

F. Where “l” or “U” shaped MCC layouts are indicated, corner compartments shall have similar current and short circuit ratings as functional compartments.

G. Fans, heat exchangers, transformers, capacitors, junction boxes, or other devices may not be mounted on the outside of the motor control center enclosure.

H. Finish for motor control center shall be the manufacturers standard color. The panels shall be given two coats of primer inside and out and two coats of enamel finish.

2.7 MOTOR CONTROLLERS

A. Combination starter units shall be full-voltage non-reversing, unless otherwise shown, and shall utilize Eaton type HMCP Motor Circuit Protectors.

1. Each combination unit shall be rated 65,000 AIC symmetrical at 480 Volt. The HMCP shall provide adjustable magnetic protection and be adjustable to 1700% motor nameplate full load current to comply with NEC requirements. All HMCP combination starter units shall have a “tripped” position on the unit disconnect and a push-to-test button on the HMCP. Type HMCP motor circuit protectors through size 4 shall include transient override feature for motor inrush current.

B. Motor Starters

1. Magnetic starters through NEMA Size 9 shall be equipped with double-break silver alloy contacts. The starter must have straight-through wiring. Each starter shall have a minimum of one (1) normally open auxiliary contact

2. Coils shall be of molded construction through NEMA Size 9. All coils to be color-coded through size 5 and permanently marked with voltage, frequency and part number

3. Overload relays shall be an ambient compensated bimetallic-type with interchangeable heaters, calibrated for 1.0 and 1.15 service factor motors. Electrically isolated normally open and normally closed contacts shall be provided on the relay. Visual trip indication shall be standard. A test trip feature shall be provided for ease of troubleshooting and shall be conveniently operable without removing components or the motor starter. Overload to have (+/-) 24% adjustability, single-phase sensitivity, isolated alarm contact, and manual or automatic reset

4. Solid-State Overload Relay

    a. Provide a solid-state overload relay for protection of the motors. The relay shall be Eaton C440 or approved equal.

    b. The overload relay shall provide high accuracy through the use of state-of-the-art microelectronic packaging technology. The relay shall be suitable for application with NEMA Size 1 through Size 7 motor starters.

    c. The overload relay shall be modular in design, be an integral part of a family of relays to provide a choice of levels of protection, be designed to directly replace existing electromechanical overload relays, and be listed under UL Standard 508.

    d. The overload relay shall have the following features:

        1) Self-powered

        2) Class 10A, 10, 20, or 30 selectable tripping characteristics

        3) Manual or automatic reset

        4) Supply with 24 VDC Electronic reset

        5) Reset capabilities through onboard fieldbus

        6) Selectable (On/Off) Phase loss protection. The relay shall trip in 10 seconds or less under phase loss condition

        7) Selectable (On/Off) Phase Imbalance protection. The relay shall trip in 10 seconds or less under phase imbalance condition.

8) Visible trip indication

9) One normally open and one normally closed isolated auxiliary contact

10) Test button that operates the normally closed contact

11) Test trip function that trips both the normally and normally closed contacts

12) A current adjustment range of 5:1 or greater

13) Embedded, selectable (On/Off)Ground fault protection shall be supplied. Relay shall trip when ground fault is detected at 50% of full load ampere setting

14) An LED that provides self-diagnostic information

15) An LED that aids in commissioning by indicating running current is too high compared to the FLA dial

16) EtherNet/IP with I/O with webserver Communication shall be provided.

17) Additional digital Inputs and Outputs (4 in and 2 out additional) shall be an available option. Inputs shall be 120 Vac, or 24 VDC, and outputs shall be discrete relay outputs

18) Diagnostic Trip Information indicating a specific trip on either ground fault, phase loss, phase imbalance, or thermal

19) When using any of the available fieldbus the relay shall be capable of providing the following data monitoring:

    a) Individual Phase Currents

    b) Average RMS Current

    c) Thermal Capacity

    d) % Phase unbalance

    e) GF Current

    f) Line Frequency

    g) Relay settings

    h) Contactor Status

C. Solid-state reduced-voltage starters, Eaton type S811 shall be provided where shown on the contract drawings. The solid-state reduced-voltage starter shall be UL and CSA listed in the motor control center, and consist of an SCR-based power section, logic board and paralleling bypass contactor. The paralleling bypass contactor shall be energized when the motor reaches full speed. Each solid-state reduced voltage starter shall have an addressable communication card capable of transmitting control and diagnostic data over an open network to either a personal computer or Logic Controller via network translator to DeviceNet with I/O, Modbus 485, Modbus 485 with I/O, Modbus TCP with I/O or Ethernet IP with I/O.

D. Adjustable frequency drives shall be provided in MCC(s) and meet the requirements of specification 26 29 23 " Variable-Frequency Motor Controllers."

2.8 OVERCURRENT DEVICES

A. Circuit breakers

1. Individual feeder breakers shall have a minimum interrupting capacity of 65 kAIC at rated voltage or as scheduled on the drawings

2. Circuit breakers with a frame size of 225 amperes to 1,200 amperes shall be molded case with interchangeable thermal, and adjustable magnetic trip elements.

3. Circuit breaker disconnect operators shall be capable of accommodating three padlocks for locking in the "open" position.

B. Fusible Switches

1. Individual feeder switches shall be quick-make, quick-break gang-operated type, utilizing Class R fuse clips. The fused switch shall be rated 100 kAIC at rated voltage

2.9 VOLTAGE PRESENCE INDICATOR

A. Voltage Presence Indicators shall be provided on the unit door of MCC starter and feeder units as per contract documents. The voltage presence indicator shall be a hardwired voltmeter or voltage detector connected to the load side of the main incoming disconnect, and shall provide a "through-door" visual indication at the MCC unit door of any voltage presence in any individual phase to enable operators to "pre-verify" voltage presence while the MCC unit door is safely closed. The voltage presence indicator shall be equipped with an adapter to enable installation in a 30mm device-panel on the MCC unit or any other standard 30mm pilot device knockout. The voltage presence indicator shall be of potted construction with 6-foot leads and equipped with dual redundant circuitry to ensure reliability. The voltage presence indicator shall also be phase insensitive, UL type 4X listed and have immunity to high surges. The voltage presence indicator shall be Eaton "VoltageVisionTM" Catalog No. R-3W.

2.10 FIELDBUS COMMUNICATIONS

A. ETHERNET/IP DEVICES

1. Motor Control Center assemblies shall be provided with a factory assembled EtherNet/IP field bus communications network providing direct connectivity between MCC devices and the system controller and/or HMI.

2. Ethernet 10/100 auto negotiate layer 2 managed industrial switches shall be provided as required in the MCC lineup. The Ethernet switch shall have sufficient ports available to connect to each EtherNet/IP device and have at least 2 open ports for a customer connection and a PC connection for maintenance. The Ethernet switch shall be mounted in the top removable unit of each vertical section or shipping split and not in the vertical wireway. If required by the application, the switch shall be capable of connecting to multiple sections.

3. The EtherNet/IP system installed in the MCC shall include a complete and tested cabling system. The cabling system shall be 600V Cat 5 and consist of home run connections from the device to a switch located in the MCC and in accordance with the ODVA specification. Non-standard, non-shielded cable will not be accepted.

4. It shall be permissible to daisy chain Ethernet/IP devices using a 2-port switch configuration in each device unit or bucket and not use the home run topology.

5. All cabling shall be securely supported and attached to the MCC structure in accordance with the contract drawings and the manufacturer’s recommendations.

6. EtherNet/IP communications modules shall be provided at each device interfacing to the EtherNet/IP field bus. The communications modules shall be installed in the unit device compartment or bucket, and shall be direct-connected to the EtherNet/IP Ethernet cable. Each device shall be provided with the appropriate factory fabricated cable for interfacing the communications module with the associated EtherNet/IP device.

7. Operator interface unit(s) shall be an Eaton XP Series or approved equal. PanelMate Power Series. Operator interface units shall be able to display the following: starter status, three-phase current, control voltage, overload condition (alarm), cause of device trip, operations count, run time, set points, starter description and identification, and system process graphics screens. Operator interface shall have the capability of communicating on the EtherNet/IP network.

2.11 INCOMING FEEDER TERMINATIONS AND DEVICE

A. Incoming cable shall terminate within the control center on a main breaker termination point. Main lug terminations shall have adequate dedicated space for the type and size of cable used and the lugs shall be standard mechanical screw with anti-turn feature. Main breakers shall be provided as indicated on the drawings and shall be molded case.

2.12 OWNER METERING

A. Where indicated on the drawings, provide a separate, owner metering compartment with front hinged door.

B. Provide as a minimum of three (3) current transformers for each meter. Current transformers shall be wired to shorting-type terminal blocks.

C. Provide fused potential taps as the potential source for metering as shown on the drawings.

D. Microprocessor-Based Metering System.

E. Web-Enabled Communications

1. Where indicated on the drawings, provide a separate compartment with a front facing hinged door as a central point of connection for all internally located communicating devices to an external Ethernet network and allow close monitoring of the power infrastructure with real-time, web-enabled data.

2. The compartment shall have a lockable, hinged door with a functional through-the-door RJ45 network access port. Power for the components in the compartment shall be supplied by a pre-wired, bus-connected control transformer in the compartment that is fused and has a disconnecting means.

3. The included communications components shall be a Power Xpert Ethernet Switch(es), which is specified in Section 26 27 13.11 (should specify paragraphs in the section).

2.13 ENCLOSURES

A. The type of enclosure shall be in accordance with NEMA standards for type 12 dust-tight and drip-proof. All enclosing sheet steel, wireways and unit doors shall be gasketed.

2.14 NAMEPLATES

A. Each unit will have a 1.0 x 2.5-inch engraved nameplate. The lettering shall be 3/16-inch high, black on a white background.

2.15 FINISH

A. The control center shall be given a phosphatizing pretreatment. The paint coating shall be a polyester urethane, thermosetting powder paint. Manufacturer’s standard color shall be used. All structural steel and panels will be painted.

B. The control center finish shall pass 600 hours of corrosion-resistance testing per ASTM B 117.

2.16 CLEAN MOTOR CONTROL CENTER

A. The Clean Motor Control Center shall consist of an Eaton F2100 design Motor Control Center and integral harmonic correction unit for the attenuation of harmonics induced by nonlinear loads such as ac Adjustable Frequency Drives.

B. The harmonic correction unit for the Clean Motor Control Center shall be in a totally enclosed dead-front and incorporated into the MCC assembly complete with pass- through bus allowing for future expansion of the MCC. Structures shall be 90 inches high and 21 inches deep for front-mounted units. Structures shall contain a horizontal wireway at the top, isolated from the horizontal bus by metal barriers and shall be readily accessible through a hinged cover. Adequate space for conduit and wiring to enter the top or bottom shall be provided without structural interference.

C. An operating mechanism shall be mounted on the primary of each harmonic correction unit. It shall be mechanically interlocked with the door to prevent access unless the disconnect is in the “OFF” position. A defeater shall be provided to bypass this interlock. With the door open, an interlock shall be provided to prevent inadvertent closing of the disconnect. Padlocking facilities shall be provided to positively lock the disconnect in the “OFF” position with from one (1) to three (3) padlocks with the door open or closed.

D. Harmonic Correction Units shall be disconnected from the power source by a molded case switch. All units shall include 200,000 AIC rated fuses with Class T actuation. All units shall be provided with a grounding lug. Grounding by the contractor shall be performed according to local and national standards.

E. The harmonic correction units shall be sized to meet 5% total harmonic current distortion {THD (I)}, 5% total demand distortion (TDD), and <5% total harmonic voltage distortion {THD (V)} levels as defined by IEEE 519-1992 at system Point of Common Coupling as defined in IEEE 519. The harmonic correction unit shall be integral to Eaton F2100 Motor Control Centers.

F. The harmonic correction unit shall be designed in accordance with the applicable sections of the following standards. Where a conflict arises between these standards and this specification, this specification shall govern.

1. ANSI IEEE standard C62.41-1991 [Surge Withstand Capacity]

2. CSA 22.2, No. 14 & 66 [CSA requirements for power electronics]

3. FCC Part 15, Sub Part J, Class A [RFI/EMI emission standards]

4. ANSI IEEE standard 519-1992 [Harmonic limits]

5. UL 508C [UL requirements for power conversion equipment]

G. The motor control center manufacturer shall install the harmonic correction unit in the motor control center. The harmonic correction unit shall be approved by UL or CSA for installation in the motor control center.

H. Modes of Operation

1. The harmonic correction unit shall be designed to electronically inject harmonic current to cancel load produced harmonic current such that the upstream power harmonic current and voltage are reduced to below 5% TDD and 5% THD (V) as defined by ANSI IEEE standard 519-1992 for load demand and voltage distortion limits. TDD as used herein refers to the total load demand of the applied circuit. The applied circuit may be a single nonlinear load, an entire distribution bus load, or the facility load at the Point-of-Common Coupling (PCC)

2. Reactive current compensation (displacement power factor correction) shall be activated via a digital keypad/display mounted on the door of the enclosure. When reactive current compensation is activated, the harmonic correction unit shall first perform harmonic current correction and then use the remaining capacity to inject reactive current compensation to the specified level herein defined

I. Design

1. Each unit of the harmonic correction units shall meet FCC Part 15, Sub Part J, Class A requirements for both radiated and conducted EMI

2. All harmonic correction units shall be defined as a power electronic device consisting of power semiconductors that switch into the AC lines to modulate its output to cancel detrimental harmonic and/or reactive currents. A DC bus shall store power for power semiconductor switching. A microprocessor shall control the operation of the power converter

3. Each unit shall be designed with a current limiting function to protect the semiconductors. When this level is attained, a message shall be displayed indicating the output capacity is at-maximum capacity and actuate the at-maximum capacity relay. Operation shall continue indefinitely at this level without trip off or destruction of the power correction unit

4. Two distinct levels of faults shall be employed. Non-critical level faults will provide automatic restart and a return to normal operation upon automatic fault clearance. Critical level faults stop the function of the unit and await operator action

    a. Faults such as ac line over-voltage, AC line under-voltage, AC line power loss, and AC line phase imbalance shall be automatically restarted. Upon removal of these fault conditions, the power correction system shall restart without user action. Automatic restart will not occur if 5 faults have occurred in less than 5 minutes. During the fault condition, except line loss, the display shall state the type of fault and indicate that automatic restart will occur. The run relay and run LED shall be disabled. The fault relay shall not be enabled unless time out occurs. Upon AC line loss, the power-on relay shall be disabled and no display shall be provided.

    b. All other types of faults shall be considered critical and stop the power correction system. The display shall indicate the fault condition and “STOP.” The run LED and relay shall be disabled and the fault relay enabled. User shall be required to initiate a power reset (turn power OFF and ON) to restart the power correction system.

5. The logic of the harmonic correction unit shall monitor the load current by utilizing two (2) current transformers (CT's) mounted on phases A and B to direct the function of the power electronic converter. A third current transformer is required if single-phase or three-phase line-to-neutral connected loads are present downstream from the location of the CT's. The ratio of the CT's must be entered into the logic via the digital keypad/display to calibrate the operation of the power correction system. The output of the current transformers shall be 5 amperes

6. Up to three (3) harmonic correction units may be installed in parallel to inject current according to the information received from one set of CT's. The units will function independently. If one unit is stopped or faulted, the remaining units will adjust accordingly to maintain optimum harmonic cancellation levels up to the capacity of the remaining units

J. Performance Requirements

1. Input Power:

a. Voltage: 480 Volt, 3-phase, 3-wire, plus ground

b. Voltage Tolerance: +/- 10% of nominal

c. Frequency: 60 Hz, +/- 5%

d. Current Limit: 100% of rating

e. Surge Withstand Capability: ANSI/IEEE std. C62.41-1991 without damage

f. Input Fuses: Rated at 200 kAIC, Class J.

K. Output Performance

1. Performance of the harmonic correction unit shall be independent of the impedance of the power source. All performance levels shall be attained whether on the ac lines or backup generator or output of the uninterruptible power supply (UPS)

2. Harmonic Correction:

a. Limit 2nd through 50th order harmonic current to <5% TDD as defined in ANSI/IEEE STD 519-1992 at each installed location. Harmonic levels for individual harmonic orders shall comply with respective levels established in ANSI/IEEE STD 519-1992.

b. Limit the THD (V) added to the electrical system immediately upstream of the power correction system location(s) to less than or equal to 5% as defined in ANSI/IEEE STD 519-1992. The power correction system shall not correct for utility supplied voltage distortion levels.

3. Reactive Current Compensation: to .90 lagging displacement power factor. Leading power factor is not permitted

L. Environmental Conditions

1. The harmonic correction unit shall be able to withstand the following environmental conditions without damage or degradation of operating characteristics or life

a. Operating Ambient Temperature: 0 degrees C (32 degrees F) to 40 degrees C (104 degrees F).

b. Storage Temperature: -40 degrees C (-40 degrees F) to 65 degrees C (149 degrees F).

c. Relative Humidity: 0 to 95%, non-condensing.

d. Altitude: Operating to 2000 meters (6500 ft). Derated for higher elevations.

e. Audible Noise: Generated by power correction system not to exceed 65 dbA measured 1 meter from surface of unit.

f. Vibration: Seismic Zone 4.

M. Current Transformers

1. Split core type current transformers shall be installed as defined herein and shown in the electrical drawings. Current transformers shall be rated for the total rated RMS current of the total load at each installed location

2. Two current transformers per power correction system location shall be provided and shall be mounted on phases A and B. A third current transformer shall be provided if single or three-phase line-to-neutral connected loads are present downstream from the location of the CT’s

3. Each current transformer shall have a current output of 5 amperes. Current capacity of each current transformer shall be 5000, 3000, 1000 or 500, as required for the electrical system where installed. No other ratings are acceptable

4. Each current transformer shall be rated for 400 Hz

N. Operator Controls and Interface

1. All units shall include a digital interface model (DIM) that includes an alphanumeric display consisting of 2-lines with 20 characters per line. All information shall be in English. Operators include run, stop, setup, enter, and up/down scroll

2. The display shall provide operating data while functioning. Standard operating parameters available for display are ac line voltage, total RMS load current, harmonic current of load, reactive current of load, output harmonic and reactive current of power correction system

3. When the output of the power correction unit is at full rated capacity, the display shall indicate at-maximum capacity and actuate an at-maximum capacity relay

4. All fault conditions shall be displayed as they occur. Diagnostic information shall be provided in English and clearly indicate the nature of the fault

5. The run pushbutton shall include a green LED. LED shall be lighted when unit is running

6. Contacts shall be provided for operator information for power-on, run, fault and at-maximum capacity. Each contact shall be rated for 1 ampere at 120/240 volts. One Form C contact shall be provided for each relay

7. An RS-485 serial communication port shall be provided for remote control and diagnostic information.

2.17 SPARE PARTS

A. The Contractor shall furnish the following for each MCC:

1. One unit control transformer of each size furnished in magnetic starters installed

2. Three bezels of each color installed for pilot indicators

3. One dozen panel lamps

4. One dozen control fuses of each size installed.

PART 3 - EXECUTION

3.1 FACTORY TESTING

A. Representative motor control centers shall have been tested in a high-power laboratory to prove adequate mechanical and electrical capabilities.

B. All factory tests required by the latest ANSI, NEMA and UL standards shall be performed.

C. A certified test report of all standard production tests shall be available to the Engineer upon request.

3.2 FIELD QUALITY CONTROL

A. Provide the services of a qualified factory-trained manufacturer’s representative to perform startup of the equipment specified under this section for a period of five (5) working days.

B. The following minimum work shall be performed by the Contractor under the technical direction of the manufacturer’s service representative:

1. Rig the MCC assembly into final location and install on level surface

2. Check all removable cells and starter units for easy removal and insertion

3. Perform insulation tests on each phase and verify low-resistance ground connection on ground bus

4. The Contractor shall provide three (3) copies of the manufacturer's field startup report.

3.3 TRAINING

A. The Contractor shall provide a training session for up to five (5) owner's representatives for one(1) normal workdays at the job site or other office location chosen by the owner.

B. A manufacturer's qualified representative shall conduct the training session.

C. The training program shall consist of the following:

1. Review of the MCC one-line drawings and schedules

2. Review of the factory record shop drawings and placement of the various cells

3. Review of each type of starter cell, components within, control, and power wiring

4. Review contactor coil replacement and contact replacement procedures

5. Discuss the maintenance timetable and procedures to be followed in an ongoing maintenance program

6. Provide three-ring binders to participants complete with copies of drawings and other course material covered

3.4 EXAMINATION

A. Contractor shall fully inspect shipments for damage and report damage to manufacturer and file claim upon shipper, if necessary.

B. Contractor shall supply overload relay heater ratings that are properly sized and coordinated for each motor starter unit.

3.5 INSTALLATION

A. Contractor shall follow the installation instructions supplied by the manufacturer.

B. Control wiring shall be as shown on the contract drawings except as modified by the approval and submittal process. Interface all local and remote devices into the control wiring and operational systems for each load.

3.6 FIELD ADJUSTMENTS

A. The Contractor shall perform field adjustments of the short circuit and overload devices as required to place the equipment in final operating condition. The settings shall be in accordance with the approved short-circuit study, protective device evaluation study, protective device coordination study, manufacturer's instruction leaflets, and the contract documents.

3.7 FIELD TESTING

A. Contractor is responsible for generation of a field report on tests performed, test values experienced, etc., and make the report available to owner upon request.

END OF SECTION 26 29 00

SECTION 26 29 23 – VARIABLE-FREQUENCY MOTOR CONTROLLERS)

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes solid-state, PWM and VFD, VFCs for speed control of three-phase, induction motors. These VFCs are to be enclosed in freestanding NEMA 250, Type 12, unless otherwise indicated to comply with environmental conditions at installed location, see Electrical Drawings and Divisions 40-46 and 46 specifications.

B. VFC vendor to provide VFC that will operate at installed altitude. Vendor shall verify altitude.

1.2 SUBMITTALS

A. Product Data: For each type of VFC, provide dimensions; mounting arrangements; location for conduit entries; shipping and operating weights; and manufacturer's technical data on features, performance, electrical ratings, characteristics, and finishes.

B. The following shall be included in the bid package:

1. Description of equipment and tests included in bid to meet the indicated power quality requirements.

2. Nearest factory authorized service center meeting all points of 1.03A.

3. Qualification and name of engineering and technical persons responsible for support and warranty of this project.

C. The following shall be included in the submittal package and be approved by the engineer prior to any construction of the VFC system:

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Each installed unit's type and details.

b. Nameplate legends.

c. Short-circuit current ratings of integrated unit.

d. Features, characteristics, ratings, and factory settings of each motor-control center unit.

2. Wiring Diagrams: Power, signal, and control wiring for VFC. Provide schematic wiring diagram for each type of VFC.

3. Detailed description of the filter equipment and sample graphs and data to meet IEEE 519-1992.

4. Carrier frequency information.

D. Field Test Reports: Written reports specified in Part 3.04D below.

E. Manufacturer's field service report.

F. Operation and Maintenance Data: For VFCs, all installed devices, and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 26 05 00 – Electrical, General, include the following:

1. Routine maintenance requirements for VFCs and all installed components.

2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and 24 hour emergency maintenance and repairs.

B. Source Limitations: Obtain VFCs of a single type through one source from a single manufacturer.

C. The system shall be pre-integrated with the necessary harmonic mitigation equipment.

D. 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.

E. Comply with NFPA 70, IEEE 519-1992, ANSI C37, and ANSI C57.

1.4 COORDINATION

A. Match features of VFCs, installed units, and accessory devices with pilot devices and control circuits to which they connect.

B. Match features, accessories, and functions of each VFC and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load. See Division 40 sections for information on motor control sequence.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: To match existing parts and integration requirements, provide products by the following:

1. Allen Bradley; Rockwell Automation.

2. Eaton

3. Schnieder Electric

4. Siemens

5. Or equal

B. Contractor job site integration of reactors, harmonic filters, power components, etc. may be required. Start-up, harmonic testing and warranty support services must be supplied by the above or other qualified company approved by engineer. Allowable harmonic limits to be coordinated with Avista Utilities.

2.2 VARIABLE FREQUENCY CONTROLLERS

A. Description: NEMA ICS 2, IGBT, PWM, VFD, VFC; listed and labeled as a complete unit and arranged to provide variable speed of a NEMA MG 1, Design B, 3-phase, induction motor by adjusting output voltage and frequency. Refer to Divisions 40 – 43 and 46 for additional information on motors controlled by VFCs.

B. Design and Rating: Match load type such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

C. Output Rating: 3-phase; 6 to 120 Hz, with horsepower constant throughout speed range.

D. Unit Operating Requirements:

1. Input ac voltage tolerance of 480 V, plus or minus 10 percent.

2. Input frequency tolerance of 60 Hz, plus or minus 6 percent.

3. Output Rating: 3-phase; 6 to 66 Hz, with amperage equal or greater to motor nameplate amperage including altitude derating.

4. Minimum Inverter Efficiency: 96 percent at 60 Hz, full load.

5. Minimum Displacement Primary-Side Power Factor: 96 percent lagging.

6. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds.

7. Starting Torque: Default to be 50% with adjustment to 120%.

8. Speed Regulation: Plus or minus 1 percent.

9. Isolated control interface to allow controller to follow control signal over an 11:1 speed range.

E. 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: Adjustable from .01 to 3600 seconds.

4. Deceleration: Adjustable from .01 to 3600 seconds.

5. Current Limit: 50 to a minimum of 110 percent of maximum rating.

F. Self-Protection and Reliability Features:

1. Input transient protection by means of surge suppressors.

2. Snubber networks to protect against malfunction due to system voltage transients.

3. Under- and overvoltage trips; inverter overtemperature, overload, and overcurrent trips.

4. Filtering to prevent noise interference with other electronic equipment.

5. Motor Overload Relay: Adjustable.

6. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.

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.

G. Automatic Reset and Restart: To attempt three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bi-directional autospeed search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.

H. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped. VFC to automatically re-start motor after outage.

I. Carrier Frequency Adjustment: Provide ability to manually adjust drive carrier frequency. VFCs 100HP and less shall provide carrier frequency adjustment capability from 1 to 10kHz. VFCs over 100HP shall include carrier frequency adjustment information recommended by the manufacturer.

J. Torque Boost: Automatically vary starting and continuous torque to at least 1.5 times the minimum torque to insure high-starting torque and increased torque at slow speeds.

K. Motor Temperature Compensation at Slow Speeds: Adjustable current fallback based on output frequency for temperature protection of self-cooled fan-ventilated motors at slow speeds.

L. Provide line and load side filtering to minimize total harmonic distortion.

M. Status Lights: Door-mounted LED indicators shall indicate the following conditions:

1. Power on.
2. Run.
3. Overvoltage.
4. Line fault.
5. Overcurrent.
6. External fault.

N. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual speed control potentiometer and elapsed time meter.

O. Indicating Devices: Meters or digital readout devices and selector switch, mounted flush in controller door and connected to indicate the following controller parameters:

1. Output frequency (Hz).
2. Motor speed (rpm).
3. Motor status (running, stop, and fault).
4. Motor current (amperes).
5. Motor torque (percent).
6. Fault or alarming status (code).
7. PID feedback signal (percent).
8. DC-link voltage (VDC).
9. Set-point frequency (Hz).
10. Motor output voltage (V).

P. Control Signal Interface: Provide VFC with the following:

1. Electric Input Signal Interface: A minimum of 2 analog inputs (0 to 10 V or 0/4-20 mA) and 6 programmable digital inputs.

2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BMS or other control systems:

    a. 0 to 10-V dc.

    b. 0-20 or 4-20 mA.

    c. Potentiometer using up/down digital inputs.

    d. Fixed frequencies using digital inputs.

    e. RS485.

    f. Ethernet connectivity using Ethernet/IP or MODBUS protocol

    g. Keypad display for local hand operation.

    h. Remote start/stop input

3. Output Signal Interface:

    a. Provide two analog output signals (0/4-20 mA), which can be programmed for the following:

    b. Output frequency (Hz).

    c. Output current (load).

    d. DC-link voltage (VDC).

    e. Motor torque (percent).

    f. Motor speed (rpm).

    g. Set-point frequency (Hz).

4. Remote Indication Interface: Provide dry circuit relay outputs (120-V ac, 1 A) for remote indication of the following:

    a. Motor running.

    b. Set-point speed reached.

    c. Fault and warning indication (overtemperature or overcurrent).

    d. PID high or low speed limits reached.

    e. Drive system is in remote.

Q. Integral Disconnecting Means: Provide HACR rated breaker as indicated on drawings.

2.3 ACCESSORIES

A. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.

B. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.

C. Control Relays: Auxiliary and adjustable time-delay relays.

D. Standard Displays:

1. Output frequency (Hz).

2. Set-point frequency (Hz).

3. Motor current (amperes).

4. DC-link voltage (VDC).

5. Motor torque (percent).

6. Motor speed (rpm).

7. Motor output voltage (V).

E. Historical Logging Information and Displays:

1. Real-time clock with current time and date.

2. Running log of total power versus time.

3. Total run time.

4. Fault log, maintaining last four faults with time and date stamp for each.

F. Harmonic Mitigation: Complying with IEEE Standard 519-1992 shall be a requirement of this project. Harmonic filters, 18 pulse converter configurations, phase multiplication devices, or any other components required to mitigate harmonic voltage and current to IEEE Std. 519-1992 shall be an integral part of the VFC system. Designs which are not pre-integrated and factory wired as part of the UL label will not be acceptable.

1. Designs which cause voltage rise at the VFC terminals must document coordination with the total system variation to prevent nuisance tripping.

2. Designs which do not provide both true and displacement, measured at the VFC terminals, of at least 95% or better at full load are not acceptable. Designs that allow leading power factor at minimum loads are not acceptable.

G. Relevant data for VFC vendor calculations to meet IEEE Std. 519-1992 requirements are as follows:

1. The point of common coupling (PCC) shall be defined per 3.01.C below.

2. The calculated load current (I_L) shall be the total combined full load current of each ASD system supplied as part of this project or the total combined amperage of loads designated as “non-linear”.

3. The VFC vendor is responsible for determining the short circuit current (I_{SC}) available at the PCC.

2.4 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFCs for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Select features of each VFC to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; and duty cycle of motor, drive, and load.

B. Select rating of controllers to suit motor controlled. The VFC vender shall certify that the supplied equipment is properly matched to the loads being fed.

C. The drive shall be capable of operating in compliance with IEEE 519-1992, with point of common coupling (PCC) defined as the point at which each individual device is connected to the electrical distribution system. Drive manufacturer shall provide harmonic calculations and on-site post installation harmonic testing with certified reports prior to final acceptance of installation. See 3.04D.

3.2 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

3. All tests necessary to prove compliance with IEEE Standard 519-1992.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including pretesting and adjusting VFCs.

C. Test Reports: Prepare a written report to record the following:

1. Test procedures used.

2. Test results that comply with requirements.

3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

3.3 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 26 sections.

C. Complete installation and startup checks according to manufacturer's written instructions.

3.4 ADJUSTING

A. Set field-adjustable switches.

3.5 CLEANING

A. Clean VFCs internally, on completion of installation, according to manufacturer's written instructions. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain VFCs.

END OF SECTION 26 29 23

SECTION 26 32 13 – ENGINE GENERATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of engine generator set Work is indicated by drawings and is hereby defined to include, but not by way of limitation, engines, electrical generators, engine starting systems including batteries, instrument control panel, transfer switches, annunciator panel, exhaust silencer, and accessories required for a complete generator installation.

B. Generator set required for the project is a diesel engine-driven unit.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's data on engine-driven generator sets and components. Submit wiring diagrams for engine-driven generator units showing connections to electrical power panels, feeders, automatic transfer switches, and ancillary equipment. Differentiate between portions of wiring that are manufacturer-installed and portions that are field-installed.

B. Maintenance data for materials and products, for inclusion in Operating and Maintenance Manual specified in Section 26 05 00 – Electrical, General. Include complete Operations and Maintenance Manual, Illustrated Parts List and Maintenance Schedule.

C. Certifications: Provide engine-driven generator sets certified test record of the following final production testing:

1. Single-step load pickup.

2. Transient and steady state governing. The generator will serve loads controlled by VFD’s. Manufacturer shall take appropriate measures. Refer to drawings for loads served.

3. Safety shutdown device testing.

4. Voltage regulation.

5. Rated power.

6. Maximum power.

D. Provide certified test record prior to engine-driven generator set being shipped from factory to project location.

E. Unit Responsibility: The complete standby emergency generator systems are to be tested under full load conditions, as a unit, before being shipped to the job site from factory. Installation and hook-up to be under direct supervision of factory trained personnel.

F. The automatic transfer control shall be supplied per specification Section 26 36 00 – Transfer Switches and integrated with the engine-generator.

G. Generator support shall be a factory authorized service center located within a 200 mile radius of the project site.

1.3 DELIVERY, STORAGE AND HANDLING

A. Deliver engine-driven generator properly packaged and mounted on pallets, or skids to facilitate handling of heavy items. Utilize factory-fabricated type containers or wrappings for engine-generator and components that protect equipment from damage.

B. Store engine-driven generator equipment in original packaging and protect from weather and construction traffic. Wherever possible, store indoors; where necessary to store outdoors, store above grade and enclose with watertight wrapping.

C. Handle engine-driven generator equipment carefully to prevent physical damage to equipment and components. Do not install damaged equipment; remove from site and replace damaged equipment with new.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering diesel generator sets which may be incorporated in the Work include the following:

1. Caterpillar Tractor Co.

2. Cummins Corp.

3. Kohler Power Systems

4. Generac

B. Generator Sets

1. General: Except as otherwise indicated, provide manufacturer's standard engine-driven generator sets and auxiliary equipment as indicated by published product information, and as required for a complete installation.

2. Engine-Driven Generator: Provide packaged electrical power engine-driven generator assembly unit rated as indicated on drawings, at a governed speed of 1800 RPM, and rated 80 percent power factor for continuous operation, 480/277 volt, 3-phase, 4-wire, 60 Hz, at installed altitude (verify altitude), at 110 deg. F. Equip generator with a turbo-charged, 1800 RPM, engine, and fueled as noted; liquid cooled. Engine shall meet all EPA Tier level requirements at time engine is manufactured. Provide unit-mounted radiator, blower fan, water pump, and thermostat. Connect engine drive directly to 4-pole revolving-field type single, maintenance-free, bearing generator through semi-flexible steel disk coupling; equip set with associated control equipment to automatically start engine, transfer load to standby power upon failure of normal power source, transfer load back to normal power upon its restoration, and stop engine. Actual temperature rise measured by resistance method at full load shall not exceed 125 degrees Centigrade. Cushion-mount engine-generator on heavy steel base with spring type vibration isolators to reduce possibility of torsional vibration. Provide water-cooled type engine with unit-mounted radiator. Equip engine with low-oil pressure, high-water temperature, and automatic overspeed safety shutdown devices. Equip generator with exciter and voltage regulator to maintain voltage within 2 percent of rated value. Direct-connect generator to fly wheel by semi-flexible steel disk coupling. Provide unit capable of voltage recovery, within regulated range, of 7 seconds following sudden load increase from 0 to 100 percent of rated load, and with voltage dip not to exceed 35 percent upon application of rated load at rated power factor. Construct unit in compliance with applicable standards; and with additional construction features as indicated:

   a. Motor Starting Accessories: The generator will be used to feed motor loads that are controlled via variable frequency drives. Provide items for improved motor starting and generator regulation such as permanent magnet generator end, electronic governor, voltage regulators, etc..

   b. Starting System: Provide engine-generator units with 24-volt, 3-wire, negative ground, starting systems including 24-volt positive engagement solenoid shift-starting motors, batteries and 35-ampere, or greater, automatic battery charging alternators with solid-state voltage regulation.

   c. Instrument Control Panel: Provide engine-generator units with engine oil-pressure and water-temperature indicators, battery charge-rate ammeter, START - STOP switch for manual operation of unit, reset circuit breaker, static voltage regulator, voltage-adjusting rheostat, voltmeter, ammeter with phase selector switch with an OFF position, and with running time indicator and frequency meters. Select type circuitry of plug-in design capable of quick replacement, and of accepting a plug-in device that allows maintenance to test control panel performance without operating the engine.

   d. Controller: Provide a set mounted controller that complies with applicable NFPA standards. Controller shall provide all indicators, alarms, and monitoring functions that a Cummins Power Command Control 2100 provides per NFPA 110 level one requirement. Controller shall be accessible without the use of ladders, steps, etc.

e. Connection to Data Link: Provide a Ethernet/IP connection to SCADA. The controls shall have the ability to communicate in a common protocol with the programmable logic controller for the following:

1) Engine high-temperature shutdown.

2) Lube-oil low-pressure shutdown.

3) Overspeed shutdown.

4) Remote emergency-stop shutdown.

5) Engine high-temperature pre-alarm.

6) Lube-oil low-pressure pre-alarm.

7) Fuel tank, low-fuel level.

8) Low coolant level.

9) Over crank shutdown.

10) Coolant low-temperature alarm.

11) Control switch not in auto position.

12) Battery-charger malfunction alarm.

13) Battery low-voltage alarm.

f. Provide hardwired dry contact connection to SCADA for the following signals:

1) Generator Running

2) Generator Fault

3) Generator not in Auto.

2.2 ENGINE-GENERATOR SET ACCESSORIES

A. Provide battery rack, battery warmers, battery cables, 12-volt battery(ies) capable of delivering the minimum cold-cranking amps required at zero degrees Fahrenheit per SAE Standard J-537.

B. Provide gas proof, seamless, stainless steel, flexible exhaust connector.

C. Provide flexible fuel line(s) rated 300 degrees F and 100 PSI ending in pipe thread.

D. Provide engine exhaust silencer, coated to be temperature and rust resistant, rated for critical applications 35dB reduction. Exhaust silencer to be housed inside of weatherproof enclosure.

E. Provide block heater of proper wattage and voltage, thermostatically controlled to maintain engine coolant at 90 degrees Fahrenheit (32 degrees Celsius). The block heater shall be installed with shut-off valves for maintenance. Valves to be field installed.

F. Provide 10-ampere automatic float and equalize battery charger with +/- 1% constant voltage regulation from no load to full load over +/- 10% AC input line variation, current limited during engine cranking and short circuit conditions, temperature compensated for ambients from -40 degrees C to +60 degrees C, 5% accurate voltmeter and ammeter, fused, reverse polarity and transient protected.

G. Provide a U.L. 142 label double wall sub base fuel tank of adequate capacity to operate generator 24 hours at full load and meet the requirement for 110% fuel tank volume containment. Tank shall be of steel construction and installed under the generator. Provide Sub Base Tank to include C Channel or I beam welded beneath the tank spaced 40 inches apart to accept neoprene pads between support beams and concrete floor. Tank shall be equipped with normal and emergency venting. Provide all necessary piping for a complete venting system. Venting shall comply with applicable requirements of IFC. Tank openings and overflow protection shall comply with IFC. Tank to be equipped with supply/return lines installed to engine, low fuel level switch, leak detection, and tank heater. Install tank and accessories per applicable codes, standards, and manufacturers requirements.

H. Provide U.L listed weatherproof sound attenuated (79dB at 23 feet) housing. Housing to be finished inside and out with a rust-inhibiting primer, and then a top coat paint. Side panels to be removable for maintenance and lockable. Provide necessary louvers and exhaust silencer connections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which diesel engine-driven generator units are to be installed and notify Contractor in writing of conditions detrimental to proper completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

3.2 INSTALLATION OF DIESEL ENGINE-DRIVEN GENERATOR SETS

A. Install engine-driven generator unit as indicated, in accordance with the equipment manufacturer's written instructions, and with recognized industry practices, to ensure that engine-generator unit fulfills requirements. Comply with NFPA and NEMA standards pertaining to installation of engine-generator sets and accessories.

B. Coordinate with other work, including raceways, electrical boxes and fittings, fuel tanks, piping and accessories, as necessary to interface installation of engine-generator equipment work with other work.

C. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds 486A, B and the National Electrical Code.

D. Align shafts of engine and generator within tolerances recommended by engine-generator unit manufacturer.

E. Contractor to fill tank prior to testing.

3.3 GROUNDING

A. Provide equipment grounding connections for diesel engine-driven generator units as indicated. Tighten connections to comply with tightening torques specified in UL Std 486A to assure permanent and effective grounding.

3.4 FIELD QUALITY CONTROL

A. Start-up Testing

1. Engage local equipment manufacturer's representative to perform start-up and load tests upon completion of installation, with the Engineer in attendance; provide certified test record. Tests are to include the following:

   a. Check fuel, lubricating oil, and antifreeze in liquid cooled models for conformity to the manufacturer's recommendations under environmental conditions present.

   b. Test, prior to cranking engine for proper operation, accessories that normally function while the set is in a standby mode.

   c. Check, during start-up test mode, for normal and emergency line-to-line voltage and phase rotation.

   d. Test, by means of simulated power outage, automatic start-up by remote-automatic starting, transfer of load, and automatic shutdown. Prior to this test adjust, for proper system coordination, transfer switch timers. Monitor throughout the test, engine temperature, oil pressure, battery charge level, generator voltage, amperes, and frequency. All tests shall be conducted with generator under full (100%) load. Full load test shall be minimum 4 hours under full load.

2. Upon completion of installation demonstrate capability and compliance of system with requirements. Where possible, correct malfunctioning unit at site, then retest to demonstrate compliance; otherwise, remove and replace with new unit, and proceed with retesting. Initial testing and retesting to be at no cost to Owner.

3. Upon completion of all tests and Owner acceptance, Contractor to top off fuel tank.

3.5 PERSONNEL TRAINING

A. Building Operating Personnel Training: Train Owner's building personnel in procedures for starting-up, testing and operating diesel engine-driven generator sets. In addition, train Owner's personnel in periodic maintenance of batteries.

END OF SECTION 26 32 13

SECTION 26 36 00 - 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.

C. Manufacturer Seismic Qualification Certification: Submit certification that transfer switches accessories, and components will withstand seismic forces for the area/location installed.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1, Section 01 78 23 - Operation and Maintenance Data, 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 100 mile radius of project location.

B. Source Limitations: Obtain automatic transfer switches 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 NEMA ICS 1 – Industrial Control and Systems: General Requirements.

E. Comply with NFPA 70 – National Electric Code.

F. Comply with NFPA 110 – Standard for Emergency and Standby Power Systems.

G. Comply with UL 1008 unless requirements of these Specifications are stricter.

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. Schneider; ASCO Power Technologies, LP.

c. Onan/Cummins Power Generation; Industrial Business Group.

d. Kohler Power Systems.

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.

1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.

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. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.

F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Switch Action: Double throw; mechanically held in both directions.

2. 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.

G. Neutral Terminal: Solid and fully rated, unless otherwise indicated.

H. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.

I. 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 16050 "Electrical Identification."

J. Enclosures: General-purpose NEMA 250, Type 12, complying with NEMA ICS 6 and UL 508, unless otherwise indicated/required.

2.3 AUTOMATIC TRANSFER SWITCHES

A. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.

B. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.

C. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.

D. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.

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. Motor Disconnect and Timing Relay: Controls designate starters so they disconnect motors before transfer and reconnect them selectively at an adjustable time interval after transfer. Control connection to motor starters is through wiring external to automatic transfer switch. Time delay for reconnecting individual motor loads is adjustable between 1 and 60 seconds, and settings are as indicated. Relay contacts handling motor-control circuit inrush and seal currents are rated for actual currents to be encountered.

G. 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-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. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details.

B. Identify components according to Section 26 05 00 – Electrical, General.

C. 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 Section 26 05 26 – Grounding and Bonding for Electrical Systems.

C. Connect wiring according to Section 26 05 19 – Low-Voltage Power Conductors and Cables.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. 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. Verify time-delay settings.

c. Verify pickup and dropout voltages by data readout or inspection of control settings.

d. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.

e. 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.

C. Coordinate tests with tests of generator and run them concurrently.

D. 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.

E. 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.

END OF SECTION 26 36 00

SECTION 26 43 13.A - SURGE PROTECTIVE DEVICES (SPD) FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 SCOPE

A. The Contractor shall furnish and install the Surge Protective Device (SPD) equipment having the electrical characteristics, ratings, and modifications as specified herein and as shown on the contract drawings. To maximize performance and reliability and to obtain the lowest possible let-through voltages, the ac surge protection shall be integrated into electrical distribution equipment such as switchgear, switchboards, panelboards, busway (integrated within bus plug), or motor control centers (MCC). Refer to related sections for surge requirements in:

1.2 RELATED SECTIONS

A. Section 16426A – Metal Enclosed Draw out Switchgear (Magnum DS) – Low Voltage

B. Section 16426B – Metal Enclosed Draw out Switchgear (DSII) – Low Voltage

C. Section 16428 – Switchboards – Low Voltage (Compartmentalized Feeders – Pow-R-Line i)

D. Section 16429 – Switchboards – Low Voltage (Group Mounted Feeders – Pow-R-Line C)

E. Section 16431 – Switchboards – Low Voltage (Commercial Metering)

F. Section 16466 – Busway – Low Voltage

G. Section 16470 – Panelboards

H. Section 16482A & B – Motor Control Centers – Low Voltage (Freedom and Advantage)

1.3 REFERENCES

A. SPD units and all components shall be designed, manufactured, and tested in accordance with the latest applicable standards.

1. ANSI/UL 1449 4th Edition or later

2. ANSI/UL 1283 5th Edition or later (Type 2 applications)

3. IEEE C62.41.1

4. IEEE C62.41.2

5. IEEE C62.43-2005

6. IEEE C62.45-2002

7. IEEE C62.48-2005

8. IEEE C62.62-2010

9. UL 96A

10. NFPA 780

11. FCC Part 15, Subpart B and ICES-003 – Radiated Emissions (for surge protection devices with communication capabilities)

12. FCC Part 15, Subpart B and ICES-003 – Conducted Emissions (for surge protection devices with communication capabilities)

1.4 SUBMITTALS – FOR REVIEW/APPROVAL

A. The following information shall be submitted to the Engineer:

1. Provide verification that the SPD complies with the required ANSI/UL 1449 4th Edition or later listing by Underwriters Laboratories (UL). Compliance may be in the form of a file number that can be verified on UL's website www.ul.org, the website should contain the following information at a minimum: model number, SPD Type, system voltage, phases, modes of protection, Voltage Protection Rating (VPR), and Nominal Discharge Current In.

B. Where applicable the following additional information shall be submitted to the engineer:

1. Descriptive bulletins

2. Product sheets

1.5 SUBMITTALS – FOR CONSTRUCTION

A. The following information shall be submitted for record purposes:

1. Final as-built drawings and information for items listed in Section 1.04 and shall incorporate all changes made during the manufacturing process.

1.6 QUALIFICATIONS

A. The manufacturer of the electrical distribution equipment shall be the manufacturer of the SPD within the listed electrical distribution equipment.

B. For the equipment specified herein, the manufacturer shall be ISO 14001 and ISO 9001 or 9002 certified.

C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of twenty-five (25) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

D. The SPD shall be compliant with the Restriction of Hazardous Substances (RoHS) Directive 2011/65/EU and have a visible label showing compliance.

E. The SPD shall be UL 1449 current edition listed, 20 kA I_n Type 1 or Type 2 for use in UL 96A systems.

1.7 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of manufacturer's instructions shall be included with the equipment at time of shipment.

1.8 OPERATION AND MAINTENANCE MANUALS

A. Operation and maintenance manuals shall be provided with each SPD shipped.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Eaton

1. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features, and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

2.2 VOLTAGE SURGE SUPPRESSION – GENERAL

A. Electrical Requirements

1. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.

2. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall not be less than 115% of the nominal system operating voltage.

3. The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards. End of life mode to be open circuit. Unit with end of life short-circuit mode are not acceptable.

4. Unit shall operate without the need for an external overcurrent protection device (OCPD) and be listed by UL as such. Unit must not require external OCPD or replaceable internal OCPD for the UL Listing.

5. Protection Modes – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

Protection Modes				
Configuration	L-N	L-G	L-L	N-G
Wye	●	●	●	●
Delta	N/A	●	●	N/A
Single Split Phase	●	●	●	●
High Leg Delta	●	●	●	●

6. Nominal Discharge Current (In) – All SPDs applied to the distribution system shall have a 20kA In rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an In less than 20kA shall be rejected.

7. ANSI/UL 1449 4th Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 4th Edition VPR for the device shall not exceed the following:

Modes	208Y/120	480Y/277	600Y/347
L-N; L-G; N-G	700	1200	1500
L-L	1200	2000	3000

B. SPD Design

1. Maintenance Free Design – The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable single-mode modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

2. Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating replaceable SPD modules shall not be accepted.

3. Electrical Noise Filter – Each Type 2 unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable able to meet this specification shall not be accepted.

4. Type 2 units with filtering shall conform to UL 1283 5th Edition.

5. Type 1 units shall not contain filtering or have a UL 1283 5th Edition Listing.

6. Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.

7. Monitoring Diagnostics – Each SPD shall provide the following integral monitoring options:

   a. Protection Status Indicators - Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.

      1) For wye configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes. Wye configured units shall also contain an additional green / red solid-state indicator light that reports the status of the protection elements and circuitry in the N-G mode. SPDs that indicate only the status of the L-N and L-G modes shall not be accepted.

      2) For delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes

      3) The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.

   b. Remote Status Monitor (optional) – The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.

   c. Audible Alarm and Silence Button (optional) – The SPD shall contain an audible alarm that will be activated under any fault condition. There shall also be an audible alarm silence button used to silence the audible alarm after it has been activated.

d. Surge Counter (optional) – The SPD shall be equipped with an LCD display that indicates to the user how many surges have occurred at the location. The surge counter shall trigger each time a surge event with a peak current magnitude of a minimum of 50 ± 20A occurs. A reset pushbutton shall also be standard, allowing the surge counter to be zeroed. The reset button shall contain a mechanism to prevent accidental resetting of the counter via a single, short-duration button press. In order to prevent accidental resetting, the surge counter reset button shall be depressed for a minimum of 2 seconds in order to clear the surge count total.

1) The ongoing surge count shall be stored in non-volatile memory. If power to the SPD is completely interrupted, the ongoing count indicated on the surge counter's display prior to the interruption shall be stored in non-volatile memory and displayed after power is restored. The surge counter's memory shall not require a backup battery in order to achieve this functionality.

e. Advanced Monitoring Display (AMD) (optional) - The SPD shall be equipped with an LCD display that indicates to the user the quantity and magnitude of surges that have occurred on each phase.

1) AMD shall display remaining surge protection levels as a percentage with 0% = unprotected, 1-99% = partially protected, 100% = fully protected.

2) In addition to the green/red monitoring solid-state indicator LED (reference 2.E.a) the LED shall include a yellow status to indicate the unit as partially protected

3) AMD shall provide a surge counter for each phase with three categories as defined by IEEE standards (C62.41) as follows:

4) Low Level surge (IEEE Category A)

5) Medium Level surge (IEEE Category B)

6) High Level surge (IEEE Category C)

7) AMD shall provide local access to the following information and data: Surge counts for each phase and per category, total surge counts, event logs with time & date stamps (last 20 events of each category per phase), SPD Protection Level percentage, alarm status, device catalog number, style number, serial number, date code, firmware version, PCB serial number, device name, IP address, ethernet MAC address, and customer support contact information.

8) User shall be capable of inputting the following info into the AMD: set date and time, set device name, change password, clear surge counts & event logs, edit MODBUS status, Edit IP Address, Edit Subnet Mask, and Edit Gateway.

9) User shall be capable of testing the display.

10) The AMD option shall provide a RJ45 ethernet connection port on the surge device, which shall provide a means for secure firmware updates to the SPD.

11) Time and date stamped events to be capable of being downloaded through a RJ45 ethernet connection port.

f. Remote Monitoring (optional with AMD) – The SPD shall be capable of Ethernet communications via Modbus/TCP and BACnet protocols and contain an onboard webpage which complies with UL 2900 standards.

g. BACnet and Modbus/TCP shall be user configurable with access to the following registers:

h. Remaining surge protection levels as a percentage with 0% = unprotected, 1-99% = partially protected, 100% = fully protected

i. LED status for each indicator color (red/yellow/green)

j. Surge counter for each phase with three categories defined using the resultant current from IEEE waveforms (C62.41.2) as follows: Low Level surge (IEEE Category A), Medium Level surge (IEEE Category B), High Level surge (IEEE Category C)

k. Access to the following information and data: Surge counts for each phase and per category, total surge counts, event logs with time & date stamps (last 2000 low, 1500 medium, and 1000 high events on each phase), SPD Protection Level percentage, alarm status, device catalog number, style number, serial number, date code, firmware version, PCB serial number, device name, IP address, ethernet MAC address, and customer support contact information.

l. User shall be capable of remotely inputting the following information: set date and time, set device name, change password, clear surge counts & event logs, change sensitivity settings, edit MODBUS status, edit IP Address, edit Subnet Mask, and edit Gateway.

m. The onboard webpage shall provide a pre-configured user interface with access to the following information:

n. Remaining surge protection levels as a percentage with 0% = unprotected, 1-99% = partially protected, 100% = fully protected

o. LED status for each indicator color (red/yellow/green)

p. Surge counter for each phase with three categories defined using the resultant current from IEEE waveforms (C62.41.2) as follows: Low Level surge (IEEE Category A), Medium Level surge (IEEE Category B), High Level surge (IEEE Category C)

q. Access to the following information and data: Surge counts for each phase and per category, total surge counts, event logs with time & date stamps (last 2000 low, 1500 medium, and 1000 high events on each phase), SPD Protection Level percentage, alarm status, device catalog number, style number, serial number, date code, firmware version, PCB serial number, device name, IP address, ethernet MAC address, and customer support contact information.

r. User shall be capable of remotely inputting the following information: set date and time, set device name, change password, clear surge counts & event logs, edit MODBUS status, edit IP Address, edit Subnet Mask, and edit Gateway.

C. Thermal MOV Protection

1. The unit shall contain thermally protected MOVs. These self-protected MOVs shall have a thermal protection element integrated with the MOV and a mechanical disconnect with arc quenching capabilities in order to achieve overcurrent protection of the MOV. The thermal protection assembly shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur, that would cause them to enter a thermal runaway condition.

2. Fully Integrated Component Design – All of the SPD's components and diagnostics shall be contained within one discrete assembly. The use of plug in single-mode modules that must be ganged together in order to achieve higher surge current ratings or other functionality shall not be accepted.

D. Safety Requirements

1. The SPD shall minimize potential arc flash hazards by containing no single-mode plug in user serviceable / replaceable parts and shall not require periodic maintenance. SPDs containing items such as replaceable single-mode plug in modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

2. SPDs designed to interface with the electrical assembly via conductors shall require no user contact with the inside of the unit. Such units shall have any required conductors be factory installed.

2.3 SYSTEM APPLICATION

A. The SPD applications covered under this section include distribution and branch panel locations, busway, motor control centers (MCC), switchgear, and switchboard assemblies. All SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C, B, and A environments.

B. Surge Current Capacity – The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table:

Minimum surge current capacity based on ANSI / IEEE C62.41 location category			
Category	Application	Per Phase	Per Mode
C	Service Entrance Locations (Switchboards, Switchgear, MCC, Main Entrance)	250 kA	125 kA
B	High Exposure Roof Top Locations (Distribution Panelboards)	160 kA	80 kA
A	Branch Locations (Panelboards, MCCs, Busway)	120 kA	60 kA

2.4 LIGHTING AND DISTRIBUTION PANELBOARD REQUIREMENTS

A. The SPD application covered under this section includes lighting and distribution panelboards. The SPD units shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category B environments.

1. The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.

2. SPDs shall be installed immediately following the load side of the main breaker. SPDs installed in main lug only panelboards shall be installed immediately following the incoming main lugs.

3. The panelboard shall be capable of re-energizing upon removal of the SPD.

4. The SPD shall be integral to the panelboard and connected directly to the bus. Alternately, an integral SPD can be connected to a circuit breaker for disconnecting purposes, in the case a disconnect is required.

5. The SPD shall be included and mounted within the panelboard by the manufacturer of the panelboard.

6. The SPD shall be of the same manufacturer as the panelboard.

7. The complete panelboard including the SPD shall be UL67 listed.

2.5 SWITCHGEAR, SWITCHBOARD, MCC AND BUSWAY REQUIREMENTS

A. The SPD application covered under this section is for switchgear, switchboard, MCC, and busway locations. Service entrance located SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C environments.

B. The SPD shall be of the same manufacturer as the switchgear, switchboard, MCC, or busway.

C. The SPD shall be factory installed integral to the switchgear, switchboard, MCC, and/or bus plug at the assembly plant by the original equipment manufacturer.

D. Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.

E. The SPD shall be connected through a disconnect (30A circuit breaker). The disconnect shall be located in immediate proximity to the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.

F. The SPD shall be integral to switchgear, switchboard, MCC, and/or bus plug as a factory standardized design.

G. All monitoring and diagnostic features shall be visible from the front of the equipment.

2.6 SERVICE ENTRANCE REQUIREMENTS

A. Service entrance located SPDs shall be tested and designed for applications within ANSI/IEEE C62.41 Category C environments.

PART 3 - EXECUTION

3.1 FACTORY TESTING

A. Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of NEMA, IEEE, and UL standards.

3.2 INSTALLATION

A. The installation of the SPD shall be factory installed integral to the distribution equipment. The Contractor shall install all distribution equipment per the manufacturer's recommendations, applicable electrical codes, and the contract drawings.

3.3 WARRANTY

A. The manufacturer shall provide a ten (10) year warranty (15 year warranty with registration) that covers replacement of the complete unit, including lightning, from the date of shipment against any SPD part failure when installed in compliance with manufacturer's written instructions and any applicable national or local electrical code.

END OF SECTION 26 43 13.A

SECTION 40 05 51 - VALVES, GENERAL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide valves, actuators, and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section shall apply to all valves and valve actuators pertaining to this Work as outlined in Contract Documents. Valves and actuators in particular locations may require a combination of units, sensors, and controls indicated in other sections of the Specifications.

C. Where a valve is to be supported by means other than the piping to which it is attached, the Contractor shall obtain from the valve manufacturer a design for support and foundation that satisfies the criteria in Section 43 05 01 – Equipment General Provisions. The design, including drawings and calculations sealed by an engineer, shall be submitted with the Shop Drawings. When the design is approved, the support shall be provided.

D. Unit Responsibility: A single manufacturer shall be made responsible for coordination of design, assembly, testing, and furnishing of each valve; however, the Contractor shall be responsible to the Owner for compliance with the requirements of each valve section. Unless indicated otherwise, the responsible manufacturer shall be the manufacturer of the valve.

E. Single Manufacturer: Where two or more valves of the same type and size are required, the valves shall be furnished by the same manufacturer.

1.2 REFERENCE STANDARDS

A.	ANSI B1.20.1	Pipe Threads, General Purpose
B.	ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings
C.	ANSI B16.5	Pipe Flanges and Flanged Fittings
D.	ANSI B16.18	Cast Copper Alloy Solder Joint Pressure Fittings Class 25, 125, 250 and 800
E.	AWWA C111	Rubber-Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings
F.	AWWA C207	Steel Pipe Flanges for Waterworks Service - Sizes 4 through 144 IN
G.	NEMA	Motors and Generators

1.3 SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Shop Drawings: Shop Drawings shall contain the following information:

1. Valve name, size, Cv factor, pressure rating, identification number (if any), and specification section number.

2. Complete information on valve actuator, including size, manufacturer, number, limit switches, and mounting.

3. Cavitation limits for control valves.

4. Assembly drawings showing part nomenclature, materials, dimensions, weights, and relationships of valve handles, handwheels, position indicators, limit switches, integral control systems, needle valves, and control systems.

5. Data in accordance with Section 40 05 93 – Motor Requirements for Process Equipment.

6. Complete wiring diagrams and control system schematics.

7. Valve Labeling: A schedule of valves to be furnished with stainless steel tags, indicating in each case the valve location and the proposed wording for the label.

8. Certification that products being used under meet requirements of standards referenced.

C. Operation and Maintenance Data: Provide in accordance with Section 01 78 23 – Operation Maintenance Data.

D. Spare Parts List: A Spare Parts List shall contain the required information for each valve assembly, where indicated.

E. Factory Test Data: Where indicated, signed, dated, and certified factory test data for each valve requiring certification shall be submitted before shipment of the valve. The data shall also include certification of quality and test results for factory-applied coatings.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Valve manufacturers shall have a successful record of not less than five (5) years in the manufacture of the valves indicated.

B. Valve Testing: As a minimum, unless otherwise indicated or recommended by the reference Standards, valves 3-inches in diameter and smaller shall be tested in accordance with manufacturer's standard, larger valves shall be factory tested as follows:

1. Hydrostatic Testing: Valve bodies shall be subjected to internal hydrostatic pressure equivalent to twice the water rated pressure of the valve. Metallic valves rating pressures shall be at 100 degrees F and plastic valves shall be at 73-degrees, higher temperature according to type of material. During the hydrostatic test, there shall be no leakage through the valve body, end joints, or shaft seals, nor shall any part of the valve be permanently deformed. The duration shall be sufficient time to allow visual examination for leakage. Test duration shall be at least 10 minutes.

2. Seat Testing: Valves shall be tested for leaks in the closed position with the pressure differential across the seat equal to the water rated pressure of the valve. The duration of test shall be sufficient time to allow visual examination for leakage. Test duration shall be at least 10 minutes. Leakage past the closed valve shall not exceed 1 fluid ounce per hour per inch diameter for metal seated valves and drop-tight for resilient seated valves.

3. Performance Testing: Valves shall be shop operated from fully closed to fully open position and reverse under no-flow conditions in order to demonstrate the valve assembly operates properly.

C. Certification: Prior to shipment, the Contractor shall submit for valves over 12- inches in size, certified, notarized copies of the hydrostatic factory tests, showing compliance with the applicable standards of AWWA, ANSI, or ASTM.

PART 2 - PRODUCTS

2.1 GENERAL

A. All valves used in potable water systems shall be NSF/ANSI 61 certified and compliant with 14 and 372.

2.2 PRODUCTS

A. Valves and gates shall be new and of current manufacture. Shut-off valves 6-inches and larger shall have actuators with position indicators. Gate valves 18-inches and larger or where chain wheel is required, shall be furnished with spur gear and hand wheel. Buried valves shall be provided with valve boxes and covers containing position indicators and valve extensions. Manual shut-off valves mounted higher than 7-feet above working level shall be provided with chain actuators.

B. Valve Actuators: Unless otherwise indicated, valve actuators shall be in accordance with Section 40 05 57 – Actuators for Process Valves and Gates.

C. Protective Coating: The exterior surfaces of all valves and the wet interior surfaces of ferrous valves of sizes 4-inches and larger shall be coated in accordance with manufacturer’s written instructions. The valve manufacturer shall certify in writing that the required coating has been applied and tested in the manufacturing plant prior to shipment. Flange faces of valves shall not be epoxy coated.

D. Valve Labeling: Except when such requirement is waived by the Engineer in writing, a label shall be provided on shut-off valves and control valves except for hose bibbs. The label shall be of 1/16-inch plastic or stainless steel, minimum 2-inches by 4-inches in size and shall be permanently attached to the valve or on the wall adjacent to the valve as directed by the Engineer.

E. Valve Lining: Each valve shall be lined with the same material required for the pipeline in which the valve is installed.

2.3 MATERIALS

A. Materials shall be suitable for the intended application. Materials in contact with potable water shall be listed as compliant with NSF Standard 61. Materials not indicated shall be high-grade standard commercial quality, free from defects and imperfections that might affect the serviceability of the product for the purpose for which it is intended. Unless otherwise indicated, valve and actuator bodies shall conform to the following requirements:

1. Cast Iron: Close-grained gray cast iron, conforming to ASTM A 48 - Gray Iron Castings, Class 30, or to ASTM A 126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

2. Ductile Iron: ASTM A 536 - Ductile Iron Castings, or to ASTM A 395 - Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.

3. Steel: ASTM A 216 - Steel Castings, Carbon Suitable for Fusion Welding for High- Temperature Service, or to ASTM A 515 - Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service.

4. Bronze: ASTM B 62 - Composition Bronze or Ounce Metal Castings, and valve stems not subject to dezincification shall conform to ASTM B 584 - Copper Alloy Sand Castings for General Applications.

5. Stainless Steel: Stainless steel valve and operator bodies and trim shall conform to ASTM A 351 - Steel Castings, Austenitic, for High-Temperature Service, Grade CF8M, or shall be Type 316 stainless steel.

6. PVC: Poly Vinyl Chloride materials for valve body, flanges, and cover shall conform to Cell Classification 12454.

7. CPVC: Chlorinated Poly Vinyl Chloride materials for valve body, flanges, and cover shall conform to Cell Classification 23447.

2.4 VALVE CONSTRUCTION

A. Bodies: Valve bodies shall be cast, molded (in the case of plastic valves), forged, or welded of the materials indicated, with smooth interior passages. Wall thicknesses shall be uniform in agreement with the applicable standards for each type of valve, without casting defects, pinholes, or other defects that could weaken the body. Welds on welded bodies shall be done by certified welders and shall be ground smooth. Valve ends shall be as indicated, and be rated for the maximum temperature and pressure to which the valve will be subjected.

B. Valve End Connections: Unless otherwise indicated, valves 2-1/2 inches diameter and smaller may be provided with threaded end connections. Valves 3-inches and larger shall have flanged end connections.

C. Bonnets: Valve bonnets shall be clamped, screwed, or flanged to the body and shall be of the same material, temperature, and pressure rating as the body. The bonnets shall have provision for the stem seal with the necessary glands, packing nuts, or yokes.

D. Stems: Valve stems shall be of the materials indicated, or, if not indicated, of the best commercial material for the specific service, with adjustable stem packing, O-rings, Chevron V-type packing, or other suitable seal. Where subject to dezincification, bronze valve stems shall conform to ASTM B 62, containing not more than 5 percent of zinc or more than 2 percent of aluminum, with a minimum tensile strength of 30,000 psi, a minimum yield strength of 14,000 psi, and an elongation of at least 10 percent in 2 inches.

E. Stem Guides: Stem guides shall be provided per the manufacturer’s recommendations. Submerged stem guides shall be 304 stainless steel.

F. Internal Parts: Internal parts and valve trim shall be as indicated for each individual valve. Where not indicated, valve trim shall be of Type 316 stainless steel or other best suited material.

G. Nuts and Bolts: Nuts and bolts on valve flanges and supports shall be in accordance with Section 43 05 50 – Equipment Mounting.

2.5 VALVE ACCESSORIES

A. Valves shall be furnished complete with the accessories required to provide a functional system.

2.6 SPARE PARTS

A. The Contractor shall furnish the required spare parts suitably packaged and labeled with the valve name, location, and identification number. The Contractor shall also furnish the name, address, and telephone number of the nearest distributor for the spare parts of each valve. Spare parts are intended for use by the Owner, after expiration of the correction of defects period.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to installation, inspect interconnecting piping and end connections to ensure compatibility.

B. Prior to installation, inspect and verify condition of valve and appurtenances. Installation constitutes installer's acceptance of product condition for satisfactory installation.

C. Ensure exposed piping is sufficiently supported to bear weight of valve when it is installed.

3.2 PREPARATION

A. Correct defects or conditions, which may interfere with or prevent a satisfactory installation.

3.3 VALVE INSTALLATION

A. Valves, actuating units, stem extensions, valve boxes, and accessories shall be installed in accordance with the manufacturer's written instructions and as indicated. Gates shall be adequately braced to prevent warpage and bending under the intended use. Valves shall be firmly supported to avoid undue stresses on the pipe.

B. Access: Valves shall be installed with easy access for actuation, removal, and maintenance and to avoid interference between valve actuators and structural members, handrails, or other equipment.

C. Valve Accessories: Where combinations of valves, sensors, switches, and controls are indicated, the Contractor shall properly assemble and install such items so that systems are compatible and operating properly. The relationship between interrelated items shall be clearly noted on Shop Drawing submittals.

END OF SECTION 40 05 51

SECTION 40 05 57 – ACTUATORS FOR PROCESS VALVES AND GATES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide all valve actuators and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section shall apply to all valves and gates, except where otherwise indicated in the Contract Documents. This Section includes manual operators and motorized valve operators, and mechanical, gear type limit switches.

C. Unit Responsibility: A single manufacturer shall be responsible for furnishing and coordinating design, assembly, testing, and installation of each type of valve and gate; however, the Contractor shall be responsible to the Owner for compliance with the requirements of each valve and gate section.

D. Single Manufacturer: Where two or more valve or gate actuators of the same type or size are required, the actuators shall all be produced by the same Manufacturer.

1.2 REFERENCE STANDARDS

A. Unless otherwise indicated and where applicable, all actuators shall be in accordance with ANSI/AWWA C540 - AWWA Standard for Power-Actuating Devices for Valves and Sluice Gates.

B. National Electrical Manufacturer’s Association (NEMA).

1.3 SUBMITTALS

A. Submittals shall be furnished in accordance with Section 01 33 00 – Submittal Procedures and Section 40 05 51 - Valves, General.

B. Shop Drawings: Shop Drawings of all actuators shall be submitted together with the valve and gate submittals as a complete package.

C. Motorized valve submittals shall include the following:

1. Installation list of similar municipal applications with contacts and phone numbers to verify experience.

2. Shop drawings and product data.

3. Motor, gear type and design information.

4. Design Data shall include:

a. Operating calculations for max break and max dynamic torques and minimum safety factor at which degree of valve opening and at break.

b. Submit data and calculations to substantiate operating time.

c. Submit proposed operator configuration and dimensions for each valve.

5. Wiring Schematics.

6. Manufacturer's published installation instructions.

7. Submit Operation and Maintenance Manuals in accordance with Section 01 78 23 – Operation and Maintenance Data.

8. Warranty.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. The motorized operators offered for this project shall have a minimum of 5 years of commercial use in municipal wastewater installations of a similar scope and use. New and prototype hardware/software will not be accepted.

2. Submit evidence of satisfactory operation of the proposed product in at least five separate facilities in accordance with the following requirements. Include contact names and phone numbers.

PART 2 - PRODUCTS

2.1 GENERAL

A. All valve and gate actuators shall comply with the requirements of Section 40 05 51 – Valves, General.

B. Unless otherwise indicated, all shut-off and throttling valves, and externally actuated valves and gates, shall be provided with manual or power actuators. The Contractor shall furnish all actuators complete and operable with mounting hardware, motors, gears, controls, wiring, solenoids, handwheels, levers, chains, and extensions, as applicable. All actuators shall be capable of holding the valve in any intermediate position between fully-open and fully-closed without creeping or fluttering. All wires of motor-driven actuators shall be identified by unique numbers.

C. Where indicated, certain valves and gates may be provided with actuators manufactured by the valve or gate Manufacturer. Where actuators are furnished by different manufacturers, the Contractor shall coordinate selection to have the fewest number of manufacturers possible.

D. Materials: All actuators shall be current models of the best commercial quality materials and liberally-sized for the maximum expected torque. All materials shall be suitable for the environment in which the valve or gate is to be installed.

E. Mounting: All actuators shall be securely mounted by means of brackets or hardware specially designed and sized for this purpose and of ample strength. The word "open" shall be cast on each valve or actuator with an arrow indicating the direction to open in the counter-clockwise direction. All gear and power actuators shall be equipped with position indicators. Where possible, manual actuators shall be located between 48 and 60 inches above the floor or the permanent working platform.

F. Functionality: Electric and pneumatic actuators shall be coordinated with power and instrumentation equipment indicated elsewhere in the Contract Documents.

2.2 MANUAL ACTUATORS

A. Unless otherwise indicated, all valves and gates shall be furnished with manual actuators as specified below:

1. Valves up to and including 4 inches in diameter shall have direct acting lever or handwheel actuators of the manufacturer’s best standard design.

2. Larger valves and gates shall have gear-assisted manual actuators, with a maximum operating pull of 60 pounds on the rim of the handwheel.

a. Above ground valves 6-inches to 24-inches in diameter may have traveling nut actuators, worm-gear actuators, spur- or bevel-gear actuators, as appropriate for each valve.

b. Above ground valves 30-inches in diameter and greater and valves for pressures higher than 250 psi shall have totally enclosed worm-gear actuators.

~~c.~~ Buried and submerged valves, gates, and other valves as indicated shall have totally enclosed worm-gear actuators, hermetically-sealed water-tight and grease-packed.

B. Buried Valves: Unless otherwise indicated, buried valves shall have extension stems to grade, with square nuts or floor stands, position indicators, and cast-iron or steel pipe extensions with valve boxes, covers, and operating keys. Where so indicated, buried valves shall be in cast-iron, concrete, or similar valve boxes with covers of ample size to allow operation of the valve actuators. Covers of valve boxes shall be permanently labeled as required by the local Utility Company or the Engineer. Wrench-nuts shall comply with AWWA C500 – Metal-Seated Gate Valves for Water Supply Service.

C. Chain Actuator: Manually-activated valves with the stem located more than 7-feet above the floor or operating level shall be furnished with chain drives consisting of sprocket-rim chain wheels, chain guides, and operating chains, and be provided by the valve Manufacturer. The wheel and guide shall be of ductile-iron, cast-iron, or steel, and furnish heavy-duty, Type 304 stainless steel operating chain looped to extend within 3-feet of the operating floor level. The valve stem of chain-actuated valves shall be extra strong to allow for the extra weight and chain pull. Hooks shall be provided for chain storage where chains interfere with pedestrian traffic.

D. Floor Boxes: Hot-dip galvanized cast-iron or steel floor boxes and covers to fit the slab thickness shall be provided for all operating nuts in or below concrete slabs. For operating nuts in the concrete slab, the cover shall be bronze-bushed.

E. Manual Worm-Gear Actuator: The actuator shall consist of a single or double reduction gear unit contained in a weather-proof cast-iron or steel body with cover and minimum 12-inch diameter handwheel. The actuator shall be capable of 90-degree rotation and shall be equipped with travel stops capable of limiting the valve opening and closing. The actuator shall consist of spur or helical gears and worm-gearing. The spur or helical gears shall be of hardened alloy steel and the worm-gear shall be alloy bronze. The worm-gear shaft and the handwheel shaft shall be of stainless steel. All gearing shall be accurately cut with hobbing machines. Ball or roller bearings shall be used throughout. Actuator output gear changes shall be mechanically possible by simply changing the exposed or helical gear set ratio without further disassembly of the actuator. All gearing shall be designed for a 100 percent overload.

2.3 ELECTRIC MOTOR ACTUATORS

A. Where electric motor actuators are indicated, an electric motor-actuated valve control unit shall be attached to the actuating mechanism housing by means of a flanged motor adaptor piece.

B. Design:

1. The actuators shall be suitable for use on a nominal 480 volt, 3 phase, 60Hz power supply and are to incorporate motor, integral reversing starter, local control facilities and terminals for remote control and indication connections housed within a self-contained, sealed enclosure.

2. Meet applicable AWWA requirements and meet the requirements set out in EN15714-2 and ISA SP96.02.

3. The actuator shall be sized to guarantee valve closure. The safety margin of motor power available for seating and unseating the valve shall be sufficient to ensure torque switch trip at maximum valve torque with the supply voltage 10% below nominal. For linear operating valves, the operating speed shall be such as to give valve closing and opening at approximately 10-12 inches per minute unless otherwise stated in the data sheet. For quarter turn valve types, the operating time will be a maximum of 60 seconds.

4. Handwheels for Manual Operation:

a. Metallic with arrows to indicate "open" rotation; incapable of rotation during motor operation; unaffected by fused motor, being mechanically independent of the motor drive; maximum 80 pound pull on rim for manual operation. Actuators shall be fitted with 2-inch AWWA nut for portable operator. When in the manual operating mode, actuator to remain in this mode until motor is energized, at which time the actuator shall automatically return to electric operation.

5. Declutch Lever: Padlockable, capable of mechanically disengaging motor and related gearing positively when motor is de-energized and freeing handwheel for manual operation.

    a. Do not share any gearing between motor operation and handwheel operation.

    b. Design so that simultaneous manual and motor operation is impossible.

6. Motorized operators shall be provided with an integrally mounted communication module within the actuators, to allow non-intrusive set up, double sealed electrical housing and shall not require access after factory fitting. In order to maintain the integrity of the enclosure, setting of the torque levels, position limits and configuration of the indication contacts etc. shall be carried out without the removal of any actuator covers and without mains power over an Infra-red or *Bluetooth*® wireless interface. Sufficient commissioning tools shall be provided with the actuators and must meet the enclosure protection and certification levels of the actuators. Commissioning tools shall not form an integral part of the actuator and must be removable for secure storage. In addition, provision shall be made for the protection of configured actuator settings by a means independent of access to the commissioning tool. Provision shall be made to disable *Bluetooth*® communications or only allow a *Bluetooth*® connection initiated by an Infra-Red command for maximum security.

    a. Each operator shall have independent HAND-OFF-AUTO selector switch and OPEN-CLOSE control devices that are wired to the motor starter circuit and completely isolated and independent of the valve actuator remote control network.

    b. The actuator shall include a device to ensure that the motor runs with the correct rotation for the required direction of valve travel irrespective of the connection sequence of the power supply.

7. The complete motorized operator enclosure shall be:

    a. NEMA 4 and NEMA 6 submersible to IP68 (20 feet of head for 72 hours). Actuators shall be suitable for indoor and outdoor use. The actuator shall be capable of functioning in an ambient temperature ranging from -6°C (22°F) to 70°C (158°F), up to 100% relative humidity.

    b. Actuators for hazardous area applications shall meet the area classification, gas group and surface temperature requirements specified in data sheet.

    c. Equipped with a separately sealed (double “O” ring) terminal area, such that with the terminal cover removed the actuator’s internal components are protected from environmental moisture and dust during storage and “no-power” conditions, start-up and working life. Enclosure must allow for temporary site storage without the need for electrical supply connection.

    d. All external fasteners shall be stainless steel.

C. Actuator Gearing:

1. Meet applicable AWWA requirements.

2. Single reduction type with hardened alloy steel worm gear, and aluminum bronze worm gear set; self-locking to maintain gate position.

3. Power Gearing: Accurately cut to assure minimum backlash; anti-friction bearing with caged balls or rollers throughout.

4. Stem Nuts: High tensile aluminum bronze; accurately machined and mounted in heavy ball or roller bearings.

5. Actuator Gear Housing: Aluminum housing with a separate cast iron thrust base.

6. Lubrication: Rotating power train components immersed in oil with provisions for inspection and re-lubrication without disassembly.

a. Lubricants: Suitable for ambient conditions of -20 degrees F to +150 degrees F.

b. Provide seals on shafting. All seals, feed throughs, and bearings shall provide sealing such that the actuator can be mounted in any position with no leakage of oil. Secondary gearboxes shall be externally attached to the actuator to accommodate variations in output speeds, torques or operating times and for use with quarter-turn valves. These multi-turn and quarter-turn gearboxes are to use accurately cut gears suitable for motor drive.

D. Motors:

1. The motor shall an integral part of the actuator, designed specifically for valve actuator applications. It shall be a low inertia high torque design, class F insulated with a class B temperature rise giving a time rating of 15 minutes at 40°C (104°F) at an average load of at least 33% of maximum valve torque. Where the total cycle time (two complete strokes) is longer than 15 minutes then NEMA Class H motor for 30 minute duty rating is to be used, with a maximum continuous temperature rating of 125 degrees C rise over ambient Temperature shall be limited by 2 thermostats embedded in the motor end windings and integrated into its control. Type: Specifically designed for gate actuator service with high starting torque, low inertia, totally enclosed, non-ventilated construction.

2. Protection shall be provided for the motor as follows:

a. Stall - the motor shall be de-energized within 8 seconds in the event of a stall when attempting to unseat a jammed valve.

b. Over temperature - thermostat will cause tripping of the motor. Auto-reset on cooling.

c. Single phasing - lost phase protection

d. Direction – phase rotation correction

3. Motor Windings: Epoxy treated.

4. Size: Sufficient to provide the maximum torque required for valve opening/closing operation, with a safety factor of 1.5. Torque shall be based on the valve manufacture's calculated torque required for opening/closing at full differential and maximum valve dynamic torque.

5. Voltage Tolerance: Capable of operating at within 10 percent of specified voltage.

6. Motor Starters:

   a. For Open-Close Service: Self-contained electromechanical reversing starter suitable for 60 starts/hr.

   b. For Modulating Service: Self-contained solid-state reversing starter suitable for 1,200 starts per hour. The hammer action will be replaced by a direct drive.

7. Accessories: Internal thermal contacts embedded in the motor windings for detecting motor overload and a ground lug.

8. Power Supply: As scheduled or as indicated on the Drawings.

9. Enclosures for Motors, Switches, and Other Electrical Compartments shall be:

   a. In Class 1, Division 1 or Division 2, classified areas or where indicated in the Motorized Operator Schedule: NEMA 7 and NEMA 6 submersible to IP68.

   b. In other locations: NEMA 4 and NEMA 6 submersible to IP68.

   c. Terminal compartment shall have three threaded cable entries as a minimum. Provide additional threaded entries if required or indicated on the Drawings.

E. Controls:

1. Voltage Transformer:

   a. As required to step down power supply to control voltage.

   b. Size voltage transformer to provide 24VDC or 120 VAC control power, for customer signals, indication and interlock relays as needed with 25 percent spare capacity or 15 VA, whichever is greater, for the multi-turn actuator.

2. Control Station:

   a. Integral with operator. Enclosures shall be:

      1) In Class 1, Division 1 or Division 2 classified areas: NEMA 7 and NEMA 6 submersible to IP68.

      2) In other locations: NEMA 4 and NEMA 6 submersible to IP68.

   b. Provided with Following Devices:

      1) HAND-OFF-AUTO selector switch, lockable in the OFF position.

      2) OPEN and CLOSE pushbuttons.

      3) OPEN and CLOSE indicating lights.

3. Torque Sensing:

   a. Torque and thrust loads in both closing and opening directions shall be limited by a torque sensing device.

   b. Torque setting: 40 percent to 100 percent rated torque, adjustable in 1% increments and indicated locally.

4. Electric Circuit Diagrams:

   a. Identical regardless of whether gates are to open or close on torque or position limit.

   b. Non-intrusive calibration-adjustment and interrogation of the actuator shall be accomplished without the removal of any of the actuator's covers. Non-intrusive calibration, adjustment & interrogation will be by means of a setting tool to provide speedy interrogation capabilities as well as security. The setting tool shall be in a non-intrusive intrinsically safe watertight casing. In addition it shall be possible to use a PDA or laptop.

5. Valve Position/Actuator Status Indication:

   a. The actuator shall provide a local display of the position of the valve, even when the power supply is not present.

   b. In the event of a (main) power (supply) loss or failure, the position contacts shall continue to be able to supply remote position feedback and maintain interlock capabilities.

   c. Absolute position measurement should be incorporated within the actuator. The technology must be capable of reliably measuring position even in the case of a single fault. The design must be simple with the minimum amount of moving parts (no more than 5). Technologies such as LEDs or potentiometers for position measurement are considered unreliable and therefore not preferred. The position of the actuator and valve shall be updated contemporaneously, even when the power supply is not present.

d. Four contacts shall be provided which can be selected to indicate any position of the valve; Provision shall be made for the selection of a normally closed or open contact form. Contacts shall maintain and update position indication during handwheel operation when all external power to the actuator is isolated. The contacts shall be rated at 5 Amps, 250 VAC, 30 VDC. Provision shall be made in the design for an additional eight contacts having the same functionality. A configurable monitor relay shall be provided as standard, which can be used to indicate either Availability or Fault. The relay should be a spring return type with a Normally Open / Normally Closed contact pre-wired to the terminal bung.

e. As an alternative to providing valve position, any of the above contacts shall be selectable to signal one of the following:

1) Valve Opening or Closing.

2) Motor Tripped on Torque in Mid Travel.

3) Motor Stalled.

4) Actuator Being Operated by Handwheel.

f. For actuators in modulating service, provide a controller that will accept a 4-20 mA analog signal. Additionally, a 4-20 mA position transmitter shall be included to provide a valve position feedback. The controller shall compare the input signal with the feedback signal to produce an error signal. The controller shall cause the motor to move the valve or gate in a direction so as to reduce the magnitude of the error signal. The controller positioning accuracy shall be plus or minus 1.0 percent of travel or better. It shall be possible to adjust Dead Band (0 to 9.9 percent of travel) and a Motion Inhibit Timer (2 to 99 seconds), and select action upon loss of signal, open/close/stay put.

6. Integral Starter and Transformer

a. The reversing starter, control transformer and local controls shall be integral with the valve actuator, suitably housed to prevent breathing and condensation. The starter shall be suitable for 60 starts per hour and of rating appropriate to motor size. The controls supply transformer shall be fed from two of the incoming three phases and incorporate overload protection. It shall have the necessary tapping and be adequately rated to provide power for the following functions:

1) Energizing of the contactor Coils

2) 24VDC or 110V AC output for remote controls (maximum 5W/VA)

3) Supply for all internal electrical circuits

7. Local Position Indication:

   a. The actuator display shall include a dedicated numeric/symbol digital position indicator displaying valve position from fully open to fully close in 0.1% increments. Valve closed and open positions shall be indicated by symbols showing valve position in relation to the pipework to ensure that valve status is clearly interpreted. With mains power connected, the display shall be backlit to enhance contrast at all ambient light levels and shall be legible from a distance of at least 5m (16ft).

   b. Red, green, and yellow LEDs corresponding to open, closed and intermediate valve positions shall be included on the actuator display when power is switched on. The yellow LED should also be fully programmable for on/off, blinker and fault indication. The digital display shall be maintained and updated during handwheel operation when mains power to the actuator is isolated.

   c. The actuator display shall include a fully configurable dot-matrix display element with a minimum pixel resolution of 168 x 132 to display operational, alarm, configuration and graphical datalogger information. The text display shall be selectable between English and other languages such as: Spanish, German, French, and Italian. Provision shall be made to upload a different language without removal of any covers or using specialized tools not provided as standard with the actuator Local Display: Large enough to be readable from a distance of six feet when the actuator is powered up. It shall be possible to rotate the display in 90 degree increments to compensate for the actuators installed position.

   d. Each actuator shall include a Data Logger to provide diagnostic information for maintenance & preventative maintenance purposes, including torque curves for both open & close strokes. This information is to be accessed by means of a) the setting tool, b) PDA or c) laptop, and in a format that can be saved electronically or on paper and then viewed at a later date. The software to achieve this and any updates to the software are to be supplied at no extra cost to the end user. Datalogger graphical displays should as a minimum be able to display log and trend graphs on the local LCD for the following:

      1) Torque versus Position

      2) Number of Starts versus Position

      3) Number of starts per hour

      4) Dwell Time

      5) Average temperature.

   e. The main display shall be capable of indicating 4 different home-screens of the following configuration:

      1) Isolation and status

2) Position and torque (analogue)

3) Position and torque (digital)

4) Position and demand (positioning).

F. Operation:

1. Controller System: Rated as follows:

a. Open-Close Service - 60 starts per hour (minimum).

b. Modulating Service - 1,200 starts per hour (minimum).

G. Manufacturers:

1. Intelligent electric actuators with torque output requirements of 750 ft-lbs and less for butterfly valves and eccentric plug valves shall be quarter turn type. Acceptable manufactures include:

a. Rotork “IQT Series”

b. Limitorque “QX”

c. EIM “HQ Series”

2. Intelligent electric actuators for open-close service shall be multi-turn type. Acceptable manufacturers include:

a. Rotork “IQ Series”

b. Limitorque “MX”

c. EIM “TEC 2000”

3. Intelligent electric actuators for modulating service shall be as follows:

a. Rotork “IQ Series”

b. Limitorque “MX”

c. EIM “TEC 2000”

4. Intelligent actuators for explosion proof service shall be as follows:

a. Rotork “IQ Series”

b. Limitorque “MX”

c. EIM “TEC 2000”

PART 3 - EXECUTION

3.1 GENERAL

A. Field representatives of manufacturers of valves or gates with electric actuators shall adjust actuator controls and limit switches in the field for the required function.

B. All valve and gate actuators and accessories shall be installed in accordance with Section 40 05 51 - Valves, General. Actuators shall be located to be readily accessible for operation and maintenance, without obstructing walkways. Actuators shall not be mounted where shock or vibrations will impair their operation, nor shall the support systems be attached to handrails, process piping, or mechanical equipment.

3.2 SOURCE QUALITY CONTROL

A. Factory test each motorized operator assembly in accordance with AWWA C540, except as modified herein.

B. Demonstrate that the stroke time is within the specified range.

C. Verify limit switch and torque switch functions in both directions.

D. Provide individual factory test certificates for each motorized actuator at no additional cost. Record the following parameters as a minimum.

1. No load current.

2. Current at maximum torque setting.

3. Stall current.

4. Torque at maximum torque setting.

5. Stall torque.

6. Test voltage and frequency.

7. Flash test voltage.

8. Actuator output speed.

E. Record details of specification, such as gear ratios for both manual and automatic drive, closing direction, wiring diagram, and serial number on the test certificates.

F. Require the motorized actuator manufacturer to submit certified statements that proof-of-design tests were carried out per the “Valve Actuator” section of AWWA C540 and that all requirements were successfully met.

3.3 INSTALLATION

A. Install operators in accordance with manufacturer's instructions.

3.4 MANUFACTURER'S FIELD SERVICES

A. Coordinate field service work with Owner and Engineer prior to initiating such work.

B. Contractor shall furnish a qualified Manufacturer’s Representative to provide manufacturer’s field services for inspection, testing, equipment startup, and operator training.

C. Require manufacturer’s representative to perform the following services as described below and as specified in Section 01 75 00 - Equipment Testing and Startup Procedures.

1. Installation Assistance:

a. Advise/observe the Contractor on the installation of motorized operators.

b. Check and verify that installation of the motorized operators is in accordance with the Drawings and manufacturer’s installation instructions.

c. Provide additional assistance as required.

2. Provide a 2-year warranty from date of substantial completion for the project.

3. Training: Provide a minimum of four (4) hours of training for the Owner’s staff on the operation and maintenance of electric operated gates and valves.

3.5 COMMISSIONING KIT

A. Each actuator shall be supplied with a start-up kit comprising installation instruction manual, electrical wiring diagram and cover seals to make good any site losses during the commissioning period. In addition, sufficient actuator commissioning tools shall be supplied to enable actuator set up and adjustment during valve/actuator testing and site installation commissioning.

END OF SECTION 40 05 57

SECTION 40 05 64 - BUTTERFLY VALVES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish all labor, materials, and equipment as required to furnish and install butterfly valves with manual, electric or pneumatic actuators as indicated on the Plans and in accordance with these specifications.

1.2 REFERENCE STANDARDS

A. Commercial Standards:

1.	ANSI/AWWA C504	Rubber-Seated Butterfly Valves.
2.	ANSI/AWWA C540	Power Actuating Devices for Valves and Sluice Gates
3.	ANSI/AWWA C550	Protective Epoxy Interior Coatings for Valves and Hydrants
4.	ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800
5.	ANSI B16.5	Pipe Flanges and Flanged Fittings
6.	ASTM A48	Specifications for Gray Iron Castings
7.	ASTM A126	Gray Iron Castings for Valves, Flanges and Pipe Fittings
8.	STM A276	Specifications for Stainless and Heat-Resisting Steel Bars and Shapes
9.	ASTM A436	Austenitic, Gray Iron Castings
10.	ASTM A536	Ductile Iron Castings
11.	MSS SP67	Butterfly Valves

1.3 SUBMITTALS

A. Provide shop drawings per Section 01 33 00 – Submittal Procedures and Section 40 05 51 – Valves, General including:

1. Complete Shop Drawings of butterfly valves and actuators.

2. Drawings showing valve port diameter complete with dimensions, part numbers and materials of construction

3. Certification of proof-of-design test form the valve manufacturer.

4. If automatically actuated, provide actuator information in accordance with Section 40 05 57 – Actuators for Process Valves and Gates.

5. For above grade installations, provide literature regarding valve position indicators and installation information to indicate if valves must be installed in the upright position. If valve must be installed in upright position, provide modified valve position indicator that can be seen from the floor when opening or closing the valve.

1.4 QUALITY ASSURANCE

A. Valves shall be subjected to performance, leakage, and hydrostatic test in accordance with procedures and acceptance criteria established by AWWA C504.

PART 2 - PRODUCTS

2.1 GENERAL

A. Butterfly valves shall comply with the requirements of Section 40 05 51 – Valves, General.

2.2 BUTTERFLY VALVES FOR GENERAL PURPOSE SERVICE

A. Valves shall be certified to NSF Standard 61.

B. Butterfly valves shall be rubber seated butterfly valves that conform to AWWA C504, rated for water working pressures up to 150 psig, subject to the following requirements. Butterfly valves for general purpose service shall be rubber seated butterfly valves that conform to AWWA C504, rated for water working pressures up to 150 psig, subject to the following requirements. Valves shall be of the size and class indicated, suitable for bubble tight shut-off service as well as throttling service at rated pressure at ambient temperatures of 33 to 125 degrees F. Lug or wafer style valves shall have ANSI 125 lb flange bolt hole patterns.

C. Body: The valve body shall be of cast iron conforming to ASTM A126 - Specifications for Gray Iron Castings for Valves, Flanges and Pipe Fittings, Class B, with either wafer, lug, or flanged design as indicated in drawings, drilled to ANSI B 16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 125. The entire body shall be factory coated with an epoxy coating system in accordance with AWWA C550.

D. Disc: The disc shall be a ductile iron conforming to ASTM A536, with factory applied epoxy coating in accordance with AWWA C550. The disc shall have no holes drilled into it for securing the disc to the stem with pins, screws, or any other such hardware. If the disc design is such that securing hardware is required then the disc and securing hardware shall both be type 316 stainless steel.

E. Seat: The valve seat shall be Ethylene-Propylene-Diene Monomer (EPDM) or Buna N and shall be bonded or vulcanized to the valve body.

F. Stem: The valve stem shall be a Type 316 stainless steel ASTM A276, with keyed slots on the stem to make with receiving slots on the inner part of the disc requiring no disc screws or pins for connection of the tem to the disc. If connecting pins or screws are required for a particular manufacturer's design, then the disc as well as the connecting hardware shall be type 316 stainless steel.

G. Stem Bushing: The stem bushing shall be a non-corrosive, heavy duty acetal bushing.

H. Stem Seal: The stem shall be a double "U" cup seal or O-ring designed which is self adjusting and provides positive sealing in both directions, and is suitable for the service condition.

I. Flange / Style: Unless otherwise specified or noted on the drawings, the style of each butterfly valve shall be lug style. The Contractor shall not use any type of raised face type PVC flange on either side of any butterfly valve. Contractor shall be responsible to ensure that the selected butterfly valve will fully open and close without any physical interference at all.

J. Testing: Valves shall be factory leak tested in accordance with AWWA C504.

K. Manufacturers or equal:

1. DeZurik Water Controls

2. Henry Pratt Company

3. Bray

4. Val-matic

2.3 BUTTERFLY VALVES FOR AIR SERVICE

A. General: Butterfly valves for air service shall be specifically designed for this service and meet or exceed the design, strength, performance, and testing standards of AWWA C504. They shall be suitable for pressures from vacuum to 125 psi and temperatures from minus 40 degrees F to 300 degrees F.

B. Body: The valve body shall be of cast iron conforming to ASTM A126, Class B, with lug or flanged design as indicated, drilled to ANSI B16.1, Class 25, 125, 250, and 800, Class 125.

C. Disc: The disc shall be cast iron conforming to ASTM A126 with a nylon coating, bronze, or Type 316 stainless steel. The disc shall be designed with the air- profile or other suitable shape. Sprayed or plated disc edges are not acceptable.

D. Seat: The elastomer seat shall be in the body. It shall be field-replaceable without special tools. The seat material shall be EPDM or PTFE/Viton to provide a tight shut-off at the temperatures above.

E. Shaft: The valve shaft shall be of Type 316 or 304 stainless steel, with sufficient strength to allow for the increased torque for air service.

F. Bearings: Shaft bearings shall be of the self-lubricating corrosion resistant sleeve type.

G. Packing: The packing shall be of the adjustable or self adjustable (a-ring) type, suitable for the temperature and service conditions.

H. Manufacturers, or Equal:

1. DeZurik water Controls

2. Henry Pratt Company

3. Bray

2.4 VALVE SCHEDULE

A. In addition to providing all necessary valves 3-inch diameter and smaller, the Contractor shall provide the butterfly valves as shown on the valve schedule in the Contract Drawings.

2.5 ACTUATORS

A. Manual Actuators: Actuators shall conform to Section 40 05 57 – Actuators for Process Valves and Gates and to ANSI / AWWA C540 - Power Actuating Devices for Valves and Sluice Gates, subject to the following requirements. Unless otherwise indicated, all manually-actuated butterfly valves of 6 inch diameter and larger shall be equipped with a handwheel and 2-inch square actuating nut and position indicator. Manual lever type actuators shall allow for positive throttling and have at minimum 10 stop positions from open to close for positive locking of the valve. The manual lever type actuators as well as handwheel actuators shall have an epoxy coating per manufacturer's standard coating.

B. Electric Actuators: Where indicated on Plans, provide electric actuators that meet the requirements of AWWA C 540 and are in accordance with Section 40 05 57 – Actuators for Process Valves and Gates. The maximum torque for the valve shall be input into the actuator program to be the maximum torque applied by the actuator.

2.6 PAINTING AND COATINGS

A. All valves inside of hydraulic structures shall be provided with a high build epoxy coating system, per manufacturers standard coating.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to installation, inspect interconnecting piping and end connections to ensure compatibility.

B. Prior to installation, inspect and verify condition of valve and appurtenances.

C. Ensure exposed piping is sufficiently supported to bear weight of valve when it is installed.

3.2 PRODUCT HANDLING

A. Protect valves and components against dirt and damage during shipment and storage.

B. Handle valves to prevent damage or contamination.

3.3 INSTALLATION

A. Install all valves in accordance with manufacturer's recommendations and with Section 40 05 51 – Valves, General.

END OF SECTION 40 05 64

SECTION 40 05 65.29 – DOUBLE-DISK CHECK VALVES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide double-disk check valves and appurtenances, complete and operable, for process air piping in accordance with the Contract Documents..

1.2 REFERENCE STANDARDS

A.	ANSI/AWWA C 508	Swing-Check Valves for Waterworks Service, 2 in. through 24 in.
B.	ASTM A 126	Gray Iron Casting for Valves, Flanges, and Pipe Fittings;
C.	ANSI/ASME B 16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 300;
D.	ASTM B 584	Copper Alloy Sand Castings for General Applications
E.	ASTM B 584 or B 148	Aluminum-Bronze Castings, or of Buna-N;
F.	ASTM B 763	Copper Alloy Sand Castings for Valve Application, or
G.	ANSI/ASME B1.20.1	Pipe Threads, General Purpose (inch);
H.	ASTM B 16	Free-Cutting Brass Rod, Bar, and Shapes for Use in Screw Machines.

1.3 SUBMITTALS

A. The Contractor shall furnish submittals in accordance with Section 40 05 51 – Valves, General.

PART 2 - PRODUCTS

2.1 DOUBLE-DISK CHECK VALVES

A. Double-disk check valves for air and gas service and where indicated, shall be of the wafer-type designed to fit between ANSI B16.1 flanges for 125-lb rating. The check valve leaves shall be spring-loaded. Flow from one direction shall cause the valve to open, and upon valve shutoff, the spring shall shut the valve leaves before reverse flow starts, acting at a point of zero velocity, for non-slam closure. The spring-tension of each valve shall be designed for the individual operating condition.

B. Body: The valve body shall be of cast iron conforming to ASTM A 126 with integrally-cast seat, rated for minimum 150-lb working pressure at up to 250 degrees F.

C. Leaves: The leaves shall be of bronze, aluminum bronze, or ductile iron, revolving on stainless steel or monel hinge pins with retainers.

D. Seat: The valves shall have resilient seats for bubble-tight shut-off, suitable for temperatures up to 250 degrees F without sticking. The seats shall be Viton or other suitable material for the intended purpose. The seat rings shall be firmly attached a shoulder cast in the body or to the disc by compression-molding or similar acceptable method.

E. Springs: The springs shall be of Type 316 stainless steel or Inconel, as best suited for the service condition.

F. Manufacturers, or equal:

1. APCO (Valve and Primer Corporation)

2. Proquip International

3. VAL-MATIC (Valve and Manufacturing Corporation)

PART 3 - EXECUTION

3.1 GENERAL

A. Valves shall be installed in accordance with provisions of Section 40 05 51 – Valves, General.

END OF SECTION 40 05 65.29

SECTION 40 05 82 – SOLENOID VALVES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide miscellaneous valves, and appurtenances, complete and operable in accordance with the Contract Documents.

1.2 REFERENCE STANDARDS

A. Commercial Standards:

1.	AWWA C511	Reduced-Pressure Principle Backflow Prevention Assembly
2.	ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings
3.	C-510-97	Double Check Valve Backflow Prevention Assembly
4.	C-511-97	Reduced Pressure Principle Backflow Prevention Assembly
5.	NPFA 820	Standard for Fire Protection in Wastewater Treatment and Collection Facilities

1.3 SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures and Section 40 05 51 – Valves, General.

B. Technical Manual: Furnish operation and maintenance information in accordance with Section 01 78 23 – Operation and Maintenance Data.

1.4 QUALITY ASSURANCE

A. Comply with quality assurance requirements listed in Section 40 05 51 – Valves, General.

PART 2 - PRODUCTS

2.1 GENERAL

A. All valves specified in this Section shall meet the applicable requirements of Section 40 05 51 – Valves, General.

B. All components that are in contact with potable water shall be certified to NSF Standard 61.

2.2 SOLENOID VALVES

A. All coil ratings shall be for continuous duty. For electrical characteristics see electrical drawings or specifications.

B. Explosion-proof valves shall be provided in Class 1, Division 1 areas as required under NPFA 820 guidelines. This applies to any solenoid valves located in the Headworks Building.

C. Solenoid valves shall be of the size, type, and class indicated and shall be designed for not less than 150 psi water-working pressure. Valves for water, air, or gas service shall have brass or bronze body with screwed ends, stainless steel trim and spring, Teflon or other resilient seals with material best suited for the temperature and fluid handled. Unless otherwise indicated, for chemicals and all corrosive fluids, solenoid valves with PVC, CPVC, polypropylene (PP), polyvinylidene fluoride (PVDF), or Teflon materials of construction, suitable for the specific application shall be provided. Enclosures shall be NEMA rated in accordance with the area designations.

D. Solenoid valves shall be pilot controlled and shall be water hammer free.

E. Solenoid valves shall fail in the closed position unless otherwise indicated on the project drawings.

F. Where solenoid valves are apart of a packaged equipment system, those solenoids valves shall be specified and provided by the equipment manufacturer.

G. Manufacturers, or Equal:

1. For general duty

    a. Automatic Switch Co. (ASCO), Model "RED HAT"

    b. Skinner Valve (Parker Hannifin Corporation)

    c. Magnatrol Valve Corporation

    d. J. D. Gould Co.

2. Metallic valves for corrosive fluids

    a. Valcor Engineering Corporation

3. Plastic valves for corrosive fluids

    a. GF Plastic Systems, Inc.

    b. Spears Mfg. Co.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Valves shall be installed in accordance with the manufacturer's printed recommendations, and with provisions of Section 40 05 51 – Valves, General.

B. After installation is complete, the solenoid valve shall be tested for proper operation.

END OF SECTION 40 05 82

SECTION 40 05 93 – COMMON MOTOR REQUIREMENTS FOR PROCESS EQUIPMENT

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall provide electrical motors, accessories, and appurtenances complete and operable, in conformance with the individual driven equipment specifications and the Contract Documents.

B. The provision in this Section apply to all low voltage AC squirrel cage induction motors except as indicated otherwise.

C. All motors shown on the Drawings or specified in other divisions of the specifications shall in general, be furnished with the driven equipment and connected under Division 26 of the Specification.

D. If motors are specified in other divisions of the Specification, then in the event of conflicts, the more restrictive specification shall apply.

E. The Contractor shall assign to the equipment supplier the responsibility to select suitable electric motors for the equipment. The choice of motor manufacturer shall be subject to review by the Engineer. Such review will consider future availability of replacement parts and compatibility with driven equipment.

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Motors shall be designed, built, and tested in accordance with the latest revision of the following standard documents. In the case of conflict between the requirements of this Section and those of the standard documents, the requirements of this Section shall prevail.

1.	NEMA MG 1	Motors and Generators
2.	ANSI/IEEE 112	Test Procedures for Polyphase Induction Motors and Generators
3.	UL l004	Motors, Electric

1.3 CONTRACTOR SUBMITTALS

A. Refer to Section 01 33 00 – Submittal Procedures and individual equipment specification requirements.

B. Submit the motor manufacturer's certification of bearing life on motors where application conditions suggest significant belt drive or thrust loads.

C. A Motor Data form (sample Form follows section) shall be submitted for each and every motor furnished under this Contract.

D. Motor outline, dimensions, and weight.

E. Manufacturer's descriptive information relative to specified features.

F. Motor Performance Characteristics:

1. Guaranteed minimum efficiency at rated load at rated voltage.

2. Guaranteed minimum power factor at rated load at rated voltage.

3. Expected efficiency at 1/2, 3/4, and full load at rated voltage.

4. Expected power factor at 1/2, 3/4, and full load at rated voltage.

5. Motor no-load current at rated voltage.

6. Full load current at rated voltage.

7. Full load current at 110 percent voltage.

8. Starting current at rated voltage.

9. Full load speed.

10. Certified copy of test report for identical motor tested in accordance with NEMA MG 1-12.53a and IEEE Standard 112, Test Method B, showing full load efficiency and power factor not less than specified value. Motors not as specified will be rejected.

G. Vertical Motor Data:

1. Thrust bearing life

2. Type of thrust bearing lubrication.

3. Type of guide bearing lubrication.

H. Operation and Maintenance Manuals (provided before or during training of treatment plant staff), including:

1. Complete information for storage and installation.

2. Complete operating and maintenance instructions.

3. Bill of Materials.

1.4 EQUIPMENT GUARANTEE

A. Guarantees shall cover:

1. Faulty or inadequate design.

2. Improper assembly or erection.

3. Breakage, or other failure.

4. Defective workmanship or materials

1.5 FACTORY TESTS

A. Provide factory test and test reports as listed below for all polyphase motors. For motors 7 1/2 hp and above, provide test reports for the actual motor being supplied. For motors under 7 1/2 hp, test reports of an identical motor may be provided. Perform all tests in accordance with the Procedures for Polyphase Induction Motors and Generators No. 112A and NEMA MG 1.

B. Measurements of no-load current and speed at nominal voltage and frequency

1. Measurement of locked rotor current at rated frequency.

2. Results of high-potential test.

3. Determination of efficiency and power factor at 1/2 load, 3/4 load, full-load, and service factor load.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide squirrel-cage induction motors unless otherwise noted.

B. Electric motors driving identical machines shall be identical.

C. Coordination: Provide motors especially suitable both electrically and mechanically to drive the loads specified. The speed, horsepower, torque base, bearing, shaft, insulation and enclosure shall be closely coordinated with this specification so as to provide a satisfactory, efficient drive without overloading, overheating, abnormal noise or vibration. The BHP required of the driven equipment under the most severe operating conditions for the equipment served shall not exceed the rated nameplate horsepower of the motor when operating at its rated service factor, nor shall it exceed the rated nameplate horsepower of the motor when operated at specified conditions at a service factor of 1.0. The "most severe operating conditions" shall include the full possible range of normal operating conditions but shall not include unusual conditions such as equipment failure.

D. Standards: All motors shall be in accordance with NEMA-MG 1 "T" Line, IEEE and ANSI latest revision insofar as they are applicable.

E. Service Conditions: Provide motors designed and built for long, trouble-free life in industrial service capable of operating successfully under the following application conditions:

1. 40°C maximum ambient temperature to -20 degrees Celsius minimum ambient temperature.

2. Altitude at the facility site shall be verified.

3. Voltage variations to + 10 percent of nameplate rating.

4. Frequency variations to + 5 percent of nameplate rating.

5. Multiple speed motors suitable for use with multiple speed starter furnished.

6. Inverter duty motors suitable for use with variable frequency drives, if furnished.

F. Operating Characteristics: All motors shall be rated for full-voltage starting, NEMA Design B, normal torque, normal starting current, unless otherwise required by the driven equipment or specified.

G. Installation Environment: Provide motors suitable for the environment in which they are to be installed. Where the installation environment is specified, provide motors suitable for the environment indicated and in conformance with the specification.

H. Exempt Motors: Motors for valve operators, submersible pumps, or motors which are integral part of standard manufactured equipment, i.e., non-NEMA mounting, common shaft with driven element, or part of domestic or commercial uses apparatus may be exempted from these specifications to the extent that such variation reflects a necessary condition of motor service or a requirement of the driven equipment.

2.2 ENCLOSURES

A. Horizontal: Dripproof NEMA Standard MG 1, unless otherwise specified. Provide screen over all air openings.

B. Vertical: Motors shall be weather protected Type 1 (WP-l) NEMA Standard MG 1, with inlet and outlet openings screened unless otherwise specified.

C. TEFC and TENV: Totally enclosed fan cooled (TEFC) where specified. Provide horizontal TEFC motors with condensate drain holes. Totally enclosed non- ventilated (TENV) may be substituted for TEFC at Contractor's option.

D. Cast iron or extruded aluminum or die cast aluminum stator frames and end shields, rigid construction.

E. Heavy fabricated steel, cast iron or aluminum frames for single phase motors.

2.3 ACCESSORY REQUIREMENTS

A. Motor Assembly: Provide NEMA conduit entrance box. Provide conduit entrance box size and drilling to conform to the conduit or wiring requirements indicated on the electrical drawings. Include motor leads and all accessory leads in a common conduit entrance box.

B. Motor Leads: Provide motor leads compatible with motor insulation systems, permanently identified.

C. Eyebolts: Provide drilling and tapping for eyebolts on all motors weighing more than 83 pounds.

D. Nameplates: Provide one or more engraved stainless steel stamped metal nameplates with the information required by NEMA-MGI-IO.38 and the following additional information:

1. Maximum ambient temperature for which motor is rated.

2. Class of insulation.

3. Service factor.

4. Bearing number.

5. Motor connection diagram if more than three leads.

6. Power rating in KW if driven equipment ratings are given in metric units.

E. Oil Lubricated Polyphase Motors: Provide lubricating oil reservoirs and sight gauges.

F. Painting: As specified in Section 43 05 01 – Equipment General Provisions.

G. Provide motor grounding lug suitable to terminate ground wire, sized as indicated.

2.4 INSULATION CLASS

A. Provide NEMA Class B insulation for all polyphase squirrel-cage induction motors, unless otherwise specified.

1. Provide additional anti-abrasion protection for non-enclosed motors, per NEMA MGl-l.27.

2. Provide additional moisture protection for enclosed motors, per NEMA MGl-20.48a.

B. Class F insulation with additional nonhygroscopic moisture protection as specified in paragraph 2.03A above may be utilized at the Contractor's option, however, the temperature rise as measured by resistance when operating at rated service factor and load shall conform to the limiting observable temperatures in NEMA-MGl, for class of insulation used.

C. Class A insulating materials shall not be utilized except in single-phase fractional horsepower motors or used in dry locations, with a standard reduction in rated temperature rise.

D. Encapsulation: Where specified. Provide insulating resin encapsulation by a molded or equivalent process in which the resin completely surrounds the conductors in the slots and end turns, leaving no voids between the conductors or adjacent stator steel. Allowable temperature rise shall not exceed the limits of NEMA-MGl.

E. Motors to be operated from adjustable frequency drives shall be provided with insulation systems to withstand 1600 volt spikes, with dV/dt as defined in NEMA MG 1-31 and shall be labeled as “Inverter Duty”.

2.5 SERVICE FACTOR

A. Provide the service factor indicated, or NEMA standard for the specified insulation and enclosure, whichever is greater. Minimum service factor shall be 1.15.

2.6 NEMA TYPE

A. Provide motors in accordance with standard NEMA type classifications as specified. The use of industry standard subclassifications such as "mill and Chemical" motors and similar" standard" heavy-duty designs are encouraged where they meet or exceed the specified minimum requirements.

2.7 POWER RATINGS

A. Motor horsepower or kw ratings, if indicated in the detailed equipment specifications, are minimum size acceptable.

B. Ratings indicated on the electrical drawings are for guidance only and do not limit the equipment size.

C. Frame/hp relationships shall conform to the latest NEMA standards for "T" or "U" frames and all dimensions shall meet NEMA standards.

2.8 STANDARD RATED VOLTAGE PHASE AND FREQUENCY

A. Provide motors nameplate-rated for 60 Hertz power supply as follows unless otherwise specified or shown on the drawings:

1. Motor less than 1/6 hp, single-phase, 115 volts.

2. Motors 1/6 hp through 1 hp, single phase, 115/230 volts.

3. Motors 1 hp and greater, three phase, 460 volts.

4. Multi-speed motors may have single voltage rating if manufacturer's standard.

B. Conform to the specified service conditions and the equipment specifications without reduction in the service factor.

2.9 BEARINGS AND SHAFTS

A. Motors greater than 2 HP shall have bearings designed for 17,500 hours (belted) or 100,000 hours (coupled) L-10 life.

B. Fractional Horsepower: Motors with fractional horsepower through 2 HP shall be provided with Lubricated-for-Life ball bearings.

C. Horizontal Motors Over 2 HP: Motors larger than 2 HP shall be provided with relubricatable ball bearings. Lubrication shall be per manufacturer's recommendation for smooth operation and long life of the bearings.

D. Vertical Motors Over 2 HP: Vertical motors larger than 2 HP shall be provided with relubricatable ball, spherical, roller, or plate type thrust bearings. Lubrication shall be per manufacturer's recommendation for smooth operation and long life of the bearings.

E. Shafts: Shafts shall be in accordance with NEMA "T" or "TS" dimensions. Long shafts shall be suitable for belt, chain or gear drive within limits established by good industrial practice and documented by NEMA. Short shafts shall be used for direct connection. Vertical motors shall be the solid-shaft type except where application requires a hollow-shaft design.

F. Inverter Duty Motors: Motors to be used in VFD applications must have bearing protection from shaft currents. Provide AEGIS shaft grounding ring, ceramic bearings or equivalent means to prevent premature bearing failure due to shaft current discharge.

2.10 DUTY CYCLE

A. Provide motors rated for continuous duty unless otherwise specified. Short time rated motors may be provided where the application is well documented by NEMA, is usual industrial practice and the driven equipment and motor is a tested combination under the specified performance conditions.

2.11 LUBRICATION

A. Horizontal polyphase motors shall be grease lubricated. The bearing housing shall be large enough to hold sufficient lubricant to minimize the need for frequent relubrication, but facilities shall be provided for adding new grease and draining out old grease without major motor disassembly. Motors 180T frame and smaller may utilize grease release fitting in lieu of grease drain plug. The bearing housing shall have long, tight, running fits or rotating seals to protect against the entrance of foreign matter into the bearings or leakage of grease out of the bearing cavity.

B. Vertical polyphase motor lubrication shall conform to the motor manufacturer's recommendations. Except as otherwise recommended, guide bearings shall be ball bearings, grease lubricated; thrust bearings shall be grease lubricated through frame 28OT, oil lubricated in larger frame sizes.

2.12 MOTOR THERMAL PROTECTION

A. Provide one heat-sensing detector per phase, embedded in the windings to provide even temperature protection on motors 75 hp or larger. Coordinate over-temperature protection system with motor starter overload relays.

B. Single Phase Motor: Single phase 120, 208, or 230 volt motor shall have integral thermal overload protection or shall be inherently current limited.

C. Thermostats: Winding thermostats shall be snap action, bi-metallic, temperature-actuated switch, and shall be factory mounted integral to the motors. Thermostats shall be provided with one normally closed contact. The thermostat switch point shall be precalibrated by the manufacturer.

2.13 HIGH EFFICIENCY MOTORS

A. All motors provided shall be high efficiency as specified below.

B. High efficiency motors shall have minimum and nominal efficiencies which meet or exceed the efficiencies specified below when tested in accordance with the latest version of IEEE Test Procedure 112A. Method B. using accuracy improvement by segregated loss determination including stray load loss improvement as specified in NEMA Standard MGl-12.S3A. latest revision. Minimum efficiencies shall be guaranteed in writing.

C. Single speed induction high efficiency motors, three-phase, NEMA Design B, 460V, continuous duty, 40°C ambient shall meet or exceed the efficiencies specified in the following table.

Energy Efficiency Horizontal					
		Percent Guaranteed Minimum Rated Load Efficiencies		Percent Guaranteed Minimum Rated Load Power Factor	
HP	Nominal Speed RPM	DP	TEFC	DP	TEFC
1	1,800	80.0	81.5	85.0	85.0
	1,200	78.5	79.3	74.0	74.0
1.5	3,600	79.3	81.5	86.0	86.0
	1,800	79.3	82.0	88.0	88.0
	1,200	82.5	84.0	69.5	69.5
2	3,600	82.0	84.0	88.0	88.0
	1,800	81.5	83.7	84.0	84.0
	1,200	85.5	85.5	69.0	69.0
	900	82.9	82.5	54.0	54.0
3	3,600	82.0	84.0	91.0	88.0
	1,800	84.8	86.5	79.0	79.5
	1,200	87.5	88.1	71.0	71.5
	900	84.1	82.9	62.0	62.5
5	3,600	84.8	86.5	87.0	91.5
	1,800	86.5	86.5	81.0	81.0
	1,200	87.5	88.1	75.5	75.5
	900	87.5	86.5	70.0	70.5
7.5	3,600	86.5	88.1	90.0	90.0
	1,800	89.3	89.5	86.5	86.5
	1,200	88.5	88.5	80.0	80.0
	900	87.5	86.5	72.0	72.0
10	3,600	89.3	89.5	90.0	90.0
	1,800	89.3	89.5	86.0	86.0
	1,200	89.5	89.5	80.5	81.0
	900	89.3	88.5	77.5	78.0

2.14 ACCEPTABLE MANUFACTURER

A. U.S. Motors

B. General Electric

C. Equal

PART 3 - EXECUTION

3.1 ERECTION

A. Motors shall be factory installed on common bases, stands, etc., with the driven equipment. Provide suitable couplings and guards between motor and driven equipment.

B. Align and connect to driven equipment.

C. Connect motors to power supply and controllers and verify correct rotation of equipment.

3.2 INSTALLATION CHECK

A. Provide services of an experienced, competent, and authorized representative of the manufacturer to visit site of work and inspect, check, adjust if necessary, and approve equipment installation for motors 25 hp and larger.

B. Assure that equipment manufacturer's representative is present when equipment is placed in operation.

C. Verify that equipment representative revisits jobsite as often as necessary until all trouble is corrected and equipment installation and operation are satisfactory, in the opinion of the Owner.

D. The Installing Contractor shall perform the following field checks:

1. Inspect each motor installation for any deviation from rated voltage, phase, or frequency and improper installation.

2. Visually check for proper phase and ground connections. Verify that multi-voltage motors are connected for proper voltage.

3. Check winding and bearing temperature detectors and space heaters for functional operation.

4. Test for proper rotation prior to connection to the driven equipment.

5. Test insulation (megger test) of all new and re-used motors in accordance with NEMA MG-1. Test voltage shall be 1000 VAC plus twice the rated voltage of the motor.

END OF SECTION 40 05 93

MOTOR DATA FORM

Equipment Name: _____ Equipment Number(s):_____

Site Location: _____

Nameplate Markings

Mfr: _____ Mfr Model: _____ Frame: _____ HP: _____

Volts: _____ Phase: RPM: _____ Service Factor: _____

FLA: _____ LRA: _____ Freq: _____ Ambient Temp Rating: _____°C

Time Rating:_____ Design Letter _____
(NEMA MG-10.35) (NEMA MG-1.16)

KVA Code Letter: _____ Insulation Class: _____

The following information is required for high efficiency motors only:

A. Guaranteed minimum efficiency at full load at NEMA efficiency index:

_____
(NEMA MG1-12.53B)

B. Nameplate or nominal efficiency: _____

Data Not Necessarily Marked on Name Plate

Type of enclosure: _____ Enclosure Material: _____

Temp rise: _____ °C (NEMA MG1-12.41, 42)

Space heater included: _____ Yes _____ No;

If yes, _____ Watts _____ Volts

Type of Rotor winding over-temperature protection, if specified:

Use the space below to provide additional information on other motor modifications, if specified:

_____

_____

SECTION 40 67 00 - CONTROL PANELS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide control panels, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section apply to local panels provided in equipment systems specified in other sections unless indicated otherwise in those sections.

1.2 REFERENCE STANDARDS

A. ASTM A 283 Low and Intermediate Tensile Strength Carbon Steel Plates

B. UL 508A Industrial Control Panels

1.3 SUBMITTALS

A. Submittals shall be furnished in accordance with Sections 01 33 00 – Submittal Procedures.

B. Shop Drawings: The Contractor shall submit shop drawings for each panel and enclosure provided under Division 40. The shop drawings shall completely define and document the construction, finish, layout, power circuits, signal and safety grounding circuits, fuses, circuit breakers, signal circuits, internally mounted instrumentation, face plate mounted instrumentation components, internal panel arrangements, and external panel arrangements. The submittal shall include the following:

1. A complete index shall appear in the front of each bound volume. Drawings and data sheets associated with a panel shall be grouped together with the panels being indexed by systems or process areas. Panel tagging and nameplate nomenclature shall be consistent with the requirements of the Contract Documents.

2. Scaled physical arrangement drawings drawn to scale that define and quantify the physical groupings comprising control panel sections, auxiliary panels, subpanels, and racks. Cutout locations with nameplate identifications shall be shown.

3. Front of panel layouts for all control panels.

4. Schematic/elementary diagrams shall depict all control devices and circuits and their functions.

5. Interconnection diagrams shall locate and identify all external connections between the control panel/control panel devices and associated equipment. These diagrams shall show interconnecting wiring by lines, designate terminal assignments, and show the physical location of all panel ingress and egress points.

6. A bill of material that enumerates all devices associated with the control panel.

PART 2 - PRODUCTS

2.1 GENERAL

A. Environmental Suitability: Indoor and outdoor control panels and instrument enclosures shall be suitable for operation in the ambient conditions associated with the locations designated in the Contract Documents. Heating, cooling, and dehumidifying devices shall be provided, as indicated, in order to maintain all instrumentation devices within 20 percent of the minimums and maximums of their rated environmental operating ranges. The Contractor shall provide all power wiring for these devices. Instrumentation in hazardous areas shall be suitable for use in the particular hazardous or classified location in which it is to be installed.

B. The control panel shall be the source of power for any 120 VAC solenoid valves interconnected with the control panel. Equipment associated with the control panel shall be ready for service after connection of conductors to equipment, controls, and control panel.

C. Instrument power circuits shall be fed from the associated PLC panel.

D. Control panels that do not contain motor controllers, shall not contain any voltages greater than 120VAC.

E. Unless indicated otherwise, control panels shall be housed in NEMA rated enclosures in accordance with Section 26 05 33 16 – Cabinets and Boxes For Electrical Systems. Panels shall be either freestanding, pedestal-mounted or equipment skid-mounted, as indicated. Internal control components shall be mounted on an internal back-panel or side-panel as required.

F. Each source of foreign voltage shall be isolated by providing disconnecting or pull-apart terminal blocks. Each control panel shall be provided with identified terminal strips for the connection of all external conductors. The Contractor shall provide sufficient terminal blocks to connect 25 percent additional conductors for future use.

G. Motor starters, where required, shall be in accordance with Section 26 29 13 13 – Across-the-Line Motor Controllers, 26 29 13 16 – Reduced-Voltage Motor Controllers, and Section 26 29 23 – Variable-Frequency Motor Controllers. Each motor starter shall be provided with contact closures for motor overload, local indication, and remote alarm. Discrete outputs from the control panel shall be provided by electrically isolated interposing relay contacts. Analog inputs and outputs leaving the envelope of the building shall be isolated 4-20 mA, 2-wire signals with power supply. All analog inputs and outputs shall be individually fused.

H. Control panel mounted devices shall be mounted a minimum of 3 feet above finished floor elevation.

2.2 CONTROL PANELS

A. Each PLC and remote I/O system and corresponding housing, including I/O modules, power supply modules, communication interface devices, and peripheral equipment shall be mounted inside a NEMA enclosure in accordance with Section 26 05 00 – Electrical, General. I/O wiring from the field to the remote I/O system shall be terminated on terminal blocks in the lower portion of the enclosure.

B. Materials: Panels shall be made of Grade 304 stainless steel if mounted outside. Section 2.2.B.4 lists control panels and required minimum NEMA ratings. Panel section faces shall be No. 12 gauge minimum thickness for free standing panels and No. 14 gauge minimum thickness for wall mounted or pedestal mounted panels. Materials shall be selected for levelness and smoothness.

1. Relay rack high density type panels shall utilize standard relay racks with No. 14 gauge steel frame and supports.

2. Structural shapes and strap steel shall comply with ASTM A 283 - Low and Intermediate Tensile Strength Carbon Steel Plates, Grade C.

3. Bolting Material: Commercial quality carbon steel bolts, nuts, and washers shall be 1/2-inch diameter with UNC threads. Carriage bolts shall be used for attaching end plates. All other bolts shall be hex end machine bolts. Nuts shall be hot pressed hex, American Standard, heavy. Standard wrought washers shall be used for foundation bolts and attachments to building structures. Other bolted joints shall have SAE standard lock washers.

4. Control Panel Locations and minimum required NEMA ratings:

a. Pump Station Control Panel: Inside, NEMA 1

b. Screen Control Panel: Inside, NEMA 1

c. Grit Control Panel: Inside, NEMA 1

d. Dewatering Control Panel: Inside, NEMA 1

e. SBR Main Control Panel: Inside, NEMA 1

f. Sand Filter Main Control Panel: Inside, NEMA 1

g. Sand Filter Compressed Air Control Panel: Outside, NEMA 4X

h. UV Control Panel: Inside, NEMA 12

C. Construction: Dimensions shall be in accordance with vendor's requirements. Control panels greater than 84 inches in width shall be built in sections not to exceed 84 inches. Elevations and horizontal spacing shall be subject to Engineer's approval.

D. Fabrication: End plates, top plates, and top closure panels (to hung ceiling) shall be provided when required by the material requisition. End plates, top plates, and top closure

panels shall be removable with countersunk bolts to match panels. Top closure panels shall be furnished in lengths which match the widths of standard panels, except that one top closure panel may extend across two 4-foot 6-inch wide or five 2-foot wide standard panels. The vertical joints of these panels shall align with the vertical joints of the standard panels.

1. End closure or rear closure doors shall be provided where required. Such doors shall be flush fitting, gasketed, and be of the hinged lift-off type with lockable door handles. A common key shall be provided for all doors on one panel assembly. Removable access panels shall be provided with dished handle fasteners. Screw driver 1/4 turn or Dzus type fasteners are not acceptable.

2. The flanged edges of all panels shall be straight and smooth. Corners shall be welded and ground smooth.

3. The face of the panel shall be true and level after angling.

4. All panel cutouts and holes may be cut or drilled by any standard method that does not cause deformation. Burrs shall be ground smooth.

5. Adjacent panels shall assemble with races flush. Gaps or cracks shall not be visible from the front of the assembled instrument board.

6. Stiffeners shall be welded to the back of panels, as required to prevent panel deformation due to the weight of face mounted instruments.

E. Preparation of Panel Surface: The following requirements apply to the front and rear face of the panel, both sides and the edges of all flanges, and the periphery of all holes or cutouts.

1. High spots, burrs, and rough spots shall be ground smooth.

2. The surfaces shall be sanded or sandblasted to a smooth, clean, bright finish.

3. All traces of oil shall be removed with a solvent.

4. The first coat of primer shall be applied immediately.

F. Instrument Finishing: The final coats applied to painted surface of instrument cases, doors, or bezels which are visible from the front of panels shall be manufacturer's standard unless otherwise indicated. Black Japan or "crinkle" finishes on instrument cases are not acceptable.

G. Mounting of Instruments: The panel vendor shall provide cutouts, and shall mount all instrument items indicated to be panel mounted, including any instruments indicated to be furnished by other vendors but installed in the panel.

1. The panel vendor shall also mount behind the panels other instrument accessory items as required for functionality as indicated.

2. Equipment mounted at the rear of panel shall be installed to allow for commissioning adjustments, servicing requirements, and cover removal.

3. Spare space shall be kept clear of wiring, etc., to give maximum space for future additions.

H. Panel Components:

1. Terminal Blocks.

a. Terminal blocks for power distribution and digital signals shall comply with the following requirements

1) Terminal blocks shall be UL rated for 600V, 30A minimum.

2) Terminal blocks shall have a compression-style screw clamp connection.

3) Terminal blocks shall be capable of accepting #12 AWG wire.

4) Terminal blocks directly associated with digital I/O signals shall be two-tier with pre-manufactured jumper bars for distribution of common signals.

b. Terminal blocks for analog signals shall comply with the following requirements:

1) Terminal blocks shall be UL rated for 300V, 20A minimum.

2) Terminal blocks shall have a compression-style screw clamp connection.

3) Terminal blocks shall be capable of accepting #16 AWG wire.

4) Terminal blocks shall be three-tier sensor blocks for termination of signal positive, negative, and shield with pre-manufactured jumper bars for distribution of common signals.

c. Fuse blocks shall comply with the following requirements:

1) Fuse blocks shall be UL rated for 600V, 10A minimum.

2) Fuse blocks shall incorporate a hinged lever that accepts 5x20 mm fuses.

3) Fuse blocks shall have a compression-style screw clamp connection.

4) Fuse blocks shall be capable of accepting #12 AWG wire.

5) Fuse blocks shall contain blown-fuse indication through the use of a neon lamp or an LED.

d. All terminal blocks and fuse blocks shall be designed for DIN rail mounting. Extra deep 15 mm DIN rail shall be used.

e. Contractor shall provide terminal block end sections and end stops as necessary for a complete installation.

f. Terminal blocks and fuse blocks shall be provided with pre-printed snap-on label strips. Stick-on labeling is not acceptable. Labeling shall be consistent with Contractor's control panel drawings. Contractor shall clearly label all terminal blocks in every control panel; unlabeled terminal blocks are not acceptable.

g. Terminal blocks and fuse blocks shall be ABB, Allen-Bradley, or approved equal.

2. Instrument Power: All instruments requiring power that are wired to a PLC shall also have power supplied from the same PLC control panel. All instrument power sources shall be individually fused.

3. Signal surge suppressors. Signal surge suppressors shall be provided for all analog signals leaving the envelope of the building.

a. Signal surge suppressors shall be Phoenix Contact TT-2-PE-24DC or equal.

4. Control Relays. Control relays shall comply with the following requirements:

a. Relays shall be plug-in style with a DIN-rail mountable base.

b. Relays shall have on/off indication.

c. General purpose control relays shall have 24VDC or 120VAC coil as required for application. Relay contacts shall be rated 10 Amp at 120VAC or 125VDC. Contractor shall be responsible for quantity of contacts as required for application. New general purpose control relays shall be Allen Bradley 700-HA series or equal.

d. Digital output interposing relays shall be terminal block style. Allen Bradley 700-HL series or equal.

5. Intrinsically Safe Barriers. Relays shall be solid-state electronic type in which the energy level of the sensing or actuation circuit is low enough to allow safe use in hazardous areas. Relays shall be located in non-hazardous areas. Relays shall be manufactured by GEMS, MTL, R.Stahl, Inc., or Turck.

6. Circuit Breakers. Circuit breakers for use in control panels shall be rated for 600V service.

a. Control panel circuit breakers shall be DIN-rail mounted.

b. Control panel circuit breakers shall be Allen-Bradley, Square D, or approved equal.

7. Surge Suppression. PLC control panels shall incorporate a transient-voltage surge suppressor on the incoming line. Surge suppressors shall be properly sized by the Contractor based upon the maximum current draw of the control panel.

    a. Surge suppressors shall be Innovative Technology, Leviton, or equal.

8. DC Power Supplies. PLC control panels shall be provided with a redundant DC power supply system containing two identical 24VDC power supplies and a redundancy module to regulate loading.

    a. DC Power Supplies shall be redundant. A redundancy module shall be used to regulate loading.

    b. Size DC power supplies based upon the actual 24V load. Power supplies shall not be loaded more than 50% of rated capacity.

    c. DC power supply systems shall be Sola HD SDN Series, ABB CP Series, or equal.

9. Digital Panel Indicators. Digital indicators shall be designed for semi-flush mounting in a panel. The indicator shall be a 3 1/2 digit LED, LCD, or gas discharge type display, with digits at least 0.5 inch high. The indicator shall be easily read at a distance of 10 feet in varying control room lighting environments. Operating temperature range shall be 32°F to 140°F. Accuracy shall be ±0.1 percent. The indicator shall be scaled in engineering units, with the units engraved on the display face or on the associated nameplate. The indicator shall have a selectable decimal point and shall provide over-range indication. Digital indicators shall be manufactured by Invensys/Eurotherm/Action Instruments, Newport Electronics, Precision Digital Corporation, or Red Lion Controls.

10. Selector Switches. Selector switches shall be 30.5-mm, heavy-duty, oil-tight type with gloved-hand or wing lever operators. Position legends shall be engraved on the switch faceplate. Switches for electric circuits shall have silver butting or sliding contacts, rated 10 amperes continuous at 120 V ac. Contact configuration shall be as indicated on the Drawings or for the application. Switches used in electronic signal circuits shall have contacts suitable for that duty. Switches shall be Eaton/Cutler-Hammer "10250T", General Electric "CR104P", or Allen Bradley “800T”.

11. Indicating Lights. Indicating lights shall be 30.5-mm, heavy-duty, oil-tight type, with full voltage LED lamps. Legends shall be engraved on the lens or on a legend faceplate. Lights shall be push-to-test type. Indicating lights shall be Eaton/Cutler Hammer "10250T", General Electric "CR104P", or Allen Bradley “800T”.

12. Pushbuttons. Push buttons shall be 30.5-mm, heavy-duty, oil-tight type. Legends shall be engraved on the push-button faceplate. Contacts shall be rated 10 amperes continuous at 120 V ac. Push buttons shall be Eaton/Cutler-Hammer "10250T", General Electric "CR104P", or Allen Bradley “800T”.

13. Alarm Horns. Horns shall be high-decibel, panel-mount, vibrating type designed for heavy-duty use. Horn volume shall be field-adjustable from 78 to 103 dB at

10 feet. Horns shall operate at 120 volts ac. Horns shall be weatherproof NEMA Type 4X. Horns shall be panel front mounted and shall be supplied with gasket. Horns shall be Edwards Signals "870P Series."Horns shall be supplied with a field mounted enclosure. Horns shall be Edwards Signals "876 series."

I. Electrical Requirements:

1. All conduit, wireways, switches, wire, and electrical fittings for 120 volt circuits to instruments and other electrical devices as required for a complete and operable installation.

2. Conduit, wireways, junction boxes and fittings shall be provided for signal wire, thermocouple, or resistance thermometer lead wire. Conduit or wireway runs shall include those required between temperature sensors and temperature transmitters and between the thermocouple wireway or junction box and instruments.

3. Each terminal connection shall have a plastic plate with a terminal and instrument tag number. Wiring shall be identified with stamped tubular wire end markers.

4. PLC control panels shall be provided with a 15 amp, 120 volt, service outlet circuit within the back-of-panel area.

5. PLC control panels shall be provided with fluorescent light and door activated switch.

6. Wall mounted or pedestal mounted panels shall be so sized as to adequately - dissipate heat generated by equipment mounted in or on the panel.

7. Control panels mounted outside shall be provided with thermostatically controlled heaters that maintain inside temperature above 40 degrees F.

8. Wiring Methods: Wiring methods and materials for all panels shall be in accordance with the NEC requirements for General Purpose (no open wiring) unless otherwise indicated. Control Panels shall be UL508A listed Control Panels.

9. Signal and Control Circuit Wiring: Wire type and sizes: Conductor shall be flexible stranded copper machine tool wire, UL listed Type MTW, and shall be rated 600 volts. Wires, including shielded cables, shall be No. 16 AWG minimum.

   a. Wire Insulation Colors: Ungrounded control circuit conductors operating at the supply voltage shall have a black insulation. Grounded circuit conductors shall have white insulation. Insulation for ungrounded AC control circuit conductors operating at less than the supply voltage shall be red. Wires energized by a voltage source external to the control panel shall have yellow insulation. Insulation for ungrounded DC conductors shall be blue. Insulation for grounded DC conductors shall be white with blue stripe. Twisted pair wiring shall be positive(+) black and negative(-) white/clear.

   b. Wire Marking: Wire numbers shall be marked using white numbered wire markers made from plastic-coated cloth, Brady Type B 500 or equal, or shall be heat shrink plastic.

c. Flexible conduit is not acceptable except when specifically approved by the Engineer in writing. Conduit fittings shall be Crouse Hinds cast fittings or equal.

d. Splicing of wires will only be allowed in junction boxes. Splices shall be either soldered or pressure crimped type.

e. For case grounding, panels shall be provided with a 1/4-inch by 1-inch copper ground bus complete with soderless connector for one No.4 AWG bare stranded copper cable. The copper cable shall be provided by the Contractor and be connected to a system ground loop.

10. Power Supply: Unless otherwise indicated control panel primary power supplies shall be 120 volt, 60 Hz circuits. 24VDC subsystems shall be provided for PLC control panels and as indicated on the drawings.

J. Labor and Workmanship: Panels shall be fabricated, piped, and wired by fully qualified workmen who are properly trained, experienced, and supervised.

K. At a minimum, control panels shall be constructed in a UL shop and contain UL labels prior to shipment.

2.3 UNINTERRUPTIBLE POWER SUPPLY (UPS)

A. Provide and install UPS(s) to power all PLC hardware furnished under this Specification.

B. The UPS shall receive a 120 VAC, 60 HZ power input, and generate a 120 VAC, 60 HZ output signal which is protected from incoming spikes, sags, noise, brownouts, and power outages.

1. The UPS shall incorporate a transformer, a battery pack, a battery charger, an inverter, and a microprocessor based controller to provide continuous, on-line, computer grade uninterruptible power. Lighting and surge protection shall meet ANSI/IEEE c62.41 categories A and B. The UPS shall be U.L. listed. Spike attenuation shall be 2000 to 1. The output neutral shall be bonded to ground. Noise isolation shall be 120 Db common-mode, 60 Db normal mode. Output voltage regulation shall be + 3% with less than 5% total harmonic distortion. UPS efficiency shall be at least 85%. The UPS shall be rated for ambient temperatures from 32 degrees F to 104 degrees F and relative humidity from 0 to 95%

2. Each UPS shall maintain power to all of its connected loads, including non-constant loads such as alarms and printers, for a minimum of 15 minutes with a 50% growth factor over the connected load. The equipment submittal shall include sizing calculations which support the model and size selected. The UPS shall be supplied with a low output voltage cutoff to prevent damage to loads when the battery power is exhausted.

C. The equipment shall include sizing calculation which support the unit selected being able to power all its connected loads for the indicated time period with a 50% growth factor.

D. The uninterruptible power supply shall be Eaton Ferrups UPS series, Liebert, IPM or equal.

PART 3 - EXECUTION

3.1 LISTING AND INSTALLATION

A. Control Panels shall be fabricated in accordance with UL 508A, and shall be UL Listed Industrial Control Panels.

3.2 EQUIPMENT DELIVERY

A. Panels shall be crated for shipment using a heavy framework and skids. Panel sections shall be cushioned to protect the finish of the instruments and panel during shipment. Instruments which are shipped with the panel shall further have suitable shipping stops and cushioning material installed to protect parts which could be damaged due to mechanical shock. Each separate panel unit shall be provided with removable lifting lugs to facilitate handling.

B. Shipments by air ride van unless otherwise indicated. Control panel testing and inspection, if required, shall be performed prior to shipping.

3.3 CONTROL PANEL SIGNAL AND CONTROL CIRCUIT WIRING

A. Wiring Installation: Wires shall be run in plastic wireways except (1) field wiring, (2) wiring between mating blocks in adjacent sections, (3) wiring from components on a swing out panel to components on a part of the fixed structure, and (4) wiring to panel mounted components. Wiring run from components on a swing out panel to other components on a fixed panel shall be made up in tied bundles. These bundles shall be tied with nylon wire ties and shall be secured to panels at both sides of the "hinge loop" so that conductors are not strained at the terminals.

B. Wiring run to control devices on the front panels shall be tied together at short intervals with nylon wire ties and be secured to the inside face of the panel using adhesive mounts.

C. Wiring to rear terminals on panel-mount instruments shall be in plastic wireways secured to horizontal brackets above or below the instruments in about the same plane as the rear of the instruments.

D. Shop Drawings shall show conformance to the above wiring installation requirements.

E. Wire Marking: Each signal, control, alarm, and indicating circuit conductor connected to a given electrical point shall be designated by a single unique number which shall be shown on Shop Drawings. These numbers shall be marked on conductors at every terminal.

3.4 CALIBRATION, TESTING, AND INSTRUCTION

A. Calibration, testing, and instruction shall be performed in accordance with Section 40 79 23 – Testing, Calibration, and Commissioning.

B. Inspection and Approval: Panel fabricator shall conduct the following tests before shipment.

1. Alarm circuits rung out to determine their operability.

2. Electrical circuits checked for continuity and where applicable, operability.

3. Any other test required to place the panel in an operating condition.

C. It shall be the responsibility of the Contractor to furnish all necessary testing devices and sufficient manpower to perform the tests required by the Engineer.

D. Factory Acceptance Testing: PLC control panels shall be factory tested as required by Division 40 specifications.

E. Field Testing: Each control panel shall be tested again for functional operation in the field after the connection of external conductors and prior to equipment startup.

END OF SECTION 40 67 00

SECTION 40 70 00 – INSTRUMENTATION AND CONTROL, GENERAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. General requirements applicable to all Process Control and Instrumentation Work.

2. General requirements for process control and instrumentation submittals.

3. See Section 40 70 00.2 – Instrumentation and Control, System Description for a list of Owner-selected System Integrator (SI) and a complete description of the system.

4. As specified in this Section the Contractor shall provide the following services including, but not limited to:

   a. PLC panelsand panel submittals

   b. Instrumentation required for the successful completion of the project that is not explicitly provided by others. Refer to Sections 40 67 00.A – Panel List and 40 70 00.A – Instrumentation List for description of equipment which is provided by the Contractor

   c. Termination of all control wiring of instrumentation in the field and in control panels.

   d. Loop testing and documentation of all instrumentation loops.

   e. System Integrator (SI) shall be responsible for the following for Plant Main Control Panel (LCP-D1000) and remote control panel (RCP-A1000):

      1) Panel design. Contractor shall be responsible for purchase and install of this panel along with all other panels as listed in the Contract Documents. LCP-D1000 and RCP-A1000 will be procured using the contingency allowance.

      2) HMI software and configuration

      3) PLC software and programming

      4) SCADA system programming

      5) SCADA computer(s) hardware and installation

      6) Assist electrical contractor in performing loop tests.

      7) Control system startup, documentation, and training.

5. It is the intent of these Specifications that the entire instrumentation and control system be complete and operable. Provide all necessary material and labor for the complete system from source of power to final utilization equipment, including all connections, testing, calibration of all equipment furnished by others, as well as equipment furnished by the Contractor.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.

a. Items involving electrical, control, and instrumentation construction may be indicated on the Drawings or specified in the Specifications that do not apply specifically to electrical, control and instrumentation systems.

3. It is the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.

C. Interfaces to equipment, instruments, and other components:

1. The Drawings, Specifications, and overall design are based on preliminary information furnished by various equipment manufacturers, which identify a minimum scope of supply from the manufacturers. This information pertains to, but is not limited to, instruments, control devices, electrical equipment, packaged mechanical systems, and control equipment provided with mechanical systems.

2. Provide all material and labor needed to install the actual equipment furnished, include all costs to add any additional instruments, wiring, control system inputs/outputs, controls, interlocks, electrical hardware etc., which may be necessary to make a complete, functional installation based on the actual equipment furnished:

a. Make all changes necessary to meet the manufacturer's wiring requirements.

3. Submit all such changes and additions to the Engineer for acceptance as specified in Section C-700 – General Conditions.

4. Review the complete set of Drawings and Specifications in order to ensure that all items related to the instrumentation and control systems are completely accounted for. Include any items indicated on the Drawings or in Specifications from another discipline in the scope of Work:

a. If a conflict between Drawings and Specifications is discovered, refer conflict to the Engineer as soon as possible for resolution.

D. All instrumentation, and control equipment and systems for the entire project to comply with the requirements specified in the Instrumentation and Control Specifications, whether referenced in the individual Equipment Specifications or not:

1. The requirements of the Instrumentation and Control Specifications apply to all Instrumentation and Control Work specified in other Specifications, including HVAC controls, packaged mechanical systems, LCPs, VCPs, etc.

2. Inform all vendors supplying instrumentation, control systems, panels, and/or equipment of the requirements of the Instrumentation and Control Specifications.

3. The Owner is not responsible for any additional costs due to the failure of the Contractor to notify all subcontractors and suppliers of the Instrumentation and Control Specifications' requirements.

E. Contract Documents:

1. General:

a. The Drawings and Specifications are complementary and are to be used together in order to fully describe the Work.

2. Specifications:

a. Section C-700 – General Conditions and Section C-800 – Supplementary Conditions of the Contract Documents govern the Work.

b. These requirements are in addition to all General Requirements.

3. Contract Drawings:

a. The Instrumentation and Control Drawings show in a diagrammatic manner, the desired locations, and arrangements of the components of the Instrumentation Work. Follow the Drawings as closely as possible, use professional judgment and coordinate with the other trades to secure the best possible installation, use the entire Drawing set for construction purposes.

b. Locations of equipment, control devices, instruments, boxes, panels, etc. are approximate only, exercise professional judgment in executing the Work to ensure the best possible installation:

1) The equipment locations and dimensions indicated on the Drawings and elevations are approximate. Use the shop drawings to determine the proper layout, foundation, and pad requirements, etc. for final installation. Coordinate with all subcontractors to ensure that all instrumentation and control equipment is compatible with other equipment and space requirements. Make changes required to accommodate differences in equipment dimensions.

2) The Contractor has the freedom to select any of the named manufacturers as identified in the individual Specifications; however, the Engineer has designed the spatial equipment layout based upon a single manufacturer and has not confirmed that every named manufacturer's equipment fits in the allotted space. It is the

Contractor's responsibility to ensure that the equipment being furnished fits within the defined space.

c. Installation details:

1) The Contract Drawings include installation details showing means and methods for installing instrumentation and control equipment. For cases where typical details are not provided or compatible with an installed location, develop installation details that are necessary for completing the Work, and submit these details for review by the Engineer.

d. Schematic diagrams:

1) Schematic diagrams show control function only. Incorporate other necessary functions for proper operation and protection of the system.

2) Add slave relays, where required, to provide all necessary contacts for the control system or where needed to function as interposing relays for control voltage coordination, equipment coordination, or control system voltage drop considerations.

3) Mount all devices shown on motor controller schematic diagrams in the controller compartment enclosure, unless otherwise noted or indicated.

4) Control schematics are to be used as a guide in conjunction with the descriptive operating sequences in the Specifications. Combine all information and furnish a coordinated and fully functional control system.

F. Alternates/Alternatives:

1. Substitute item provisions as specified in Section C-700 – General Conditions.

G. Changes and change orders:

1. As specified in Section C-700 - General Conditions.

1.2 REFERENCES

A. See Section 40 70 00.1 – Instrumentation and Control, References and Definitions

1.3 SYSTEM DESCRIPTION

A. See Section 40 70 00.2 – Instrumentation and Control, System Description

1.4 SUBMITTALS

A. Furnish submittals as specified in Section 01 33 00 – Submittal Procedures and this Section.

1. Furnish the submittals required by each section in the Electrical Specifications.

2. Adhere to the wiring numbering scheme specified in Division 26 throughout the Project:

    a. Uniquely number each wire.

    b. Wire numbers must appear on all Equipment Drawings.

3. Use equipment and instrument tags, as indicated on the Drawings, for all submittals.

B. Submittal organization as specified in Section 01 33 00 – Submittal Procedures and this Section

C. Submittal requirements as specified in Section 01 33 00 – Submittal Procedures and this Section:

1. Furnish submittals including:

    a. Project Shop Drawing submittals.

    b. The Process Control and SCADA Software Submittal including control system software, programming, and screens.

    c. Testing, Calibration and Start-up procedures.

    d. O&M Manual as specified in Section 01 78 23 – Operation and Maintenance Data.

    e. Training Submittals.

    f. Record Documents.

    g. Testing Documents

D. Submittal preparation as specified in Section 01 33 00 – Submittal Procedures and this Section:

E. Specific submittal requirements:

1. Control panel hardware submittal in 1 package

    a. Project Shop Drawing submittals.

        1) Control panel hardware submittal in 1 package with complete and detailed bills of materials:

            a) Including quantity, description, manufacturer, and part number for each assembly or component for each control panel.

            b) Include all items within an enclosure.

        2) Furnish sufficient information to evaluate the suitability of the proposed material or equipment for the intended use, and for compliance with these Specifications.

3) Use equipment and instrument tags as depicted on the P&IDs for all submittals.

4) Adhere to wiring identification scheme outlined in Specification 26 05 00 – Electrical, General throughout the Project.

5) Wire numbers must appear on all equipment drawings.

b. Requirements for physical separation between control system components and 120 VAC, 480 VAC, and medium voltage power cables.

c. UPS and battery load calculations to show that the backup capacity and time meet the specified requirements.

d. Provide a data sheet for each control system component together with a technical product brochure or bulletin.

2. O&M Manual

a. Spare parts list:

b. Control and SCADA System Software Record Documents:

1) Include electronic copies of all software and applications.

2) Navigation tree and screen shots of all SCADA screens with basic narrative.

3) Navigation tree and screen shots of all OIT screens with basic narrative

c. Instrument data sheets and cut sheets:

d. Training Submittals.

e. Record Documents.

3. Training submittals:

a. Develop and submit for review a general training plan. Include complete descriptions of all planned training classes, a preliminary training schedule, a list of all proposed instructors along with resumes, examples of proposed training manuals, and a description of any special training tools to be used (simulators, self-paced modules, personal computer-based training, etc.).

b. The Engineer will review the general training plan. Special emphasis will be placed on review of the qualifications of the proposed instructors and the timing of the individual courses to maximize their effectiveness. If, in the opinion of the Engineer, the proposed instructors are not sufficiently qualified to conduct the specified training courses, or lack experience, where required, on the specific configuration of the system, provide more qualified instructors.

4. Record documents:

   a. Furnish as specified in Section 01 77 00 – Closeout Procedures.

   b. Provide record documents of all Instrumentation Drawings.

   c. Shop drawings:

   d. Review and corrections:

      1) Correct any record documents or other documents found to be incomplete, not accurate, of poor quality, or containing errors.

   e. Control Panel Drawings

   f. Control System Diagram:

      1) Submit a complete set of control system diagrams including the following information:

         a) All PLCs, workstations, printers, communication devices, and communication links:

         2) All cables required for communication requirements.

5. Testing, Calibration, and Start-up Submittal:

   a. General testing submittal requirements are specified in this Section and other Sections.

   b. Test Procedure Submittals:

      1) Submit the proposed procedures to be followed during tests of the PCIS and its components in two parts:

         a) Preliminary Submittal: Outline of the specific proposed tests and examples of proposed forms and checklists.

         b) Detailed Submittal: After successful review of the Preliminary Submittal, submit the proposed detailed test procedures, forms, and checklists. Include a statement of test objectives with the test procedures.

   c. Provide certified and witnessed test and calibration checklists for any of the following tests:

      1) Calibration, adjustment, and test details for all components and systems.

      2) Factory Acceptance Tests (FAT).

      3) Site Acceptance Test (SAT)

      4) Operational Readiness Test (ORT).

d. Test reports:

1) As specified in Section 01 33 00 – Submittal Procedures.

1.2 QUALITY ASSURANCE

A. Manufacture instruments at facilities certified to the quality standards of ISO 9001.

B. Furnish all equipment listed by and bearing the label of UL or of an independent testing laboratory acceptable to the Engineer and the Authority Having Jurisdiction.

C. The panel provider must have their own operating UL listed panel fabrication facility. All panels must be fabricated at this facility and meet all UL 508/508A requirements.

D. System Integration:

1. The Contractor, through the use of a pre-qualified SI, is responsible for the implementation of the PCIS and the integration of the PCIS with other required instrumentation and control devices.

2. The contractor assumes full responsibility, working with the SI where applicable, to perform all work to select, furnish, install, test, calibrate, and place into operation all instrumentation, controls, telemetry equipment, control panels, and SCADA system including application software, for a complete, integrated and functional PCIS system.

3. Due to the complexities associated with the interfacing of numerous control system devices, it is the intent of these Specifications that the SI be responsible for the integration of the PCIS with existing devices and devices provided under the Contract Documents with the objective of providing a completely integrated control system.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Store all equipment and materials delivered to the job site in a location that will not interfere with the construction or the Owner’s operations.

B. Shipping precautions:

1. After completion of shop assembly, successful FAT, pack all equipment, cabinets, panels, and consoles in protective crates and enclose in heavy-duty polyethylene envelopes or secured sheeting to provide complete protection from damage, dust, and moisture.

2. Place dehumidifiers when required, inside the polyethylene coverings.

3. Skid-mount the equipment for final transport.

4. Provide lifting rings for moving without removing protective covering.

5. Display boxed weight on shipping tags together with instructions for unloading, transporting, storing, and handling at the job site.

C. Tagging:

1. Tag each component and/or instrument to identify its location, instrument tag number, and function in the system.

2. Firmly attach a permanent tag indelibly machine marked with the instrument tag number, as given in the tabulation, on each piece of equipment constituting the PCIS.

3. Tag instruments immediately upon receipt in the field.

4. Prominently display identification on the outside of the package.

5. Utilize the Tag and Loop Number identifications shown on the P&IDs.

D. Delivery and inspection:

1. Deliver products in undamaged condition, in manufacturer's original container or packaging with identifying labels intact and legible. Include date of manufacture on label.

1.4 PROJECT OR SITE CONDITIONS

A. Site conditions:

1. Provide a PCIS, including all equipment, raceways and any other components required for a complete installation that meets the environmental conditions for the Site as specified in the General Requirements and below.

1.5 SEQUENCING

A. General:

1. As specified in Section 01 31 19 – Project Meetings and Section 01 35 13 – Special Project Procedures.

2. Testing requirements are specified in Section 40 70 00 – Instrumentation and Control, and other sections.

3. General scheduling requirements are specified in Section 01 32 16 – Construction Progress Schedule.

4. Other scheduling activities to be determined between the Owner, contractor, engineer and SI

B. Training:

1. As specified in this Section.

2. Complete all training as agreed upon with the Owner, contractor, engineer and SI.

3. Within 10 days after the completion of training, submit the following:

a. A list of all Owner personnel that attended the session.

b. A copy of the training materials utilized during the lesson with all notes, diagrams, and comments.

C. Site Acceptance Test (SAT) or Pre-commissioning test:

1. Commence after acceptance of all training, wire test, calibration tests, and loop validation tests, and all inspections have demonstrated that the PCIS complies with all Contract requirements.

2. The Programmer will assist with SAT testing for PLCs programmed by the Programmer.

3. The Programmer shall not be required to be on site, nor shall the Programmer be required to supply application software, until the loop validation tests are complete for a PLC and all prerequisites for the pre-commissioning test are completed.

4. Complete SAT test before the ORT.

D. Operational Readiness Test (ORT)

1. Complete all with the Owner, contractor, engineer and SI.

2. Confirmation by the Owner, contractor and engineer that the PCIS functions correctly and as designed.

E. Substantial completion testing: The following conditions be fulfilled before the PCIS is considered complete:

1. All submittals have been completed and approved.

2. The Owner training has been performed.

3. All required spare parts, expendable supplies, and test equipment have been delivered to the Owner.

4. The PCIS has been calibrated, loop tested and pre-commissioned.

5. The ORT has been successfully completed.

6. All debris associated with installation of instrumentation has been removed.

7. All probes, elements, sample lines, transmitters, tubing, and enclosures have been cleaned and are in like-new condition.

1.6 WARRANTY

A. Warrant the PCIS as specified in Section C-700– Standard General Conditions of the Construction Contract:

1. Provide additional warranty as specified in the individual Instrumentation and Control Specifications.

1.7 SYSTEM START-UP

A. Replace or modify equipment, software, and materials that do not achieve design requirements after installation in order to attain compliance with the design requirements:

1. Following replacement or modification, retest the system and perform additional testing to place the complete system in satisfactory operation and obtain compliance acceptance from the Engineer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Provide similar items from a single manufacturer throughout the PCIS portion of the Project.

B. Allowable manufacturers are specified in individual instrument and equipment specifications in other sections of the Instrumentation and Control Specifications.

2.2 MATERIALS

A. Furnish all materials under this Contract that are new, free from defects, and standard products produced by manufacturers regularly engaged in the production of these devices and that bear all approvals and labels as required by the Specifications.

B. Provide materials complying with the applicable industrial standard as specified in the Contract Documents.

2.3 SOURCE QUALITY CONTROL

A. Provide all equipment that is new, free from defects, and standard products produced by manufacturers regularly engaged in the production of these products that bear all approvals and labels as required by the Specifications.

B. Arrange with all manufacturers of the equipment and fabricators of panels and cabinets, to allow the Owner and Engineer to inspect and witness the testing of the equipment at the site of fabrication:

1. Equipment includes the cabinets, special control systems, flow measuring devices, and other pertinent systems and devices.

C. Factory testing is specified in Division 26 and other sections of the Electrical, and the Instrumentation and Control Specifications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Review the existing Site conditions and examine all shop drawings for the various items of equipment in order to determine exact routing and final terminations for all wiring and cables.

B. Provide a complete instrumentation and control system:

1. Install all extra conduits, cables, and interfaces as may be necessary to provide a complete and operating electrical, and process control and instrumentation system.

3.2 FIELD QUALITY CONTROL

A. Inspection:

1. Allow for inspection of PCIS installation.

2. Provide any assistance necessary to support inspection activities.

3. Engineer inspections may include, but are not limited to, the following:

a. Inspect equipment and materials for physical damage.

b. Inspect installation for compliance with Drawings and Specifications.

c. Inspect installation for obstructions and adequate clearances around equipment.

d. Inspect equipment installation for proper leveling, alignment, anchorage, and assembly.

e. Inspect equipment nameplate data to verify compliance with design requirements.

f. Inspect cable terminations.

g. Inspect/witness instrument calibrations/verifications.

4. Inspection activities conducted during construction do not satisfy inspection requirements specified in Division 26.

B. Instrument Installation Inspection:

1. Provide any assistance necessary to support inspection activities.

2. Inspections may include, but are not limited to, the following:

a. Inspect equipment and materials for physical damage.

b. Inspect the installed arrangement, lay lengths, orientation, piping obstructions etc. that could affect the instruments accuracy or repeatability.

c. Inspect installation for compliance with Drawings and Specifications.

d. Inspect installation for obstructions and adequate clearances around equipment.

e. Inspect equipment installation for proper leveling, alignment, anchorage, and assembly.

f. Inspect equipment nameplate data to verify compliance with design requirements.

g. Inspect cable terminations.

h. Inspect/witness instrument calibrations/verifications.

3. Inspection activities conducted during construction do not satisfy inspection requirements specified in Division 26.

C. Field testing is specified in Division 26 and Section 01 75 00 – Equipment Testing and Startup Procedures.

D. Installation supervision:

1. Ensure that the entire PCIS is installed in a proper and satisfactory manner. At a minimum, the contractor with assistance of the SI where applicable, shall provide the following services:

a. Installation resources:

1) Coordinate with the Contractor regarding installation requirements of the Contract Documents.

b. Provide technical assistance to installation personnel by telephone:

1) Furnish installation personnel with at least one copy of the approved submittals, including all installation details.

c. Periodic inspections during the construction period.

d. A complete check of the completed installation to ensure that it is in conformance with the requirements of the equipment manufacturer and the Contract Documents.

e. Field-verify accuracy and calibration of all instruments.

3.3 CLEANING

A. As specified in Section 01 77 00 – Closeout Procedures.

3.4 PROTECTION

A. Protect all Work from damage or degradation until date of Substantial Completion.

END OF SECTION 40 70 00

SECTION 40 70 13 - IN-LINE LIQUID FLOW MEASURING SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide in-line liquid flow measuring systems, complete and operable, in accordance with the Contract Documents. The transmitter portion of the system shall be remotely mounted as shown on Contract Drawings.

1.2 REFERENCE STANDARDS

A. Commercial Standards:

1.	ISA – S 5.1	Instrumentation Symbols and Identification
2.	ANSI – B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800
3.	ANSI/AWWA C207	Steel Pipe Flanges for Waterworks Service – Sized 4-inch through 144-inch
4.	ANSI/AWWA C700	Cold Water Meters
5.	ASME Report	Fluid Meters, Sixth Edition, 1971

1.3 SUBMITTALS

A. Shop Drawings: At a minimum, the following information shall be submitted with each meter supplied:

1. Data sheets and catalog literature for the flow meter and the microprocessor-based signal converter.
2. Connection diagrams for equipment wiring.
3. Materials of construction and connection fittings.
4. Recommended spare parts list.

B. Test Data: Signed, dated, and certified calibration data for each flow metering system which requires factory testing, submitted before shipment of equipment.

C. Certifications: The Contractor shall provide Manufacturer's certification of proper installation and certification of satisfactory field testing.

D. Owner’s Manual: Submit Owner’s manual as specified in Special Provisions, to include operation and maintenance data and other information for the equipment.

1.4 QUALITY ASSURANCE

A. Each flow metering system shall be hydraulically calibrated at a facility which is traceable to the National Institute of Standards and Technologies. The calibration procedure shall conform to the requirements of ANSI/NCSL Z 540-1 Calibration. A real-time computer-generated printout of the actual calibration data shall be submitted to the Engineer at least 30 days prior to shipment to the site.

B. Accuracy Requirements: Unless otherwise indicated, flow meters shall be guaranteed to register flow to an accuracy of plus and minus 0.3% of actual flow throughout the range indicated.

C. Guarantees, Warranties: After completion the Contractor shall furnish to the Owner the manufacturer’s written guarantee that the metering system swill operate within the published accuracies and flow ranges and meet these specifications. The Contractor shall also furnish the manufacturer’s warranties as published in its literature.

PART 2 - PRODUCTS

2.1 GENERAL

A. All meters shall be capable of operating at an minimum ambient temperature ranging from -4 to 140 degrees F.

B. All meters shall be rated for NFPA hazardous areas, see Drawings for further information.

C. The Contractor shall be responsible for confirming necessary cable length with meter manufacturer prior to ordering any meter equipment.

2.2 ELECTROMAGNETIC (MAG) FLOW METERS

A. The electromagnetic flowmeter shall consist of a flow sensor based on Faraday’s Law of Electromagnetic Induction, the flow of liquid through the sensor induces an electrical voltage that is proportional to the velocity of the flow.

B. Electromagnetic flowmeter systems shall be the low frequency electromagnetic induction type which produces a DC pulsed signal directly proportional to and linear with the liquid flow rate. Complete zero stability shall be an inherent characteristic of the flowmeter system. Each magnetic flow metering system shall include a metering tube, signal cable, transmitter, and flowmeter grounding rings.

C. Meter Tube: The tube shall be constructed of 304 or 316 stainless steel tube with ductile iron flanged or Carbon Steel connections and include a minimum of two (2) self-cleaning electrodes. The electrodes shall be constructed of materials conforming to the manufacturer's recommendation for the intended service. The meter housing shall be IP67 or IP68, rated for a submergence depth of 3 meters for a duration of 48 hours. Grounding rings shall conform to the manufacturer's bore and material recommendation for the intended service. Grounding rings shall be designed to protect and shield the liner's edge interface from abrasion at the meter end.

D. Performance Requirements: The flow metering system shall conform to the following:

No.	Item	Units	Value
1	Time Constant	Secs	0.5 – 1,000
2	Accuracy	%	0.5 of Full Flow
3	Repeatability	%	0.25 full scale
4	Power Consumption	watts	50 or less
5	Power Requirements	VAC	120

E. Transmitter: The microprocessor-based signal converter/transmitter shall be remote mounted outdoors on disconnect support structure and shall have the following:

1. Transmitter shall be suitable for installation outdoors, subject to direct sunlight and full temperature range at installed location. Transmitter housing to be NEMA 4X, with min. IP65 ingress protection. Provide with sun shield and/or other accessories as recommended by manufacturer.

2. DC pulse technique to drive flux-producing coils and capability to convert DC pulse signal from the tube to a standardized flow VDC pulse contact and a 4-20 mA DC signal into a minimum of 700 ohms.

3. Communication using Ethernet/IP prootocol

4. Six digit LCD displays for flow rate, percent of span, and totalization. An operator interface with keypad which responds to English text entry.

5. Integral low flow cutoff and zero return to produce a consistent zero output signal in response to an external dry contact closure.

6. Automatic range change and capability to measure flow in both directions.

7. Programmable parameters including meter size, full scale Q, magnetic field frequency, primary constant, time constant.

8. Data retention for minimum of five (5) years without auxiliary power (main or battery).

9. Self diagnostics and automatic data checking.

10. Protected terminals and fuses in a separate compartment which isolates field connection from electronics.

F. Manufacturers, or equal

1. Krohne

2. Siemens

3. Endress+Hauser

4. Badger Meter

2.3 WATER METERS

A. Water meters shall be magnetic drive turbine type meters manufactured in accordance with AWWA C701 and requirements as noted herein.

B. Strainers, stainless steel mounting bolts, and flange gaskets shall be furnished with each meter. The casing of the strainer shall be provided with a removable top plate with stainless steel fasteners. Meters shall be designed for easy removal of internal parts, the strainer, and the meter.

C. Materials: Components in contact with potable water shall be certified to comply with NSF/ANSI 61, NSF/ANSI 61 Annex G, and NSF/ANSI 372. Turbine spindles shall be stainless steel or Monel. External fasteners shall be stainless steel. The internal parts of the strainer shall be stainless steel.

D. Each meter shall be furnished with a transmitter to provide 4-20mA signal proportional to the flow. Meter-mounted indicators, totalizers, and transmitters, or any combination thereof, shall be of the same manufacturer as the meters.

E. Manufacturers, or equal

1. Badger Meter, Inc.

2. Neptune Technology Group

3. Sensus

2.4 TARGET TYPE FLOW SWITCHES

A. Target-type flow switches shall utilize a vane or paddle type target to actuate the switch.

1. For pipe sizes greater than or equal to 2 inch [50 mm], switches shall have an NPT connection for insertion into the process piping.

2. For pipe sizes less than 2 inches, the flow switch shall be factory installed in a spool piece, suitable for flange or thread mounting in the process piping.

3. Switch wetted components shall be compatible with the process fluid.

4. Switches shall contain at least one non-mercury SPDT contact, rated 5 amp [A] at 120 volts ac.

5. The switch enclosure shall be a minimum NEMA Type 4 housing.

6. Switches shall be factory calibrated to actuate at the specified flow rates for the given pipe size.

7. All flow switches shall be installed in horizontal piping.

B. Manufacturers, or equal.

1. Magnetrol

2.5 ROTAMETERS

A. The meters shall be suitable for the service and chemicals conveyed at process temperatures.

B. Basic Design: Unless otherwise indicated, all rotameters in chemical solution lines and where shown shall have vertical bottom inlets and top outlets with ANSI 150-lb flanged ends, for vertical mounting. Meters in gas, air, and pump seal flushing lines shall be of the modified rotameter design with screwed ends, spring-loaded pistons, and union bodies for mounting in any position. All meters shall be rated for a minimum working pressure of 150 psi.

C. Flanged Meters for Chemical Solutions: Flanged rotameters for chemical solutions and other service, where indicated, shall be calibrated in gallons per minute, pounds per 24 hours (for chlorine gas), or cubic feet per minute for other gases and air. The meters shall have Hastelloy C floats, 10-inch long scales, and a range of 10:1 with an accuracy of plus and minus 2 percent. The scales shall be suitable for the capacity ranges noted. The following body materials shCil1 be used for the rotameters:

1. Chlorine Service - cast iron ends, Teflon-lined, or PVC ends, with heavy borosilicate glass tubes and packing glands.

D. Screwed Meters for Water, Air, and Fuel Gas: Rotameters with NPT screwed ends for water, air, and fuel gas service shall be calibrated in gallons per minute or cubic feet per minute. The bodies shall have union ends for ease of maintenance, polysulphone tubes, aluminum or brass end fittings, Type 316 stainless steel internal parts and scales suitable for the capacity range noted. The meters shall have an accuracy of not less than plus and minus 5 percent over the capacity range.

E. Manufacturers, or Equal

1. Chlorine Service - Brooks No. 1180, or Pennwalt "Varea-Meter”

2. Water, Air and Gas Meters - Headland "In-Line Meters", or Universal Flow Monitors, Inc. "INSITE" meters.

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall assemble and install all equipment specified herein, in strict accordance with the manufacturer's published instructions, under the supervision of the manufacturer's representative, under the general review of the Engineer. All installations shall be accomplished by competent craftsmen in a workmanlike manner.

B. Final acceptance of the equipment is contingent on satisfactory operation after installation.

3.2 INSTALLATION

A. The meters shall be installed in easily accessible locations for ease of reading and maintenance, and where shown, for balancing of flow in several lines, in conjunction with throttling and shut-off valves. Where possible, all meters shall be installed in such a way to provide the manufacturer's recommended straight approach and straight piping downstream. All meters, shut-off and balancing valves shall be firmly supported from the structure or from the floor with approved supports. In-line meters shall be installed to provide full-line flow and not less than the manufacturer's recommended head at all items.

B. Wiring between flow sensors and remote mounted signal converters shall use cable type and procedures as per the manufacturer's recommendations. Provide sufficient cable from meter vault to location where local display will be located. Confirm cable lengths prior to submitting shop drawings.

3.3 TESTING

A. Equipment shall be prepared for operational use in accordance with manufacturer's instructions, including bench test and calibration, where required.

B. Each item shall be subjected to an operating test over the total range of capability of the equipment. Where applicable, tests shall be conducted in accordance with the Test Code of the Standards of the Hydraulic Institute. The Contractor shall notify the Engineer one week in advance of all tests to be conducted on site.

3.4 CLEANUP

A. After completion and testing of its work, the Contractor shall remove all debris from the site, clean all meters, controls, cabinets, and other metering appurtenances, to hand over each system in perfect operating condition.

3.5 MANUFACTURERS SERVICE REPRESENTATIVE

A. Erection and Startup Assistance: During erection and startup of the magnetic flow meters, the Contractor shall obtain all necessary assistance from an experienced factory service representative to ensure a correct and first-class installation, in accordance with the manufacturer's instructions.

B. Instruction of Owner's Personnel: After completion of the installation and during startup of the plant, the Contractor shall instruct the Owner's personnel in the proper operation, maintenance and repair of all metering equipment. For this purpose, the Contractor shall obtain the services of an experienced factory service representative, who shall half a day on the site to fully instruct the Owner's operating personnel on all phases of its equipment. The Contractor shall video tape the training session and provide a DVD of the training to the Owner.

END OF SECTION 40 70 13

SECTION 40 72 00 - LEVEL MEASURING SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide level sensing equipment, complete and operable, in accordance with the Contract Documents.

1.2 SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 Submittals.

1.3 QUALITY ASSURANCE

A. Calibration: All level sensing equipment shall be shipped to the project site factory calibrated and accompanied with certificate of such.

B. Warranty: All sensors shall be provided with the manufacturer’s standard one-year product warranty.

PART 2 - PRODUCTS

2.1 SUBMERSIBLE PRESSURE SENSOR

A. Submersible pressure sensors shall consist of a transducer, transmitter/receiver, and control relays. The pressure sensing unit shall consist of a top half of a 316 stainless steel seal with a welded 316 stainless steel diaphragm. The liquid level shall be obtained by converting pressure sensed across a diaphragm-protected transducer element. A microprocessor shall amplify and convert the signal into a digital representation from pressure to a liquid level surface reading. An output is produced when manually determined trip values are exceeded. The microprocessor-based electronics shall enable user selection of range, span, setpoints, time delay, units of distance, and selectable failsafe mode. Relay setpoints shall be adjustable over the entire span without the use of reference targets. Automatic temperature compensation circuitry shall be incorporated.

1. Diaphragm: The diaphragm shall be glycerin-filled and be welded 316 stainless steel with a 0.13 cubic inch displacement.

2. Material: All wetted parts, including standoff ring, spacers, nuts and bolts shall be of 316 Stainless steel. The body shall be made of 300 stainless steel and shall be explosion-proof design. Cable shall be polyurethane-jacketed, and 40-ft shall be provided as standard.

3. Signal Output: A 4-20 MADC using 2-wire twisted pair grounded shield cable. FM and CSA explosion-proof and intrinsically safe with a response time less than 5 ms.

4. Accuracy: the pressure sensing transducer shall have a static accuracy of 0.25% FSO BFSL and a 1-year stability accuracy of 0.20% FSO.

5. Remote mounted units shall be provided with a connecting cable provided by the manufacturer of the switches. Input power shall be 120 VAC.

6. Switches shall be SPBT with a minimum rating of 10 Amps at 120 V AC.

7. Repeatability shall be 0.1-inch or less with a response time of less than one second and an accuracy of plus or minus 0.25 percent of full scale.

B. Manufacturers, or equal

1. Blue Ribbon, Model BR313S

2. WIKA, LS-10 LevelGuard

3. Hach FL1500 Flow Sensor and Controller

4. Equal must be approved during bidding process.

2.2 NON-INTRUSIVE ULTRASONIC LEVEL SENSORS

A. Non-intrusive ultrasonic level sensors shall consist of a transducer, transmitter/receiver, and control relays. The sonic level switch transmitter shall generate pulses that are directed to the liquid level. The returning echo/signal shall be detected by the receiver. A microprocessor shall amplify and convert the signal into a digital representation of the distance from the reflecting surface. An output is produced when manually determined trip values are exceeded. The microprocessor-based electronics shall enable user selection of range, span, setpoints, time delay, units of distance, and selectable failsafe mode. Relay setpoints shall be adjustable over the entire span without the use of reference targets. Automatic temperature compensation circuitry shall be incorporated.

1. The transducer housing shall be PVC with corrosion resistant sensor element.

2. Remote mounted units shall be provided with a connecting cable provided by the manufacturer of the switches. Input power shall be 120 V AC.

3. Switches shall be SPBT with a minimum rating of 10 Amps at 120 V AC.

4. Repeatability shall be 0.1-inch or less with a response time of less than one second and an accuracy of plus or minus 0.25 percent of full scale.

B. Manufacturer, or equal

1. SIEMENS HydroRanger 200

2. Equal must be approved during bidding process.

2.3 RADAR LEVEL SENSORS

A. The instrument shall be supplied with flanged/NPT process connections per Design Documentation in accordance with ANSI B16.5.

B. The probe shall be constructed of material compatible with process medium in either 316L stainless steel, Hastelloy, PTFE, or ceramic.

C. The instrument shall be capable of handling process pressures between -14.5 psi to 580 psi.

D. The instrument shall have a maximum error of ± 2 mm on measuring ranges less than 49 feet.

E. The instrument shall not be affected by changing media, changing temperatures, gas blankets or vapors.

F. Available Manufacturers: Subject to compliance with requirements, Manufacturers offering non contacting radar level sensors which may be incorporated include the following:

1. Endress + Hauser

    a. Micropilot FMR51

    b. Micropilot FMR52

2. Emerson

    a. Rosemount 5408

3. Or approved equal.

2.4 FLOAT SWITCHES

A. Float type level switches shall be mercury-free self counter-weighted, SPDT.

B. Float type level switches shall be intrinsically safe with a zener barrier between the switch contacts and the power source.

C. Cable hangers shall be constructed of material compatible with process medium in either stainless steel, PVC, or ABS.

D. Float type level switches shall be supplied with adequate cable length to reach the barrier location without splicing the cable.

E. Available Manufacturers: Subject to compliance with requirements, Manufacturers offering float type level switches which may be incorporated include the following:

1. Endress + Hauser
    a. Liquifloat FTS20
2. SJE Rhombus
3. Dwyer
    a. Series FSW2
4. Or approved equal.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

A. Store all instruments in a dedicated structure with space conditioning to meet the recommended storage requirements provided by the Manufacturer.

B. Any instruments that are not stored in strict conformance with the Manufacturer's recommendation shall be replaced.

3.2 TESTING

A. Each device shall be prepared for operational use in accordance with manufacturer's instructions, including bench test and calibration, where required.

B. Each device shall be subjected to an operating test over the total measurement range of the instrument.

C. The Contractor shall provide documented evidence of pressure testing following installation.

D. Isolate and protect instruments where in-situ testing is outside of instrument allowable range which may cause damage to the device.

3.3 CLEANUP

A. After completion of installation and testing of device operation, the Contractor shall remove all debris from the site, clean all meters, cabinets, and appurtenance. The Contractor shall submit each system to the Owner in final operating condition.

B. Provide to Owner all associated documentation including manuals, completed data sheets, configuration settings, certificates of calibration, etc.

END OF SECTION 40 72 00

SECTION 40 74 00 - TEMPERATURE MEASURING SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. General: The Contractor shall provide temperature-measuring systems, complete and operable, in accordance with the Contract Documents.

1.2 SUBMITTALS

A. The Contractor shall submit manufacturer's information for Engineer review in accordance with Section 01 33 00 – Submittal Procedures.

1.3 QUALITY ASSURANCE

A. Warranty: All temperature measuring systems shall be provided with manufacturer's standard one-year product warranty.

PART 2 - PRODUCTS

2.1 TEMPERATURE MEASURING SYSTEMS

A. Insertion type resistance temperature detectors (RTDs) shall be 100 ohms nominal at 0 degree C, tip-sensitive, 3 wire platinum in 1/4-inch Type 316 stainless steel sheath with watertight potting. Time constant in agitated water shall not exceed 6.0 seconds. RTD shall comply with International Practical Temperature Scale (IPTS) 68 standards. Accuracy shall be plus or minus 0.1 degree C. Temperature transmitters shall be 2 wire devices with continuously adjustable span and zero adjustments, integral direct reading indicator, solid state circuitry, and a 4 - 20 mA DC output linearly proportional to the indicated temperature span. Where indicated with thermowells, RTDs shall be provided with 316 stainless steel thermowell, spring-loading device, extensions, union coupler, and explosion-proof aluminum connection head. Union shall extend out beyond the pipe lagging. Surface type RTDs shall be a 100 ohm nominal at 0 degree C, 3 wire platinum element in a flexible watertight case for strapping to a pipe surface.

B. Temperature transmitters shall be 2 wire devices with continuously adjustable span and zero adjustments, integral direct reading indicator, solid state circuitry, and a 4 - 20 mA DC output linearly proportional to the indicated temperature span.

C. Where indicated with thermowells, RTDs shall be provided with 316 stainless steel thermowell, spring-loading device, extensions, union coupler, and explosion-proof aluminum connection head. Union shall extend out beyond the pipe lagging.

D. Surface type RTDs shall be a 100 ohm nominal at 0 degree C, 3 wire platinum element in a flexible watertight case for strapping to a pipe surface.

E. Resistance temperature detector assemblies shall be Rosemount Series 78, Moore Industries Ready to Install, or equal. Transmitter shall be Rosemount Model 3144/644, Moore Industries Ready to Install RTI2, or equal.

F. Resistance temperature for room detection shall be Versis Industries TE Series wall temperature sensor or equal.

2.2 BIMETALLIC TEMPERATURE DETECTION SWITCHES

A. Temperature switches shall be bimetallic type with 3/4-inch NPT thermowell process connection per applicable piping code. Switches shall have SPOT -contacts and be provided with an adjustable setpoint.

B. Bimetallic temperature detection switches shall be Mercoid Series FM-437 (water and oil service), Honeywell, or equal.

END OF SECTION – 40 74 00

SECTION 40 79 23 – TESTING, CALIBRATION, AND COMMISSIONING

PART 1 - GENERAL

1.1 GENERAL PROCEDURES FOR INSPECTION, TEST, AND INSTRUMENT CALIBRATION

A. Each instrument shall be checked against the latest version of the design documents for tagging, manufacturer, model number, range, action, etc., before functional testing or calibration.

B. Any air system, permanent or temporary, used for energizing instrumentation shall be dry and clean at all times, and be blown down thoroughly before use. Any connection between the air supply system shall be via proper filter and regulator.

C. Plastic sealing plugs shall be used for all pneumatic connections and tubing except during test and immediately before final connection in the field.

D. Care shall be observed when connecting electric power supplies to the instrumentation. Insure correct voltage and frequency on AC power supplies. Insure correct voltage, polarity, and superimposed ripple on DC power supplies. Insure correct polarity of the supply and proper grounding before connecting instruments.

E. The Instrumentation and Control Systems Contractor shall satisfy the requirement that the installation, calibration, and checkout of the instruments meet the requirements of the project specifications.

F. The Calibration procedures for verifying instrument precision should conform to accepted practices as outlined in ASTM, ASHRAE, ISA, etc. specifications.

G. The Instrumentation and Control Systems Contractor shall provide copies of manufacturer’s installation and calibration instructions to the calibration technicians prior to the commencement of calibration.

1.2 INSTRUMENT QUALITY LEVELS AND METEROLOGY

A. Instrumentation supplied for the calibrating sensing instruments for facility control system shall include documentation concerning the calibration method and traceability to the National Institute for Standards and Testing (NIST).

B. Process instrumentation shall be field checked for accuracy before installation even if the instruments have been calibrated by the manufacturer’s metrology facilities.

PART 2 - PRODUCTS

2.1 CALIBRATION AND TEST EQUIPMENT

A. All calibration and test equipment shall be in proper working order and calibrated using traceable standards and equipment set by the NIST. Certificates of traceability shall be kept on file in the field calibration office or field project office. Copies of the traceability documents shall be included with the submittal of the calibration forms.

B. All calibration and test equipment shall carry a documented current calibration sticker reflecting the date of the last calibration and the name or initials of the technician who performed the calibration. A current calibration will be performed before the equipment is shipped to the site. The calibration equipment shall be shipped directly from the calibrating authority to the site, in packaging provided by the calibrating authority. A current calibration will be performed for all calibration or test equipment every 180 days or within the normal calibration interval, whichever is less.

C. Any field instruments calibrated with test equipment whose calibration has expired will be rejected and will be required to be recalibrated.

D. All Calibration and test equipment shall be of a higher accuracy than the instrument being calibrated. The manufacturer's recommendations for calibration accuracy will prevail in all instances.

E. The Control Systems Contractor shall supply calibration and test equipment of sufficient quantity, quality, and type to calibrate the instruments and sensors used in the installation.

2.2 BENCH TEST AND CALIBRATION FORMS AND METHODOLOGY

A. Calibration forms and calibration procedures for each instrument type shall be generated by the Instrumentation and Control Systems Contractor and approved by the Owner or his representative before proceeding with any calibrations. The manufacturer's procedures or the Owner's existing procedures shall form the basis for the calibration procedure.

B. The following format shall be used for instrument calibration form:

1. A separate calibration form shall be generated for similar types of instruments that have different accuracy and tolerance requirements.

2. The form shall contain as found and as calibrated data areas. The form shall contain areas for the calibrating and test instruments manufacture, serial number, and date of calibration.

3. The forms shall be filled out and signed in black ink.

4. Those instruments that can shall be calibrated on the bench under controlled conditions. Care shall be taken with those instruments that must be calibrated in the field to approximate the conditions of the bench test.

PART 3 - EXECUTION

3.1 GENERAL

A. The Control Systems Contractor shall calibrate all instrumentation in an environment suitable to quality testing procedures. High accuracy comparative instruments or mechanisms shall be the standard against which instrument calibration is tested.

B. Verify that all process and test instruments have been calibrated and traceable to the NIST or other appropriate reference standards. Verify that a calibration sticker has been affixed to the instrument and that each instrument is within its calibration period at the time that the calibration is performed.

C. Each instrument shall be calibrated as per Owner approved calibration procedures and forms.

D. Each instrument shall have a calibration sheet completely filled out with all pertinent data related to the calibration and system. These calibration sheets shall be organized in a binder by system and turned over to the Owner at the completion of the project.

E. Instruments shall have a calibration sticker placed on the instrument. The sticker shall not be placed until the instrument has successfully completed the calibration procedure and the associated calibration form has been filled out and signed. The sticker shall bear the date of calibration and expiration and initials of the technician certifying calibration.

END OF SECTION 40 79 23

SECTION 41 12 13.36 - SCREW (SHAFTLESS) BULK MATERIAL CONVEYORS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Work includes a horizontal shaftless screw conveyor for handling dewatered, Waste Activated Sludge from the volute press. Contractor shall furnish and install one (1) complete conveyor system for conveyance of dewatered sludge, including conveyor, drive motor, gear reducer, supports, anchor bolts, wiring, and all accessories and appurtenances specified or otherwise required for a complete and properly operating installation.

B. All equipment included in this Section shall be furnished by the volute press vendor as part of the Dewatering Package, and the satisfactory operation of the system. The conveyor equipment shall be controlled by the volute press control panels and shall be coordinated with the volute press equipment for both placement as well as controls to assure a completely integrated and functional dewatered sludge handling system in the Dewatering Room.

1.2 MANUFACTURER'S QUALIFICATIONS

A. The shaftless screw conveyor shall be manufactured by a supplier with not less than 20 operating installations of shaftless screw conveyors in North America.

B. The manufacturer shall provide a written statement indicating at least 5 years experience in the construction and manufacture of shaftless conveyor systems incorporating the design features as herein specified.

1.3 SUBMITTALS

A. Shop Drawings: The Contractor shall submit shop drawings in accordance with the requirements of Section 01 30 00 – Submittal Procedures. Shop Drawings shall contain the following information, at a minimum:

1. Complete description in sufficient detail to permit an item-by-item comparison with the Specifications.

2. Layout drawings to include accessories, appurtenances, coordination with peripheral equipment, drives, and required clearances.

3. Details of transition chutes, discharge chutes, flexible connectors, hinged covers and cover locking device.

4. Electrical data including control and wiring diagrams.

5. Drive and motor in accordance with applicable electrical specifications.

6. Calculations showing the sizing of all drive components including gear reducers, belts, sheaves and electric motor horsepower. The calculations shall show allowances for all service factors and component efficiencies in determining sizing and shall show that all drive train components are capable of withstanding the drive motor torque at full load motor amps.

7. Submit bearing life calculations for the gear reducer bearing and/or drive end bearings sealed by a registered Professional Engineer in the State of Oregon.

8. Provide design loadings to be transmitted to foundations or supports and anchoring calculations sealed by a registered Professional Engineer in the State of Idaho.

9. Shop drawings for equipment anchors.

10. Manufacturer's installation and testing instructions.

B. Owner’s Manual as specified in Section 01 78 23 – Operation and Maintenance Data.

C. Spare Parts List: A spare parts list shall contain the required information for each conveyor.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN REQUIREMENTS

A. The shaftless screw conveyor system shall be designed to meet the following minimum performance and design requirements.

Description	CON-8359A
Cubic ft per Hour	40
Material	Dewatered Sludge
Material Density (lbs/ft3)	65
Solids (min.)	13%
Length	See dwgs
Angle	15
Min Flight OD	8.3in
Min Spiral Weight per ft	19.6
Minimum Trough Width	10.25in
Drive Location	Inlet end
Motor Type	TEFC

B. Spiral Design: The torsional rating of the auger flighting shall be reached at 30% of the Fy value in the extreme fiber of the flight material. Calculations shall demonstrate that, at 250% of the motor nameplate horsepower, the drive unit cannot produce more torque than the torsional rating of the flighting, and that the "spring effect" of the spiral shall not exceed + 0.8 mm per meter of length at maximum load conditions.

2.2 MANUFACTURERS, OR EQUAL

A. JDV Equipment

B. Or Approved Equal.

2.3 MATERIALS

A. Unless otherwise specified or permitted, the materials used in the fabrication of the equipment under this Section shall conform to the following:

1.	Trough, Chutes, Covers	AISI 304 stainless steel, 1/8” thick
2.	Drive and end plates	AISI 304 stainless steel, ½” thick min.
3.	Spiral Flighting	Cold-formed, high strength micro-alloy spring steel with minimum hardness of 220 Brinell
4.	Wear Liner	Plastimeric (UMHW), 3/8” thick min.
5.	Inlet &Discharge Chutes	AISI 304 stainless steel, 1/8” thick
6.	Supports	AISI 304 stainless steel, ¼” thick
7.	Hardware	AISI 316 stainless steel
8.	Cover fasteners	AISI 304 stainless steel screw clamps
9.	Drive Shaft	AISI 1045

2.4 SHAFTLESS SCREW CONVEYOR CONSTRUCTION

A. Spiral Flighting

1. Spiral flighting for the shaftless screw conveyors shall be designed to convey material without a center shaft, and with the stability to prevent distortion and jumping in the trough.

2. The spiral flighting shall be formed in sections from one continuous flat hot-rolled spring steel bar and shall be concentric to within 2mm +/-. Sectional flighting formed from plate shall not be permitted.

3. Spiral flighting shall have full penetration welds at all splice connections. The flights shall be aligned to assure true alignment when assembled in the field and shall be made in accordance with the supplier's requirements. The spiral flights shall be coupled to the end shaft by a flanged, bolted connection.

4. The connection of the spiral to the drive system shall be through a flanged connection plate that is welded to the spiral forming a smooth and continuous transformation from the flange plate to the spiral. The drive shaft shall have a mating flange and shall be bolted to the spiral connection plate.

B. Trough and Liner

1. Troughs shall be similar to the dimensional standards of CEMA 300 and enclosure classification IIE. Each conveyor trough shall be U-shaped, fabricated from a minimum 1/8-inch stainless steel plate.

2. Each trough shall be lined with 3/8-inch minimum UHMW polyethylene, with retainer strips welded to the trough along the top of the liner. The wear liner shall be furnished in maximum four-foot sections to provide ease of replacement. Fasteners shall not be used below the spiral centerline to hold the liner.

3. Stiffeners shall be placed across the top of the trough and fastened to both sides of the trough to maintain trough shape and act as a face seal for the covers; apply a continuous gasket, one half inch width, to the entire top face of the trough top flange and stiffeners.

4. Each trough shall be equipped with filling and/or discharge openings as required by the contract drawings. If required, each filling and discharge opening shall be flanged suitable for interconnection to other devices. Any interconnecting devices such as chutes and hoppers shall be fabricated from the same material as the troughs.

5. Each conveyor shall be provided with a drainage connection at the low end, as shown on the Drawing.

6. The portion of each trough that is not covered by the filling chute shall be covered by a bolted cover of a material identical to the trough. The covers shall be manufactured in maximum four-foot length section to allow for access to the conveyors. To prevent unsafe access to the conveyors, quick opening covers will not be allowed.

C. Inlet Chutes: Inlet chutes shall be provided by the volute press vendor and extended to the rotary press discharge. All chutes shall be fabricated from the same material as the conveyor trough. Manufacturer shall provide rubber flexible connectors, ends as required, to connect to the volute presses as per the volute press manufacturer’s recommendations.

D. Conveyor Supports

1. Manufacturer shall furnish conveyor with factory-mounted lugs for attaching to supports. Contractor shall furnish and install stands, beam connections, etc. to support the conveyors as shown on the drawings.

E. Drive Assembly

1. Each spiral conveyor shall be driven by a constant-speed integral gear reducer/motor drive unit mounted to an adapter flange mounted to the end plate of the conveyor. The adapter flange shall allow the leakage of any material from the conveyor trough to atmosphere rather than into the gear reducer/ motor drive unit. Direct coupling of the gear reducer/motor drive unit to the end flange of the conveyor will not be acceptable.

2. The drive unit shall be rigidly supported so there is no visible "wobble" movement under any operating condition. In the event of a prolonged power failure or emergency system shutdown, the drive system shall be designed, at a minimum, to start the conveyor from a dead stop with the trough filled throughout its entire cross-sectional area and length with partially dried and hardened dewatered material.

3. An adjustable greased gland packing ring consisting of two Teflon coated packing rings shall seal the drive shaft at its penetration through the end plate.

4. Motor: Each motor shall be 460-volt, 60 Hz, 3 phases conforming to the General Equipment specifications, except as modified herein.

5. Reducer: All gears shall be AGMA Class II, single or double reduction, helical gear units with high capacity roller bearings. Bearings shall be designed for the thrust loads from the fully loaded startup condition and shall have an AFBMA B10 life of 50,000 hours. The reducer will be the standard air-cooled unit with no auxiliary cooling. The gear reducer shall be sized with a torque service factor of 1.5 times the absorbed power or 1.1 times the motor nameplate, at the driven shaft speed, whichever is greater.

F. Torque Overload: Torque overload protection shall be provided to protect the drive components from torsional loadings exceeding the rating of the screw. A current transformer shall be provided and shall sense the current draw of the motor levels. The signal shall be transmitted to the current overload protection device, which is set as required by the equipment supplier.

G. Motion Failure Alarm Unit: Each conveyor drive unit shall be equipped with a motion failure alarm unit. The location and mounting details shall be as recommended by the conveyor manufacturer. Motion sensors shall be the non-contacting type using a probe with a pre-amplifier and main electronic assembly. The main electronic unit shall operate on 120-volt, single phase, 60 Hz power supply, and shall be housed in a NEMA 4X enclosure. A 0-60 second time delay shall be provided for startup of the conveyor.

H. Emergency Shutdown: Each conveyor shall be furnished with an emergency trip cord and safety switch. The cord shall run the full length of each conveyor. The trip switch shall immediately stop all conveyors when the switch is actuated.

2.5 CONTROLS

A. The control of the screw conveyor shall be as described in the Section 46 76 26.13 under the Volute Dewatering Press. The screw conveyor shall be controlled by the Volute Press Control Panels.

2.6 ANCHORAGE

A. Anchor Bolts: All anchor bolts shall be a minimum of ½” diameter and made of Type 316 stainless steel. The equipment supplier shall furnish all anchor bolts, nuts, and washers for the conveyor equipment.

B. Anchor bolts shall comply with manufacturer's recommendations and shall be stainless steel.

2.7 SPARE PARTS

A. Conveyor shall be furnished with a complete set of the manufacturer's suggested spare parts.

PART 3 - EXECUTION

3.1 QUALITY ASSURANCE

A. Prior to shipping, conveyors shall be inspected and operated in the shop with the actual drive unit for this project in its entire length. Conveyor longer than the required shipping lengths will have the screws tack welded together and tested in their entire length. Conveyors should be operated for a minimum of 15 minutes and observed for alignment and abnormal operation. Conveyors shall be corrected as necessary. Prior to shipment the tack welds will be broken apart and conveyors suitably prepared for shipment.

3.2 INSTALLATION

A. Contractor shall install conveyor equipment in accordance with manufacturer's recommendations.

B. Operation of the conveyor system shall be coordinated with operation of the screening equipment, to start/stop automatically.

3.3 MANUFACTURER'S FIELD SERVICES

A. Field services shall be provided by the volute press supplier and shall be included as part of the days of field service identified in Section 46 76 26.13.

END OF SECTION 41 12 13.36

SECTION 43 05 01 - EQUIPMENT GENERAL PROVISIONS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The provisions of this Section apply to all sections of Divisions 41 to 46 unless specifically revised therein.

B. Furnish each piece of equipment complete with its base, drives, shafting, couplings, controls, guards, and other appurtenances which are specified or are required for proper and safe operation.

C. Furnish any special tools or equipment required for proper operation maintenance, testing, or adjusting.

1.2 REFERENCE STANDARDS

A. Codes: All codes, as referenced herein, are specified in Section 01 42 19 – Reference Standards.

B. Equipment shall be in accordance with the following standards, as applicable and as indicated in each equipment specification:

1.	AFBMA	Anti-Friction Bearing Manufacturers Association, Inc.
2.	ASTM	American Society for Testing and Materials
3.	ANSI	American National Standards Institute
4.	ASME	American Society of Mechanical Engineers
5.	AWWA	American Water Works Association
6.	ASHREA	American Society of Heating, Refrigerating, and Air Conditioning Engineers
7.	AWS	American Welding Society
8.	NFPA	National Fire Protection Association
9.	NEMA	National Electrical Manufacturers Association
10.	OSHA	General Industry Safety Orders

C. The following standards are referenced in this and other Divisions 41 to 43 and Division 46:

1.	ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800

2.	ANSI B16.5	Pipe Flanges and Flanged Fittings, Steel, Nickel Alloy and other Special Alloys
3.	ANSI B46.1	Surface Texture
4.	ANSI S12.6	Method for the Measurement of the Real-Ear Attenuation of Hearing Protectors
5.	ASME B1.20.1	General Purpose Pipe Threads (Inch)
6.	ASME B31.1	Power Piping
7.	AWWA C206	Field Welding of Steel Water Pipe
8.	AWWA C207	Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144-inches (100 mm through 3,600 mm)
9.	AWWA D100	Welded Steel Tanks for Water Storage
10.	ASTM A48	Gray Iron Castings
11.	ASTM A108	Steel Bars, Carbon, Cold-Finished, Standard Quality
12.	ASME B17.1	Keys and Keyseats
13.	ASME B106.1M	Design of Transmission Shafting

1.3 SUBMITTALS

A. Submittals shall be made in accordance with Section 01 33 00 – Submittal Procedures and the specific equipment specifications sections.

B. Shop Drawings: Furnish complete drawings and technical information for equipment, piping, valves, electrical and controls. Where indicated or required by the Engineer, Shop Drawings shall include clear, concise calculations showing equipment anchorage forces and the capacities of the anchorage elements proposed by the Contractor.

C. Spare Parts List: The Contractor shall obtain from the manufacturer and submit at the same time as Shop Drawings a list of suggested spare parts for each piece of equipment. Contractor shall also furnish the name, address, and telephone number of the nearest distributor for each piece of equipment.

D. Operation and Maintenance Manual: Provide technical operation and maintenance manuals in accordance with Section 01 78 23 – Operation and Maintenance Data.

1.4 ADAPTATION OF EQUIPMENT

A. The Contractor shall furnish equipment readily adaptable for installation and operation. Equipment furnished shall be compatible with all other equipment furnished under the Contract.

B. The Contractor shall assume full responsibility for all modifications of mechanical and electrical controls, equipment, wiring, piping, as required to accomplish function intended by the Contract Documents.

1.5 QUALITY ASSURANCE

A. Guarantees: Unless otherwise accepted herein, guarantee all equipment and its install required. Guarantees shall cover the following: (1) Faulty or inadequate design; (2) Improper assembly or erection; (3) Leakage, breakage, or other failure; and (4) Defective workmanship or materials.

B. Inspection, Start-up and Field Adjustment: The Contractor shall demonstrate that all equipment meets the specified performance requirements. Contractor shall provide the services of an experienced, competent, and authorized service representative of the manufacturer of each item of major equipment who shall visit the site of Work to perform the following tasks:

1. Assist the Contractor in the installation of the equipment.

2. To inspect, check, adjust if necessary and approve the equipment installation.

3. To start-up and field-test the equipment for proper operation, efficiency, and capacity.

4. To perform necessary field adjustments during the test period until the equipment installation and operation are satisfactory to the Engineer.

5. To instruct the Owner's personnel in the operation and maintenance of the equipment. Instruction shall include step-by-step trouble shooting procedures with all necessary test equipment.

C. Quality and Tolerances: Tolerances and clearances shall be as shown on the Shop Drawings and shall be closely adhered to.

D. Machine Finish: The type of finish shall be the most suitable for the application and shall be shown in micro-inches in accordance with ANSI B46.1

E. Manufacturer's Experience: Equipment manufacturer shall have a record of at least 5 years of successful, trouble free operation in similar applications and size equal or larger than the equipment in this contract.

PART 2 - PRODUCTS

2.1 GENERAL

A. Protection of Equipment: Equipment shall be boxed, crated, or otherwise protected from damages and moisture during shipment, handling, and storage. Equipment shall be protected from exposure to corrosive fumes and shall be kept thoroughly dry at all times. Pumps, motors, drives, electrical equipment, and other equipment having anti-friction or sleeve bearings shall be stored in weather tight storage facilities prior to installation. For

extended storage period, plastic equipment wrappers shall be avoided to prevent accumulation of condensate in gears and bearings. In addition, motor space heaters shall be energized, and shafts shall be rotated. Equipment delivered to the Site with rust or corroded parts shall be rejected. If equipment develops defects during storage, it shall be disassembled, cleaned and recoated to restore it to original condition.

B. Identification Equipment Items: At the time of shipping, each item of equipment shall have a legible identifying mark corresponding to the equipment number in the Contract Documents for the particular item.

C. Protective Coating: Equipment shall be painted or coated in accordance with manufacturer's standard system, unless otherwise indicated. Non-ferrous metal and corrosive-resisting steel surfaces shall be coated with grease or lubricating oil. Coated surfaces shall be protected from abrasion or other damage during handling, testing, storing, assembly and shipping.

D. Controls: Equipment and system controls shall be in accordance with Division 26 and Division 40.

E. All flanges on equipment and appurtenances provided under this Section shall conform to ANSI B16.1, Class 125; or B16.5, Class 150, unless otherwise shown. All pipe threads shall be in accordance with ANSI/ASME B1.20.1.

F. Nameplates: Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in an accessible location with No. 4 or larger oval head stainless steel screws or drive pins. Nameplates shall contain the manufacturer's name, model, serial number, size, characteristics, and appropriate date describing the machine performance ratings.

G. Tools: The Contractor shall furnish one complete set of special wrenches and other special tools necessary for the assembly, adjustment, and dismantling of the equipment. Tools shall be of best quality hardened steel forgoing with bright finish. Wrench heads shall have work faces dressed to fit nuts. Tools shall be suitable for professional work and manufactured by Snap On, Crescent, Stanley, or equal. The set of tools shall be neatly mounted in a labeled toolbox of suitable design provided with a hinged cover.

H. Lubricants: The Contractor shall install lubricants for all equipment during storage and prior to initial testing of the equipment. After successful initial testing, final testing, and satisfactory completion startup testing, the Contractor shall conduct one complete lubricant change on all equipment. In addition, the Contractor shall be responsible for the proper disposal of all used lubricants. The Owner will then be responsible for subsequent lubricant changes.

I. Hazardous Location Rating of Equipment: Equipment manufacturer shall reference the hazardous-area classification drawing in the Contract Documents and provide equipment in compliance with the defined NEC- classification requirements. It will be the manufacturer's sole responsibility to submit equipment in compliance with the Contract Documents, NFPA 820, and NEC requirements.

2.2 EQUIPMENT SUPPORTS

A. All pipe connections to equipment shall be supported, anchored and guided to avoid stresses and load on equipment flanges and equipment. Supports and hangers shall be in accordance with the requirements of Section 43 05 50 - Equipment Mounting.

2.3 NOISE REQUIREMENTS

A. Noise Level: When in operation, no single piece of equipment shall exceed the OSHA noise level requirement of 105 dBA for one-hour exposure per day.

B. High Noise Level Location: The Contractor shall provide two personal hearing protection stations at the Blower Room.

C. Personal Hearing Protection: In each hearing protection station, the Contractor shall furnish three pairs of high attenuation hearing protectors in the original unopened packaging. The ear protectors shall be capable of meeting the requirements of ANSI S12.6 and shall produce a noise level reduction of 25 dBA at a frequency of 500 Hz. The hearing protectors shall have fluid filled ear cushions and an adjustable, padded headband. The protectors shall be stored in a weatherproof, labeled, steel cabinet, provided at an approved location near the noise producing equipment.

2.4 VIBRATION LIMITATIONS

A. Vibration frequencies shall span the range from 5.0 to 5,000 Hz. Where specified, measurements shall be obtained while the installed equipment is operating within the specified speed range.

B. Centrifugal Machines with Sleeve Bearings: Unless otherwise specified, centrifugal machines with sleeve bearing shafts shall not exhibit unfiltered RMS readings for vibration displacement in excess of the following:

Shaft speed range range, rpm	Displacement peak to peak, mils
Up to 900	3.5
901-1800	3.0
1801-3000	2.5
3001-4500	2.0
Above 4500	1.6

Displacement measurements shall be taken radially on the shaft at two points at each bearing. Measuring points shall be 90 degrees apart.

C. Centrifugal Machines with Antifriction Bearings: Unless otherwise specified, centrifugal machines with antifriction bearing shafts shall not exhibit unfiltered RMS readings for vibration velocity in excess of 0.12 inch per second. Velocity measurements shall be taken on one point of each bearing housing.

D. Positive Displacement Machines: Unless otherwise specified, positive displacement machines of the rotary, reciprocating and controlled volume types shall operate without any lateral or torsional vibration characteristics that may accelerate wear of the equipment. The Contractor shall provide manufacturer's certification that the manufacturer has inspected the machine under operating conditions and found it to comply with the manufacturer’s requirements.

E. Vibration Isolators: Air compressors, blowers, engines, inline fans shall be provided with restrained spring-type vibration isolators or pads per manufacturer's written recommendations. Vibration isolations shall be provided with seismic restraint.

2.5 CRITICAL SPEED REQUIREMENTS

A. Unless otherwise specified, rotating mechanical equipment shall not exhibit critical speeds within the specified range of operating speeds and impeller blade pass frequencies. Critical speeds for equipment with rigid rotor systems shall be at least 20 percent greater than maximum operating speed and maximum impeller blade pass frequency, whichever is greater. Critical speeds for equipment with flexible shaft-rotor systems shall be at least 15 percent below minimum operating speed and 20 percent above maximum operating speed and blade pass frequency.

2.6 DRIVE TRAINS AND SERVICE FACTORS

A. Drive Trains and Service Factors: Service factors shall be applied in the selection or design of mechanical power transmission components. All components of drive train assemblies between the prime mover and the driven equipment shall be designed and rated to deliver the maximum peak or starting torque, speed, and horsepower. All of the applicable service factors shall be considered, such as mechanical (type of prime mover), load class, start frequency, ventilation, ambient temperature, and fan factors. Drive train components include couplings, shafts, gears, and gear drives, drive chains, sprockets, and V-belt drives. Unless otherwise indicated, the following load classification shall apply in determining service factors:

Type of Equipment	Service Factor	Load Classification
Centrifugal Fans	1.0	Uniform
Pumps		
Centrifugal or Rotary	1.0	Uniform
Reciprocating	1.8	Moderate Shock
Cranes or Hoists	1.25	Moderate Shock

B. Mechanical Service Factors

	Mechanical Service Factors
Uniform	1.25
Moderate Shock	1.50
Heavy Shock	2.0

C. For thermal rating adjustments such as start frequency, ambient temperature, and hourly duty cycle factor, ventilation factor, and fan factor, refer to gear manufacturer sizing information.

D. For service factors of electric motor, see Section 40 05 93 – Motor Requirements for Process Equipment

Where load classifications are not indicated, service factors based on AGMA 514.02 shall be used for standard load classification and for flexible couplings.

2.7 SHAFTING

A. Shafting shall be continuous between bearings and shall be sized to transmit the power required. Keyways shall be accurately cut in line. Shafting shall not be turned down at the ends to accommodate bearings or sprockets whose bore is less than the diameter of the shaft. Shafts shall rotate in the end bearings and shall be turned and polished, straight, and true.

B. Design Criteria: All shafts shall be designed to carry the steady state and transient loads suitable for unlimited number of load applications, in accordance with ASME B 106.1 M - Design of Transmission Shafting. Where shafts are subjected to fatigue stresses, such as frequent start and stop cycles, the mean stress shall be determined by using the modified Goodman Diagram. The maximum torsional stress shall not exceed the endurance limit of the shaft after application of the factor of safety of 2 in the endurance limit and the stress concentration factor of the fillets in the shaft and keyway. Stress concentration factor shall be in accordance with ASME Standard B17.1 - Keys and KeySeats.

C. Materials: Shafting materials shall be appropriate for the type of service and torque transmitted. Environmental elements such as corrosive gases, moisture, and fluids shall be taken into consideration. Materials shall be as indicated unless furnished as part of an equipment assembly.

1. Low carbon cold-rolled steel shafting shall conform to ASTM A 108, Grade 1018.

2. Medium carbon cold-rolled shafting shall conform to ASTM A 108, Grade 1045.

3. Other grades of carbon steel alloys shall be suitable for service and load.

4. Corrosion-resistant shafting shall be stainless steel or Monel, whichever is most suitable for the intended service.

D. Differential Settlement: Where differential settlement between the driver and the driven equipment may occur, a shaft of sufficient length with sets of universal type couplings shall be provided.

2.8 BEARINGS

A. Bearings shall conform to the standards of the Anti-Friction Bearing Manufacturers Association, Inc. (AFBMA).

B. To assure satisfactory bearing application, fitting practice, mounting, lubrication, sealing, static rating, housing strength, and lubrication shall be considered in bearing selection.

C. All re-lubricatable type bearings shall be equipped with an hydraulic grease fitting in an accessible location and shall have sufficient grease capacity in the bearing chamber.

D. All lubricated-for-life bearings shall be factory-lubricated with the manufacturer's recommended grease to insure maximum bearing life and best performance.

E. Anti-Friction Type Bearing Life: Except where otherwise indicated, bearings shall have a minimum 10 life expectancy of 10 years or 20,000 hours, whichever occurs first. Where so indicated, bearings shall have a minimum rated L-10 life expectancy corresponding to the type of service, as follows:

Type of service	Design Life, years	L-10 Design Life, hours
	(Whichever comes first)	
8-hour shift	10	20,000
16-hour shift	10	40,000
Continuous	10	60,000

F. Bearing housings shall be of cast iron or steel and bearing mounting arrangement shall be as indicated or as recommended in the published standards of the manufacturer. Split-type housings may be used to facilitate installation, inspection, and disassembly.

G. Sleeve Type Bearings: Sleeve-type bearings shall have a steel, cast iron or ductile iron housing and Babbitt or bronze liner. Bearing housing shall be bolted and doweled to the lower casing half. These housings shall be provided with cast iron caps bolted in place and the bearing end caps shall be bored to receive the bearing shells. Sleeve bearings shall be designed on the basis of the maximum allowable load permitted by the bearing manufacturer. If the sleeve bearing is connected to an equipment shaft with a coupling, the coupling transmitted thrust will be assumed to be the maximum motor or equipment thrust. Lubricant, lubrication system, and cooling system shall be as recommended by the bearing manufacturer.

H. Plate Thrust Bearings: Thrust bearings shall be the Kingsbury Type, designed and manufactured to maintain the shaft in the fixed axial position without undue heating or the necessity of adjustment or attention. Bearings shall be oil lubricated to suit the manufacturer's standard method of lubrication for the specific bearing. If bearing cooling is required, manufacturer shall provide necessary piping, filters, and valves.

2.9 ELECTRIC MOTORS

A. All motors shall comply with requirements listed in Section 40 05 93 – Motor Requirements for Process Equipment. All variable frequency drive (VFD) controlled motors shall comply with NEMA MG-1 Design “B” requirements.

2.10 SPARE PARTS

A. Spare parts, where specified, shall be provided in clearly labeled boxes. Labels shall display “Mill City WPCF" a major piece of equipment to which the part belongs, the part name, and the manufacturer's part number.

PART 3 - EXECUTION

3.1 PROTECTION

A. Box, crate, or otherwise completely enclose and protect all equipment during shipment, handling, and off-site storage. Responsibility for storage on the job site will be assigned to the installing Contractor.

B. Protect equipment from exposure to elements and keep all items thoroughly dry at all times. Protect against impact, abrasion, discoloration and other damage. Protect electrical equipment, controls and insulation against moisture, freezing, or water damage.

3.2 INSTALLATION

A. Equipment shall be installed in accordance with the manufacturers written recommendations. The Contractor shall select or recommend the size and type of coupling required to suit each specific application; installation shall be per equipment manufacturer's printed recommendations. All insulating connections shall be installed in accordance with the manufacturer's printed instructions.

B. Alignment: Equipment shall be field tested to verify proper alignment.

3.3 SERVICES OF MANUFACTURER

A. Inspection, Startup, and Field Adjustment: Where required by individual sections, an authorized, experienced, and competent service representative of the manufacturer shall visit the Site for the number of days indicated in those sections to witness or perform the following and to certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation.

1. Installation of equipment

2. Inspection, checking, and adjusting the equipment and approving its installation

3. Startup and field testing for proper operation, efficiency, and capacity

4. Performing field adjustments during the test period to ensure that the equipment installation and operation comply with requirements

B. Instruction of the Owner's Personnel: Where required by the individual equipment sections, an authorized training representative of the manufacturer shall visit the Site for the number of days indicated in those sections to instruct the Owner's personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment. Instruction shall be specific to the models of equipment provided.

1. The representative shall have at least two years' experience in training. A resume of the representative shall be submitted.

2. Training shall be scheduled three weeks in advance of the scheduled session.

3. Proposed training material and a detailed outline of each lesson shall be submitted for review. Review comments from the Engineer shall be incorporated into the material.

4. The training materials shall remain with the trainees after the session. The Contractor shall videotape the training for later use by the Owner's personnel.

3.4 PACKAGED EQUIPMENT

A. When any system is furnished as pre-packaged equipment, the Contractor shall coordinate all necessary space and structural requirements, clearances, utility connections, signals, and outputs with subcontractors to avoid later change orders.

B. If the packaged system has any additional features (as safety interlocks, etc.) other than required by the Contract Documents, the Contractor shall coordinate such features with the Engineer and provide all material and labor necessary for a complete installation as required by the manufacturer.

3.5 FIELD TESTS

A. Where indicated by the individual equipment sections, equipment shall be field tested after installation to demonstrate satisfactory operation without excessive noise, vibration, or no overheating of bearings or motor.

B. The following field testing shall be conducted:

1. Start, check, and operate the equipment over its entire operating range. Vibration level shall be within the amplitude limits as indicated or as recommended by the reference applicable Standards.

2. Obtain, record and provide to Engineer concurrent readings of motor voltage, amperage, capacity, vibration, and bearing temperatures for each piece of major equipment.

C. The Engineer shall witness field testing. The Contractor shall notify the Engineer of the test schedule seven days in advance.

D. In the event that any equipment fails to meet the test requirements, the equipment shall be modified and resettled until it satisfies the requirement.

END OF SECTION 43 05 01

SECTION 43 05 50 - EQUIPMENT MOUNTING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This section specifies mounts, supports, and the anchorage for equipment, tanks, piping and accessories.

1.2 REFERENCE STANDARDS

A. Federal Specifications

1.	MIL-A-907E	Antiseize Thread Compound, High Temperature

B. Commercial Standards

1.	ASTM A 48	Gray Iron Castings
2.	ASTM A 193	Alloy Steel and Stainless Steel Building Materials for High Temperature Service
3.	ASTM A 194	Carbon and Allow Steel Nuts for Bolts for High Pressure and High Temperature Service
4.	ASTM A 307	Carbon Steel Bolts and Studs, 600,000 psi Tensile Strength
5.	ASTM A 325	Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

1.3 SUBMITTALS

A. Calculations and shop drawings shall be submitted for all of the work required above in accordance with Section 01 33 00 – Submittal Procedures. Anchor bolt and expansion bolt submittals shall be in accordance with requirements specified herein. All calculations must be made and signed by a civil or structural engineer currently registered in the State of Oregon.

B. Inasmuch as some anchorage or equipment mounting is to be made to poured-in-place concrete elements, it is imperative that these types of anchorage be coordinated with the concrete subcontractor so that anchorage may be installed at time of pouring. If calculations and anchorage details are not submitted prior to pouring of concrete, the Contractor shall become responsible for any strengthening of concrete elements because of superimposed seismic loading.

1.4 QUALITY ASSURANCE

A. Support, anchorage and mounting of all tanks, piping and equipment shall be designed and provided by Contractor according to manufacturer's recommendation, the latest version of the International Building Code and industry standards requirements, unless otherwise specified. All elements required to resist the calculated forces described herein or required by the equipment manufacturer shall be provided by the Contractor.

PART 2 - PRODUCTS

2.1 GENERAL

A. Equipment mountings shall be as shown. All equipment located in floor slabs shall be mounted on concrete pads. Where a steel or cast base is shown or specified between the equipment and the concrete pedestal, it shall be hot-dip galvanized after fabrication.

B. For belt driven equipment shown as in-line and piggyback, the base shall be, rectangular and the motor shall always be behind and above the driven equipment and never over the driven equipment unless approved by the Engineer. Motor mounting hardware for any belt driven configuration shall allow for belt tension adjustment.

2.2 EQUIPMENT SUPPORTS AND FOUNDATIONS

A. Steel Bases: Structural steel bases shall be rectangular in shape for all equipment other than centrifugal refrigeration machines and pump bases, which may be "T" or "L" 1 shaped where shown. Pump bases for split case pump shall include supports for suction and discharge base ells. All perimeter members shall be beams with a minimum depth equal to 1/10th of the longest dimension of the base. Beam depth need not exceed 14 inches provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Grout holes shall be provided for the bases of all equipment where vibration isolation is not specified. Where vibration isolation is required, height saving brackets shall be employed in all mounting locations to provide a base clearance of 1 inch.

2.3 CONNECTIONS

A. All pipe connections to equipment shall be supported, anchored, and guided to avoid stresses and loads on equipment flanges and equipment.

B. Flanges and Pipe Threads: All flanges on equipment and appurtenances provided under this Section shall conform to ANSI B16.1, Class 125; or B16.5, Class 150, unless otherwise shown. All pipe threads shall be in accordance with ANSI/ASME B1.20.1.

C. Unless otherwise indicated, equipment supports, anchors, and restrainers shall be adequately designed for static, dynamic, wind, and seismic loads. The design horizontal seismic force shall be the greater of: that noted in the general structural notes or as required by the governing building code, or 10 percent of gravity. Submitted design calculations for equipment supports shall bear the signature and seal of an engineer registered in the state wherein the project is to be built, unless otherwise indicted.

D. Equipment Foundations: Mechanical equipment, tanks, control cabinets, enclosures, and related equipment shall be mounted on minimum 4-inch high concrete bases unless otherwise indicated. Equipment foundations are indicated on Drawings. The Contractor through the equipment manufacturer shall verify the size and weight of equipment foundation to insure compatibility with equipment.

E. Couplings: Mechanical couplings shall be provided between the driver and the driven equipment. Flexible couplings shall be provided between the driver the driven equipment to accommodate sight angular misalignment, parallel misalignment, end float, and to cushion shock loads.

1. Unless otherwise indicated or recommended by the equipment manufacturer, coupling type shall be furnished with the respective equipment as follows:

Equipment Type	Coupling Type
Horizontal and end suction pumps	Gear or flexible spring
Vertical nonclog pumps, closed coupled	Flexible disk pack
Single stage centrifugal blowers	Flexible disk pack
Air compressors	Gear or flexible pack

2. Each coupling size shall be determined based on the rated horsepower of the motor, speed of the shaft, and the load classification service factor. The Contractor shall have the equipment manufacturer select or recommend the size and type of coupling required to suit each specific application.

3. Taper-Lock or equal bushing may be used to provide for easy installation and removal of shafts of various diameters.

2.4 ANCHOR BOLTS

A. The CONTRCTOR shall be responsible in providing anchor bolts for all owner–furnished equipment supplied to this project.

B. Anchor bolt holes in equipment support frames shall not exceed the bolt diameters by more than 25 percent, up to a limiting maximum oversizing of 1/4 inch. Minimum anchor bolt diameter shall be 1/2 inch. Anchor bolts shall be furnished with leveling nuts, the faces of which shall be tightened against flat surfaces as shown to not less than 10 percent of the bolt's safe tensile stress.

C. Tapered washers shall be provided where mating surface is not square with the nut.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Each piece of equipment shall be anchored to resist a minimum lateral force required by the code, the manufacturer of the equipment or a lateral seismic force of 40 percent of the

operating weight of the equipment, whichever is greater. This force shall be considered acting at the center of gravity of the piece under consideration. No equipment shall be anchored to vertical structural elements without written approval of the Engineer.

B. Equipment which is not vibration isolated shall be anchored directly to the, supporting floor system. In addition to the anchorage, all such equipment shall be internally designed so that all static and moving parts are anchored to the supporting framework to resist the imposed seismic force. All forces must be transmitted to the base in order to be anchored as required. Vibration isolated equipment shall be specially designed to meet these same requirements.

C. Equipment, tanks, piping supports, and anchorage located outside the building shall be designed to comply with the latest version of the International Building Code requirements.

D. All piping, raceways, accessories, and appurtenances, furnished with equipment shall be anchored to resist a lateral seismic force of 40 percent of its operating weight without excessive deflection. This force shall be considered acting at the center of gravity of the piece under consideration.

END OF SECTION 43 05 50

SECTION 43 05 60 – PROCESS EQUIPMENT TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes: Testing of mechanical equipment and systems.

B. Related Sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.

1.2 REFERENCES

A. American National Standards Institute (ANSI):

1. S1.4 Specification for Sound Level Meters.

B. Hydraulic Institute (HI).

1.3 SUBMITTALS

A. Test instrumentation calibration data.

B. Test plan specified in this Section.

C. Test result reports.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION

3.1 QUALITY CONTROL TESTING AND REPORTING

A. Scheduling and notification:

1. Witnessed source quality control tests: Schedule test date and notify Engineer at least 30 days prior to start of test.

2. Field quality control tests: Schedule test date and notify Engineer at least 7 days prior to start of test.

B. Testing levels:

1. Test equipment based on test levels specified in the equipment section of this Project.

2. Requirements for Test Levels 1 to 4 are defined below.

3. Test levels apply for both Source (Factory) Quality Control Tests and Field Quality Control Tests as specified in the equipment sections of this Project.

4. If testing is not specified in the equipment section, provide Level 1 testing.

C. Witnessing: Source Quality Control Tests not witnessed unless specified otherwise in the equipment section; Field Quality Control Tests shall be witnessed.

D. Instrumentation: Provide necessary test instrumentation which has been calibrated within 1 year from date of test to recognized test standards traceable to the National Institute of Standards and Technology, Washington, D.C. or approved source. Properly calibrated field instrumentation permanently installed as a part of the Work may be utilized for Field Quality Control Tests.

E. Temporary facilities and labor: Provide necessary fluids, utilities, temporary piping, temporary supports, temporary access platforms or access means and other temporary facilities and labor necessary to safely operate the equipment and accomplish the specified testing. With Owner's permission, some utilities may be provided by fully tested permanently installed utilities that are part of the Work.

F. Test fluids:

1. Factory tests: Use water or air as appropriate at ambient conditions unless specified otherwise in the equipment section.

2. Field tests: Use specified process fluid at available conditions.

G. Pressure testing: Hydrostatically pressure test pressure containing parts in the factory at the appropriate standard or code required level above the equipment component specified design pressure or operating pressure, whichever is higher. Submit pressure test reports before shipping.

H. Test measurement and result accuracy:

1. Use test instruments with accuracies as recommended in the appropriate referenced standards. When no accuracy is recommended in the referenced standard, use 1 percent or better accuracy test instruments. Improved (lower error tolerance) accuracies specified elsewhere prevail over this general requirement.

2. Do not adjust results of tests for instrumentation accuracy. Measured values and values directly calculated from measured values shall be the basis for comparing actual equipment performance to specified requirements.

I. Field testing:

1. Submit test plan as specified in this Section. Indicate test start time and duration, equipment to be tested, other equipment involved or required; temporary facilities required, number and skill or trade of personnel involved; safety issues and planned safety contingencies; anticipated effect on Owner's existing equipment and other information relevant to the test. Provide locations of all instruments to be used for testing. Provide calibration records for all instrumentation.

2. Prior to testing, verify equipment protective devices and safety devices have been installed, calibrated, and tested.

J. Reports: Submit reports for source and field-testing. Submit Source Quality Control Test result reports before shipping equipment to the field. Report features:

1. Report results in a bound document in generally accepted engineering format with title page, written summary of results compared to specified requirements, and appropriate curves or plots of significant variables in English units.

2. Include appendix with a copy of raw, unmodified test data sheets indicating test value, date and time of reading, and initials of person taking the data.

3. Include appendix with sample calculations for adjustments to raw test data and for calculated results.

4. Include appendix with the make, model, and last calibration date of instrumentation used for test measurements.

5. Include in body of report a drawing or sketch of the test system layout showing location and orientation of the test instruments relative to the tested equipment features.

3.2 EQUIPMENT TESTING, GENERAL

A. Tests for pumps, all levels of testing:

1. Test in accordance with applicable HI Standards in addition to the requirements in this and other sections.

2. Test tolerances: In accordance with appropriate HI Standards, except the following modified tolerances apply:

a. From 0 to plus 5 percent of head at the specified flows [rated design point flow].

b. From 0 to plus 5 percent of flow at the rated design point head.

c. No negative tolerance for the efficiency at the specified flows [rated design point].

d. No positive tolerance for vibration limits. Vibration limits and test methods in HI Standards do not apply, use limits and methods specified in this or other sections of the Specifications.

B. Tests for drivers: Test motors as specified in Section 40 05 93 – Motor Requirements for Process Equipment. Test other drivers as specified in the driver equipment section.

3.3 REQUIREMENTS FOR VIBRATION TESTING

A. Definitions:

1. Peak-to-peak displacement: The root mean squared average of the peak-to-peak displacement multiplied by the square root of 2.

2. Peak velocity: The root mean squared average of the peak velocity multiplied by the square root of 2.

3. Peak acceleration: The root mean squared average of the peak acceleration multiplied by the square root of 2.

4. High frequency enveloping: A process to extract very low amplitude time domain signals associated with impact or impulse events such as bearing or gear tooth defects and display them in a frequency spectrum of acceleration versus frequency.

a. Manufacturers: One of the following or equal:

1) Rockwell Automation, Entek Group, "Spike Energy" analysis.

2) CSI, "PeakVue."

5. Low speed equipment: Equipment or components of equipment rotating at less than 600 revolutions per minute.

6. High speed equipment: Equipment and equipment components operating at or above 600 revolutions per minute.

B. Vibration instrumentation requirements:

1. Analyzers: Use digital type analyzers or data collectors with anti-aliasing filter, 12 bit A/D converter, fast fourier transform circuitry, phase measurement capability, time wave form data storage, high frequency enveloping capabilities, 35 frequency ranges from 21 to 1,500,000 cycles per minute, adjustable fast fourier transform resolution from 400 to 6,400 lines, storage for up to one hundred 3,200 line frequency spectra, RS232C data output port, circuitry for integration of acceleration data to velocity or double integration to displacement.

a. Manufacturers: One of the following or equal:

1) Entek-IRD, Division of Rockwell Automation, Enpac 1200 with applicable data analysis software or Entek Model 838 analyzer with built in printer.

2) Computational Systems Inc., (CSI) Division of Emerson Electric, Model 2120A, Data Collector/analyzer with applicable analysis software.

2. Analyzer settings:

   a. Units: English, inches/second, mils, and gravitational forces.

   b. Fast fourier transform lines: Most equipment 1,600 minimum; for motors, enough lines as required to distinguish motor current frequencies from rotational frequencies, use 3,200 lines for motors with a nominal speed of 3,600 revolutions per minute; 3,200 lines minimum for High Frequency Enveloping; 1,600 lines minimum for low speed equipment.

   c. Sample averages: 4 minimum

   d. Maximum frequency (Fmax): 40 times rotational frequency for rolling element bearings, 10 times rotational frequency for sleeve bearings.

   e. Amplitude range: Auto select but full scale not more than twice the acceptance criteria or the highest peak, whichever is lower.

   f. Fast fourier transform windowing: Hanning Window.

   g. High pass filter: Minus 3 dB at 120 cycles per minute for high speed equipment. Minus 3 dB at 21 cycles per minute for low speed equipment.

3. Accelerometers:

   a. For low speed equipment: Low frequency, shear mode accelerometer, 500 millivolts per gravitational force sensitivity, 10 gravitational force range, plus/minus 5 percent frequency response from 0.5 hertz to 850 hertz, magnetic mount.

      1) Manufacturers: One of the following or equal:

         a) Wilcoxon Research, Model 797L.

         b) PCB, Model 393C.

   b. For high speed equipment: General purpose accelerometer, 100 millivolts per gravitational force sensitivity, 50 gravitational force range, plus/minus 3dB frequency response range from 2 hertz to 12,000 hertz when stud mounted, with magnetic mount holder.

      1) Manufacturers: One of the following or equal:

         a) Wilcoxon Research, Model 793.

         b) Entek-IRD Model 943.

C. Accelerometer mounting:

   1. Use magnetic mounting or stud mounting.

2. Mount on bearing housing in location with best available direct path to bearing and shaft vibration.

3. Remove paint and mount transducer on flat metal surface or epoxy mount for High Frequency Enveloping measurements.

D. Vibration testing results presentation:

1. Provide equipment drawing with location and orientation of measurement points indicated.

2. For each vibration measurement take and include appropriate data on equipment operating conditions at the time vibration data is taken; for pumps, compressors, and blowers record suction pressure, discharge pressure, and flow.

3. When Vibration Spectra Data required:

a. Plot peak vibration velocity versus frequency in cycles per minute.

b. Label plots showing actual shaft or part rotation frequency, bearing inner and outer race ball pass frequencies, gear mesh frequencies and relevant equipment excitation frequencies on the plot; label probable cause of vibration peaks whether in excess of specification limits or not.

c. Label plots with equipment identification and operating conditions such as tag number, capacity, pressure, driver horsepower, and point of vibration measurement.

d. Plot motor spectra on a log amplitude scale versus frequency.

4. For low speed equipment, plot peak vibration displacement versus frequency as well as velocity versus frequency.

5. Provide name of manufacturer and model number of the vibration instrumentation used, including analyzer and accelerometer used together with mounting type.

3.4 TESTING LEVELS

A. Level 1 Quality Control Tests:

1. Level 1 General Equipment Performance Test:

a. For equipment, operate, rotate, or otherwise functionally test for 15 minutes minimum after components reach normal operating temperatures.

b. Operate at rated design load conditions.

c. Confirm that equipment is properly assembled, equipment moves or rotates in the proper direction, shafting, drive elements and bearings are installed and lubricated in accordance with proper tolerances, and that no

unusual power consumption, lubrication temperatures, bearing temperatures, or other conditions are observed.

2. Level 1 Pump Performance Test:

   a. Measure flow and head while operating at or near the rated condition; for factory testing, testing may be at reduced speeds with flow and head corresponding to the rated condition when adjusted for speed using the appropriate affinity laws.

   b. Use of a test driver is permitted for factory tests when actual driver is given a separate test at its point of manufacture as specified in Section 26 08 00 – Field Electrical Acceptance Tests or the applicable equipment section. Use actual driver for field tests.

   c. Record measured flow, suction pressure, discharge pressure, and make observations on bearing temperatures and noise levels.

3. Level 1 Vibration Test:

   a. Test requirement:

      1) Measure filtered vibration spectra versus frequency in 3 perpendicular planes at each normally accessible bearing housing on the driven equipment, any gears and on the driver; 1 plane of measurement to be parallel to the axis of rotation of the component.

      2) Vibration spectra versus frequency shall be in accordance with Vibration Acceptance Criteria.

   b. Equipment operating condition: Test at specified maximum speed.

4. Level 1 Noise Test:

   a. Measure unfiltered overall A-weighted sound pressure level in dBA at 3 feet horizontally from the surface of the equipment and at a mid-point of the equipment height.

B. Level 2 Quality Control Tests:

1. Level 2 General Performance Test:

   a. For equipment, operate, rotate, or otherwise functionally test for at least 2 hours after components reach normal operating temperatures.

   b. Operate at rated design load conditions.

   c. Confirm that equipment is properly assembled, equipment moves or rotates in the proper direction, shafting, drive elements and bearings are installed and lubricated in accordance with proper tolerances, and that no unusual power consumption, lubrication temperatures, bearing temperatures, or other conditions are observed.

2. Level 2 Pump Performance Test:

   a. Test 2 hours minimum for flow and head at the rated condition; for factory testing, testing may be at reduced speeds with flow and head corresponding to the rated condition when adjusted for speed using the appropriate affinity laws.

   b. Use of a test driver is permitted for factory tests when actual driver is given a separate test at its point of manufacture as specified in Section 26 08 00 – Field Acceptance Tests. Use actual driver for field tests.

   c. Test for flow and head at 2 additional conditions; 1 at 25 percent below the rated flow and 1 at 10 percent above the rated flow.

   d. Record measured flow, suction pressure, discharge pressure, and observations on bearing temperatures and noise levels at each condition.

3. Level 2 Vibration Test:

   a. Test requirement:

      1) Measure filtered vibration spectra versus frequency and measure vibration phase in 3 perpendicular planes at each normally accessible bearing housing on the driven equipment, any gears and on the driver; 1 plane of measurement to be parallel to the axis of rotation of the component; measure actual rotational speeds for each vibration spectra measured using photometric or other tachometer input connected directly to the vibration data collector.

      2) Vibration spectra versus frequency shall be in accordance with Vibration Acceptance Criteria.

   b. Equipment operating condition: Repeat test requirements at design specified maximum speed and at minimum speed for variable speed equipment.

   c. Natural frequency test of field installed equipment:

      1) Excite the installed equipment and support system in 3 perpendicular planes, use same planes as operating vibration measurement planes, and determine the as-installed natural resonant frequency of the driven equipment, the driver, gears and supports.

      2) Perform test at each bearing housing, at each support pedestal, and for pumps on the suction and discharge piping.

      3) Perform with equipment and attached piping full of intended service or process fluid.

4. Level 2 Noise Test:

a. Measure filtered A-weighted overall sound pressure level in dBA for each of 8 octave band mid-points beginning at 63 hertz measured at 3 feet horizontally from the surface of the equipment at mid-point height of the noise source.

C. Level 3 Quality Control Tests:

1. Level 3 General Equipment Performance Tests:

a. For equipment, operate, rotate, or otherwise functionally test for at least 4 hours after components reach normal operating temperatures.

b. Operate at rated design load conditions for 1/2 the specified time; operate at each of any other specified conditions for a proportionate share of the remaining test time.

c. Confirm that equipment is properly assembled, equipment rotates in the proper direction, shafting and bearings are installed and lubricated in accordance with proper tolerances, and that no unusual noise, vibration or temperatures are observed.

d. Take appropriate capacity, power or fuel consumption, torque, revolutions per minute, pressure and temperature readings using appropriate test instrumentation to confirm equipment meets specified performance requirements at the design rated condition.

e. Bearing temperatures: During maximum speed or capacity performance testing, measure and record the exterior surface temperature of each bearing versus time.

2. Level 3 Pump Performance Test:

a. Test 4 hours minimum for flow and head at or near the rated condition; for factory testing, testing may be at reduced speeds with flow and head corresponding to the rated condition when adjusted for speed using the appropriate affinity laws.

b. Use of a test driver is permitted for factory tests when actual driver is given a separate test at its point of manufacture as specified in Section 26 08 00 – Field Electrical Acceptance Tests. Use actual driver for field tests.

c. Test each specified flow and head condition at the rated speed and test at minimum as well as maximum specified speeds; operate at each test condition for a minimum of 15 minutes; for factory testing, test at other speeds may be omitted if test driver at reduced speeds is used for rated condition testing.

d. Record measured shaft revolutions per minute, flow, suction pressure, discharge pressure; record measured bearing temperatures (bearing housing exterior surface temperatures may be recorded when bearing temperature devices are not required by the equipment section) and record observations on noise levels.

3. Level 3 Vibration Test:

   a. Requirements: Same as Level 2 vibration test except data taken at each operating condition tested and with additional requirements below.

   b. Perform High Frequency Enveloping Analysis for gears and bearings.

      1) Measure bearing element vibration directly on each bearing cap in a location close as possible to the bearing load zone that provides a smooth surface and direct path to the bearing to detect bearing defects.

      2) Report results in units of acceleration versus frequency in cycles per minute.

   c. Perform Time Wave Form analysis for gears, low speed equipment and reciprocating equipment; plot true peak amplitude velocity and displacement versus time and label the period between peaks with the likely cause of the periodic peaks (relate the period to a cause).

   d. Plot vibration spectra on 3 different plots; peak displacement versus frequency, peak acceleration versus frequency and peak velocity versus frequency.

4. Level 3 Noise Test: Measure filtered, un-weighted overall sound pressure level in dB at 3 feet horizontally from the surface of the equipment at mid-point height and at 4 locations approximately 90 degrees apart in plan view; report results for each of 8 octave band mid-points beginning at 63 hertz.

D. Level 4 Quality Control Tests:

1. Level 4 General Equipment Performance Test:

   a. For equipment, operate, rotate, or otherwise functionally test for at least 8 hours after components reach normal operating temperatures.

   b. Operate at rated design load conditions for1/2 the specified time; operate at each of any other specified conditions for a proportionate share of the remaining test time.

   c. Confirm that equipment is properly assembled, equipment rotates in the proper direction, shafting and bearings are installed and lubricated in accordance with proper tolerances, and that no unusual noise, vibration or temperatures are observed.

   d. Take appropriate capacity, power or fuel consumption, torque, revolutions per minute, pressure and temperature readings using appropriate test instrumentation to confirm equipment meets specified performance requirements at the design rated condition.

e. Bearing temperatures: During maximum speed or capacity testing, measure and record the exterior surface temperature of each bearing versus time.

2. Level 4 Pump Performance Test:

a. Test 8 hours minimum for flow and head; begin tests at or near the rated condition; for factory and field-testing, test with furnished motor at full speed.

b. Test each specified flow and head condition at the rated speed and test at minimum as well as maximum specified speeds; operate at each test condition for a minimum of 20 minutes or longer as necessary to measure required performance, vibration and noise data at each test condition.

c. Record measured shaft revolutions per minute, flow, suction pressure, discharge pressure; record measured bearing temperatures (bearing housing exterior surface temperatures may be recorded when bearing temperature devices not required by the equipment section) and record observations on noise levels.

d. Bearing temperatures: During maximum speed or capacity testing, measure and record the exterior surface temperature of each bearing versus time.

e. Perform efficiency and/or Net Positive Suction Head Required (NPSHr) and/or priming time tests when specified in the equipment section in accordance with the appropriate HI standard and as follows:

1) Perform NPSHr testing at maximum rated design speed, head and flow with test fluids at ambient conditions; at maximum rated speed, test at 15 percent above rated design flow, and 25 percent below rated design flow.

2) Perform efficiency testing with test fluids at maximum rated speed.

3) Perform priming time testing with test fluids at maximum rated speed.

3. Level 4 Vibration Test: Same as Level 3 vibration test.

4. Level 4 Noise Test: Same as Level 3 Noise Test except with data taken at each operating condition tested.

3.5 SOURCE QUALITY CONTROL

A. Test equipment as specified for each type of test at the test levels specified in equipment sections. Prepare and submit test reports as specified.

B. Inspection and balancing:

1. Statically and dynamically balance each of the individual rotating parts as required to achieve the required field vibration limits. Statically and dynamically balance the completed equipment rotating assembly and drive shaft components.

2. Furnish copies of material and component inspection reports including balancing reports for equipment system components and for the completed rotating assembly.

C. Critical speed of rotating equipment: Satisfy the following:

1. The first lateral and torsional critical speed of all constant, variable, and 2-speed driven equipment that is considered rigid such as horizontal pumps, all non-clog pumps, blowers, air compressors, and engines shall be at least 25 percent above the equipment's maximum operating speed.

2. The first lateral and torsional critical speed of all constant, variable, and 2-speed driven equipment that is considered flexible or flexibly mounted such as vertical pumps (vertical in-line and vertical non-clog pumps excluded) and fans shall at least 25 percent below the equipment's lowest operating speed.

3. The second lateral and torsional critical speed of all constant, variable, and 2-speed equipment that is considered flexible or flexibly mounted shall be at least 25 percent above the maximum operating speed.

3.6 FIELD QUALITY CONTROL

A. Test equipment as specified for each type of test at the test levels specified in equipment sections. Prepare and submit test reports as specified. Comply with latest version of applicable standards.

B. For variable speed equipment, conduct test to establish performance over the entire speed range and at the average operating condition. Establish performance curves for:

1. The speed corresponding to the rated maximum capacity.

2. The speed corresponding to the minimum capacity.

3. The speed corresponding to the average operating conditions.

3.7 VIBRATION ACCEPTANCE CRITERIA

A. Testing of rotating mechanical equipment: Tests are to be performed by an experienced, factory trained, and independent authorized vibration analysis expert.

B. Vibration displacement limits: Unless otherwise specified, equipment operating at speeds 600 revolutions per minute or less is not to exhibit unfiltered readings in excess of following:

Operating Speed (revolutions per minute)	Unfiltered (Overall) Peak-to-Peak Amplitude (mils)
	All Rotating Equipment
0 - 300	6.5
301 - 600	4.5
Note: For all equipment, axial shaft displacements not to exceed 50 percent of the maximum radial shaft displacements shown in the table relative to the casing.	

C. Vibration velocity limits: Unless otherwise specified, equipment operating at speeds greater than 600 revolutions per minute is not to exceed the following peak velocity limits:

Item	Unfiltered Overall Limit (inches per second)	Any Filtered Peak Limit (inches per second)
Non-Clog Solids Handling Centrifugal Pumps	0.35	0.25
Horizontal and Vertical In-Line Centrifugal Pumps (other than Non-Clog type)	0.18 (Input BHP 25 or less)	0.14 (Input BHP 25 or less)
	0.22 (Input BHP more than 25 but less than 100)	0.18 (Input BHP more than 25 but less than 100)
	0.25 (Input BHP 100 or more)	0.20 (Input BHP 100 or more)
Vertical Turbine, Mixed Flow, and Propeller Pumps	0.31 (Input BHP 100 or less)	0.22
	0.35 (Input BHP 125 or more)	0.25
Vertical Turbine, Mixed Flow, and Propeller Short Set Pumps	0.28 (Input BHP 100 or less)	0.21
	0.33 (Input BHP 125 or more)	0.24
Motors	See Applicable Motor Specification	
Gear Reducers, Radial	Not to exceed AGMA 6000-A88 limits	
Other Reducers, Axial	0.10	0.10
Centrifugal Fans and Blowers	0.15	0.10
Other Equipment, Radial	0.16	0.10
Other Equipment, Axial	0.10	0.10

D. Equipment operation: Measurements are to be obtained with equipment installed and operating within capacity ranges specified and without duplicate equipment running.

E. Additional criteria:

1. No narrow band spectral vibration amplitude components, whether sub-rotational, higher harmonic, or synchronous multiple of running speed, are to exceed 40 percent of synchronous vibration amplitude component without manufacturer's detailed verification of origin and ultimate effect of such excitation.

2. The presence of discernable vibration amplitude peaks in Test Level 2 or 3 vibration spectra at bearing inner or outer race frequencies shall be cause for rejection of the equipment.

3. For motors, the following shall be cause for rejection:

a. Stator eccentricity evidenced by a spectral peak at 2 times electrical line frequency that are more than 40 percent of the peak at rotational frequency.

b. Rotor eccentricity evidenced by a spectral peak at 2 times electrical line frequency with spectra side bands at the pole pass frequency around the 2 times line frequency peak.

c. Other rotor problems evidenced by pole pass frequency side bands around operating speed harmonic peaks or 2 times line frequency side bands around rotor bar pass frequency or around 2 times the rotor bar pass frequency.

d. Phasing problems evidenced by 1/3 line frequency side band spectral peaks around the 2 times electrical line frequency peak.

4. The presence of peaks in a High Frequency Enveloping spectra plot corresponding to bearing, gear or motor rotor bar frequencies or harmonics of these frequencies shall be cause for rejection of the equipment; since inadequate lubrication of some equipment may be a cause of these peaks, lubrication shall be checked, corrected as necessary and the high frequency envelope analysis repeated.

3.8 NOISE REQUIREMENTS AND CONTROL

A. Make measurements in relation to reference pressure of 0.0002 microbar.

B. Make measurements of emitted noise levels on sound level meter meeting or exceeding ANSI S1.4, Type II.

C. Set sound level meter to slow response.

D. Unless otherwise specified, maximum free field noise level not to exceed 85 dBA measured as sound pressure level at 3 feet from the equipment.

3.9 FUNCTIONAL AND OPERATIONAL TESTING OF EQUIPMENT

A. General checkout: Prior to operating equipment, inspect, test, and check supporting systems, including but not limited to power systems, control systems, piping systems, lubrication systems, and safety systems.

1. Test and calibrate instrumentation and electrical devices as specified in Section 26 08 00 - Field Electrical Acceptance Tests and Section 40 79 23 - Testing, Calibration, and Commissioning.

2. As a minimum for control systems associated with the equipment, perform the following:

a. Individual Loop Tests: Test from field device to intermediate terminations to controller and back to controlled element.

b. End-to-end test: Simulate input at field device and observe control system response at the final field control element.

3. Prior to testing, provide signed and dated certificates of calibration for test instrumentation and equipment.

B. Operation of related existing equipment: Owner will operate related existing equipment or facilities necessary to accomplish the testing.

C. Acceptable tests: Demonstrate the equipment performance meets the requirements of this Section and the equipment section; when the equipment fails to meet the specified requirements, perform additional more detailed testing to determine the cause, correct, repair, or replace the causative components and repeat the testing that revealed the deficiency.

END OF SECTION 43 05 60

SECTION 43 20 00 - PUMPS, GENERAL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide and install all pumps and pumping appurtenances, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section apply to all pumps and pumping equipment except where otherwise indicated in the Contract Documents.

C. Unit Responsibility: The pump manufacturer shall be made responsible for furnishing the Work and for coordination of design, assembly, testing, and installation of the Work of each pump section; however, the Contractor shall be responsible to the Owner for compliance with the requirements of each pump section.

D. Single Manufacturer: Where two (2) or more pump systems of the same type or size are required, the pumps shall all be produced by the same manufacturer.

1.2 REFERENCE STANDARDS

A.	ANSI/IEEE 112	Test Procedure for Polyphase Induction Motors and Generators
B.	ANSI/IEEE 115	Test Procedure for Synchronous Machines
C.	ANSI/HI 9.6.4	Centrifugal and Vertical Pumps – Vibration Measurements and Allowable Values
D.	ANSI/HI 14.6	Rotodynamic Pumps for Hydraulic Performance Acceptance Tests
E.	ASTM A 48	Gray Iron Castings
F.	ASTM B 62	Composition Bronze or Ounce Metal Castings,
G.	ASTM B 584	Copper Alloy Sand Castings for General Applications
H.	ANSI/ASME B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800
I.	ANSI/ASME B16.5	Pipe Flanges and Flanged Fittings

1.3 SUBMITTALS

A. Shop Drawings shall be submitted in accordance with Section 01 33 00 – Submittal Procedures. At a minimum, the following information shall be submitted with each pump supplied:

1. Pump name, identification number, and specification section number.

2. Performance data curves showing head, capacity, horsepower demand, NPSH required, and pump efficiency over the entire operating range of the pump. The equipment manufacturer shall indicate separately the head, capacity, horsepower demand, overall efficiency, and minimum submergence required at the design flow conditions and the maximum and minimum flow conditions. Performance curves at intervals of 100 rpm from minimum speed to maximum speed shall be furnished for each centrifugal pump equipped with a variable speed drive.

3. The Contractor shall require the manufacturer to indicate the limits on the performance curves recommended for stable operation without surge, cavitation, or excessive vibration. The stable operating range shall be as wide as possible based on actual hydraulic and mechanical tests.

4. Assembly and installation drawings including shaft size, seal, coupling, bearings, anchor bolt plan, part nomenclature, material list, outline dimensions, and shipping weights.

5. Data, in accordance with Section 40 05 93 – Common Motor Requirements Process Equipment, for the electric motor proposed for each pump.

6. Elevation of proposed local control panel showing panel-mounted devices, details of enclosure type, single line diagram of power distribution, and current draw of panel, and list of all terminals required to receive inputs or to transmit outputs from the local control panel.

7. Wiring diagram of field connections with identification of terminations between local control panels, junction terminal boxes, and equipment items.

8. Complete electrical schematic diagram.

B. Technical Manual: The Technical Manual shall contain the required information for each pump section.

C. Spare Parts List: A spare parts list shall contain the required information for each pump section.

D. Factory Test Data: Signed, dated, and certified factory test data for each pump system which requires factory testing, submitted before shipment of equipment.

E. Certifications: The Contractor shall provide Manufacturer's certification of proper installation and certification of satisfactory field testing.

1.4 FACTORY TESTING

A. Motors: Electric motors shall be tested in accordance with Section 40 05 93 – Common Motor Requirements for Process Equipment.

B. The following minimum test results shall be submitted:

1. At maximum speed, a minimum of five hydraulic test readings between shutoff head and 25 percent beyond the maximum indicated capacity, recorded on data sheets as defined by the Hydraulic Institute. For variable speed driven pumps, each pump shall be tested between maximum and minimum speed at 100 rpm increments.

2. Pump curves showing head, flow, bhp, and efficiency requirements. Include calculated NPSH required curve and certification that the pump shaft horsepower demand did not exceed the rated motor horsepower of 1.0 service rating at any point on the curve.

C. Acceptance: In the event of failure of any pump to meet any of the requirements, the Contractor shall make all necessary modifications, repairs, or replacements to conform to the requirements of the Contract Documents and the pump shall be retested until found satisfactory.

PART 2 - PRODUCTS

2.1 GENERAL

A. All components that are in contact with potable water shall be certified to NSF Standard 61.

B. Compliance with the requirements of the individual pump sections may necessitate modifications to the manufacturer's standard equipment.

C. Performance Curves: All centrifugal pumps shall have a continuous rising curve or the system operating range shall not cross the pump curve at two different capacities or "dip region." Unless indicated otherwise, the required pump shaft horsepower at any point on the performance curve shall not exceed the rated horsepower of the motor or engine or encroach on the service factor.

D. Each unit of pumping equipment shall incorporate all basic mechanisms, couplings, electric motors or engine drives, variable speed controls, necessary mountings, and appurtenances.

E. Redundancy: Unless otherwise specified, the Contractor shall provide pumps for each intended service in a “1 x 2” lead/lag configuration. For each service a minimum of two pumps shall be provided, unless otherwise specified, each sized to meet design flow conditions.

F. Hazardous Location Rating of Equipment: Equipment manufacturer shall reference the hazardous-area classification drawing in the Contract Documents and provide equipment in compliance with the defined NEC- classification requirements. It will be the manufacturer's sole responsibility to submit equipment in compliance with the Contract Documents, NFPA 820, and NEC requirements.

2.2 MATERIALS

A. All materials shall be suitable for the intended application; materials not indicated shall be high-grade, standard commercial quality, free from all defects and imperfections that might affect the serviceability of the product for the purpose for which it is intended, and shall conform to the following requirements.

Casings and Bowls	Cast iron pump casings and bowls shall be of close-grained gray cast iron, conforming to ASTM A 48 - Gray Iron Castings, Class 30, or equal.
Impellers	Bronze pump impellers shall conform to ASTM B 62 - Composition Bronze or Ounce Metal Castings, or B 584 - Copper Alloy Sand Castings for General Applications, where dezincification does not occur.
Shafts	Stainless steel pump shafts shall be Type 416 or 316. Miscellaneous stainless steel parts shall be Type 316.
Anchor Bolts	Anchor bolts, washers, and nuts in non-corrosive areas, shall be galvanized steel. Anchor bolts, washers, and nuts in corrosive or submerged conditions shall be stainless steel.

2.3 PUMP COMPONENTS - GENERAL

A. Flanges and Bolts: Suction and discharge flanges shall conform to ANSI/ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800 or ANSI/ASME B16.5 - Pipe Flanges and Flanged Fittings dimensions.

B. Lubrication: Vertical pump shafts of clean water pumps shall be product water lubricated, unless otherwise indicated. Deep-well pumps and pumps with dry barrels, shall have water- or oil-lubricated bearings and seals and enclosed line shafts. Pumps for sewage, sludge, and other process fluids shall be lubricated as indicated.

C. Handholes: Handholes on pump casings shall be shaped to follow the contours of the casing to avoid any obstructions in the water passage.

D. Drains: All gland seals, air valves, cooling water drains, and drains from variable speed drive equipment shall be piped to the nearest floor sink or drain, with galvanized steel pipe or copper tube, properly supported with brackets.

E. Mechanical Seals: Mechanical seals shall be fresh water-flushed unless indicated otherwise; in which case product water cleaned by a solids separator as manufactured by Lakos, or equal.

1. Mechanical seals shall be as manufactured by the following, or equal:

Potable and Raw Water Pumps	Double Seals	John Crane Type 3710, Flowserve Type PSS2, Chesterton Type 442
	Single Seals	John Crane Type 88SRS, Flowserve Type ISCPX, Chesterton Type UV, GSS or 155

2. Mechanical seals for all services shall be equipped with nonclogging, flexible-mounted seats with elastomer secondary seals. Wetted metal parts shall be Type 316 stainless steel, Alloy 20, or Hastelloy B or C, whichever has the best corrosion resistance to the pumped fluid. Dual cartridge seals shall be double balanced to allow for seal integrity in case of flush water pressure reversal. All single and double seals shall have springs in the non-wetted end of the seal.

3. Fresh water shall be delivered to the seals through appropriate size piping with plug valves, strainers, pressure regulators, electrically operated solenoid valves, and rotameters. Wiring shall comply with Division 26 and solenoid control shall comply with Division 40.

2.4 PUMP APPURTENANCES

A. Nameplates: Each pump shall be equipped with a stainless steel nameplate indicating serial numbers, rated head and flow, impeller size, pump speed, and manufacturer's name and model number.

B. Solenoid Valves: The pump manufacturer shall provide solenoid valves on the water or oil lubrication lines and on all cooling water lines. Solenoid valve electrical ratings shall be compatible with the motor control voltage.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Pumping equipment shall be installed in accordance with the manufacturers written recommendations.

B. Alignment: All equipment shall be field tested to verify proper alignment and freedom from binding, scraping, shaft runout, or other defects. Pump drive shafts shall be measured just prior to assembly to ensure correct alignment without forcing. Equipment shall be secure in position and neat in appearance.

C. Lubricants: The Contractor shall provide the necessary oil and grease for initial operation.

3.2 SERVICES OF MANUFACTURER

A. Instruction of the Owner's Personnel: An authorized training representative of the manufacturer shall visit the Site for the number of days as indicated in the individual pump specification to instruct the Owner's personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment. Instruction shall be specific to the models of equipment provided.

1. The representative shall have at least two (2) years experience in training. A resume for the representative shall be submitted a minimum of 4 weeks prior to the site visit.

2. Training shall be scheduled a minimum of three (3) weeks in advance of the first session.

3. Proposed training material and a detailed outline of each lesson shall be submitted for review. Comments shall be incorporated into the material.

4. The training materials shall remain with the trainees. The Owner may videotape the training for later use with the Owner's personnel.

3.3 FIELD TESTING

A. Test Protocols: Startup, check, and operate the pump system over its entire speed range. If the pump is driven by a variable speed drive, the pump and motor shall be tested at 100 RPM increments. If the pump is driven at constant speed, the pump and motor shall be tested at max RPM. Unless otherwise indicated, vibration shall be within the amplitude limits recommended by the Hydraulic Institute Standards at a minimum of four pumping conditions defined by the Engineer.

1. Obtain concurrent readings of motor voltage, amperage, pump suction head, and pump discharge head for at least 4 pumping conditions at each pump rotational speed if variable speed at 100 RPM increment or at max RPM if constant speed. Check each power lead to the motor for proper current balance.

2. Determine bearing temperatures by contact type thermometer. A run time until bearing temperatures have stabilized shall precede this test, unless insufficient liquid volume is available.

3. Electrical and instrumentation tests shall conform to the requirements of the sections under which that equipment is specified.

4. Field testing will be witnessed by the Engineer. The Contractor shall furnish 3 days advance notice of field testing.

B. In the event any pumping system fails to meet the indicated requirements, the pump shall be modified or replaced and re-tested as above until it satisfies the requirements.

C. After each pumping system has satisfied the requirements, the Contractor shall certify in writing that it has been satisfactorily tested and that all final adjustments have been made. Certification shall include the date of the field tests, a listing of all persons present during the tests, and the test data.

D. The Contractor shall be responsible for all costs of field tests, including related services of the manufacturer’s representative, except for power and water, which the Owner will bear. If available, the Owner's operating personnel will provide assistance in field testing.

3.4 PROTECTIVE COATING

A. Materials and equipment shall be coated per Manufacturer’s written instructions.

END OF SECTION 40 20 00

PROGRESSING CAVITY SLUDGE PUMPS

PART 1 - GENERAL

1.1 DESCRIPTION

A. SCOPE: This section specifies positive displacement progressing cavity pumps, complete with electric motors, and all specified appurtenances, as shown on the plans and specified herein. Pumps shall be used to pump waste activated sludge from a solid holding tank to a dewatering press and shall be supplied as part of the dewatering system package.

B. TYPE: The pumping units shall be of the self-priming, positive displacement, progressing cavity type specifically designed for pumping the specified wastewater sludge.

C. EQUIPMENT LIST

Item	Equipment Number
Dewatering Feed Pump	PMP-A5503

D. PERFORMANCE AND DESIGN REQUIREMENTS

1. Sludge handling pumps shall be specifically designed and selected for continuous duty pumping of liquids with the following properties:

Percent Solids	Up to 3%
Specific Gravity	Approx. 1.0
Solids Size	<1/4”
pH	5.5-8.0
Temperature	40-90 F

2. The pumps shall be of the compact, close-coupled design. The gear reducer shall be sized for a minimum service factor of 1.5 and designed with a thrust load capability of 150 percent of the actual thrust load.

3. The pumps, along with associated drive appurtenances, shall be mounted on common fabricated steel baseplates.

4. Manufacturers must currently have installations for the same liquids and of the same size pump unit, in service for a minimum of three years. Manufacturers not named in this specification must also provide a pre-submittal package to the engineer no less than three weeks prior to the bid date for approval. The pre-submittal package must include, at minimum, the following: dimensional drawing, performance curve, O&M manual, electrical/drive details, installation list (for the same liquids as specified) with minimum three contacts and phone numbers.

E. OPERATING CONDITIONS:

The progressing cavity pumps shall have the following operating characteristics:

Equipment Service	Rated Capacity, gpm	Differential Pressure psi	Maximum pump speed, rpm	Suction and discharge port size, in	Motor hp	Drive
Dewatering Feed Pump	5-50	<30	255	4” Suction, 3” Discharge	5	Variable Speed from inverter

1.2 REFERENCES

A. This section contains references to the following documents. They are part of this section as specified and modified. In case of conflict between the requirements of the section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
AGMA 6010-E-88	Spur, Helical, Herringbone, and Bevel Enclosed Drive
AGMA 6019-E-89	Gear Motors Using Spur, Helical, Herringbone, Straight Bevel, or Spiral Bevel Gears
AGMA 6023-A88	Design Manual for Enclosed Epicyclic Gear Drives

1.3 ENVIRONMENTAL CONDITIONS

A. Pumps to be provided under this section will be installed indoors in a heated building.

1.4 SUBMITTALS

A. Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures and 43 20 00 – Pumps, General.

B. Product Data: Submit manufacturer’s technical product data including:

1. Seal water pressure and flow requirements.

2. Pump performance curves per Section 43 20 00 – Pumps, General.

3. Pump outline drawing

4. Electric motor data and testing results per Section 43 20 00 – Pumps, General and Section 40 05 93 – Common Motor Requirements for Process Equipment.

5. Typical installation guides

6. Bearing life calculations

7. List of spare parts for each pump

C. Operation and Maintenance Data: Submit operation and maintenance data and parts list for the equipment. Include this data and product data in maintenance manual, in accordance with Section 01 78 23 – Operation and Maintenance Data.

1.5 QUALITY ASSURANCE

A. Pump, motor, and controls shall be coordinated by the Contractor to provide operable pumping systems as indicated by the drawings and specifications. The motor horsepower shall not be exceeded when the pump is operating anywhere on its curve.

B. Manufacturers: Firms regularly engaged in manufacture of pumping equipment of types required, whose equipment has been in satisfactory use in similar service for not less than 5 years.

C. Provide pumps in this Section from the same manufacturer.

D. Witnessing: Factory testing shall not be witnessed by the Engineer or Owner.

E. Equipment performance test: Test level as scheduled; test as specified in Section 43 05 60 – Process Equipment Testing.

F. Vibration test: Test level as scheduled; test as specified in Section 43 05 60 – Process Equipment Testing.

G. Noise test: Test level as scheduled; test as specified in 43 05 60 – Process Equipment Testing.

H. Hydrostatic pressure tests: As specified for components in this Section.

1.6 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 43 05 01 – Equipment General Provisions.

1.7 WARRANTY

A. A written manufacturer warranty shall be provided. The warranty shall be for a minimum period of one (1) year from the date of Substantial Completion. Manufacturer shall repair or replace all defects of materials or workmanship in the equipment during the warranty period.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Seepex (Basis-of-Design)

B. Or equal

2.2 MATERIALS

Component	Material - Sludge Pumps
Rotor	1.0503 (C45)/AISI 1045 – Ductile chromium coating

Component	Material - Sludge Pumps
Stator	Buna N
Pump Body	Cast iron
Shaft Sealing	Seepex GA Q1Q1VGG

2.3 EQUIPMENT

A. ROTOR AND STATOR:

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. Stators for sludge pumps shall have Buna elastomer. The sludge pump rotors shall be constructed of hardened tool steel. Additionally, the sludge pump rotors shall have a chromium nitride coating (Duktil process) with a minimum thickness of (.0108").

1. Stators shall be replaceable without dismantling the pump suction or discharge flanges or any associated piping. Pumps that require additional space for axial/horizontal removal of the stator shall not be allowed. Stator designs shall additionally incorporate a re-tensioning feature to compensate for wear in lieu of increasing pump speed.

2. Rotors shall be replaceable without dismantling the pump suction or discharge flanges or associated piping. Pumps that require additional space for axial/horizontal removal of the rotor shall not be allowed. The rotor design shall include provisions so that rotor replacement does not require the disassembly of either universal joint.

B. DRIVE TRAIN:

The drive train shall be warranted for one (1) year from acceptance and shall consist of the following:

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 304 stainless steel.

C. CASINGS: A 150-pound (ANSI B16.5 RF) flanged connection shall be provided at both the inlet and discharge ports. The suction casing shall employ two opposed cleanout openings to facilitate removal of debris without dismantling the pump or pipework.

D. BEARINGS: 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. Minimum bearing L-10 shall be 50,000 hrs.

E. SHAFT SEALING: Shaft shall be sealed using a single internal mechanical seal as specified in Section 2.02. 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 316 stainless steel metal parts and Viton elastomers.

F. MOTOR AND DRIVE UNIT:

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, TEFC motors. Where shown on the drawings, pumps shall be provided with right angle gearboxes.

2. Pumps that require variable frequency drives (VFDs) are noted in paragraph 1.01 E. VFDs shall be constant torque type. For VFD-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 in accordance with the schedule in paragraph 1.01 E. VFD-driven units may be operated at up to 60 Hz at the maximum speed.

2.4 ACCESSORIES:

A. RUN DRY PROTECTION: 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 1x115VAC/60 Hz.

2.5 STANDBY COMPONENTS

A. One set of special tools shall be provided to service the pumps.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer’s instructions and as specified in Section 43 20 00 – Pumps, General

B. General installation requirements shall be as specified for “Execution” in Section 43 20 00 – Pumps, General.

3.2 COMMISSIONING

A. Startup services shall be provided by the screw press supplier and shall be included in the services for startup of the screw press and associated equipment.

B. Contractor shall demonstrate to Owner and Engineer that the pump system meets the service conditions and provide a short report showing the flows and pressures and a red-lined pump curve with the flow, pressure, efficiency, and horsepower indicated.

C. Manufacturer shall inspect system before initial start-up and certify that system has been correctly installed and prepared for start-up as specified in this Section, Section 43 05 01 – Equipment General Provisions, and Section 43 20 00 – Pumps, General.

D. Training: Manufacturer shall provide training to Owner's staff. Training shall be for a minimum of 3 hours and shall cover standard operating and preventive maintenance procedures. The Contractor shall videotape the training and provide a copy to Owner on jump drive.

END OF SECTION 4323 57.01

SECTION 43 25 01 - SUBMERSIBLE NON-CLOG PUMPS (LIFT STATION)

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install submersible non-clog pumping equipment, associated appurtenances and controls as specified herein and as shown on the Drawings.

1.2 REFERENCE STANDARDS

A.	ASTM - A36/A36M-04	Standard Specification for Carbon Structural Steel
B.	ASTM A 48/A 48M	(2008) Standard Specification for Gray Iron Castings
C.	NFPA 820	Standard for Fire Protection in Wastewater Treatment and Collection Facilities

D. NEMA Standards Publication MG 1-1998 (latest version) Motors and Generators

E. National Electric Code (NEC)

1.3 SUBMITTALS

A. Shop Drawings, at a minimum, shall have the following information and be submitted with each pump supplied:

1. Pump performance curves showing the following:

   a. head, capacity, horsepower demand, NPSH required, pump efficiency over the entire operating range of the pump, performance curves at intervals of 5 Hz from minimum speed to maximum speed for each centrifugal pump equipped with a variable speed drive; the head, capacity, horsepower demand, overall efficiency, and minimum submergence required at the design flow conditions and the maximum and minimum flow conditions; and

   b. the limits on the performance curves recommended for stable operation without surge, cavitation, or excessive vibration with the stable operating range as wide as possible based on actual hydraulic and mechanical tests.

2. assembly and installation drawings including shaft size, seal, coupling, bearings, anchor bolt plan, part nomenclature, material list, outline dimensions, and shipping weights

3. bearing life calculations

4. rail system

5. typical installation guides

6. Electrical motor data

7. Technical manuals and parts list

8. Printed warranty

9. Management system certificate ISO 9001

10. Manufacturer’s equipment storage recommendations

B. Factory Test Data shall be signed, dated, and certified factory test data for each pump system which requires factory testing, submitted before shipment of equipment.

C. The Contractor shall provide Manufacturer's Certification of proper installation and certification of satisfactory field testing.

D. Submit Owner’s Manual as specified in Special Provisions, to include operation and maintenance data and other information for the equipment.

1.4 QUALITY ASSURANCE

A. Pump, motor, and controls shall be coordinated by the Contractor to provide operable pumping systems as indicated by the Drawings and Specifications.

B. The motor horsepower shall not be exceeded when the pump is operating anywhere on its curve.

C. Pump seals shall be designed for complete water-tightness at 65 feet submergence for 30 minutes, and data on factory testing and quality control shall be submitted with the Shop Drawings.

D. Firms regularly engaged in manufacture of pumping equipment of types required and specific impeller characteristics, whose equipment has been in satisfactory use in similar service for not less than 5 years. Manufacturer shall have authorized factory warranty service for pumps supplied available within 50-mile driving distance of the Owner.

E. The Contractor shall correct all defects in the pumping system upon notification from the Owner within 1 years from the date of Substantial Completion. Corrections shall be completed within 5 days after notification.

PART 2 - PRODUCTS

2.1 DESIGN CRITERIA

A. Submersible Wastewater Pumps shall be submersible non-clog wastewater pumps capable of pumping raw unscreened sewage in a NEC Class 1, Division 1, Group D hazardous location.

B. The submersible pumps shall have a semi open multi vane self-cleaning impeller designed to transport wastewater with fibrous materials like wet wipes. Pumps shall be capable of pumping sewage under the following conditions of service:

C. Operating Conditions

Criteria	Unit	Influent Lift Station
Design Flow Capacity (per pump) Max. point	GPM	696
Design Flow Pump Head, TDH	Ft	47
Design Flow minimum efficiency (wire-to-water)	Percent	60
Driver		
Duty		Continuous
Drive		On/Off
Maximum Pump Speed	RPM	1755
Maximum Motor Speed	RPM	1755
Motor Size	HP*	**15**

* Motor sizes may differ as long as all other pumping and process requirements are met.

Item	Unit	Value
Fluid Service		Raw Wastewater
Ambient Environment		Wet well, submerged
Ambient Temperature	Degrees F	30 to 120
Ambient Relative Humidity	Percent	30 to 100
Fluid Temperature	Degrees F	40 to 80
Fluid pH Range		5 to 8.5
Fluid Specific Gravity		1.0
Project Site Elevation	Feet	700

D. The Contractor shall ensure the pump vendor examines the site conditions, intended application, and operation of the pump system and recommends the pump that will best satisfy the indicated requirements.

E. Pumps shall be designed and provided to be raised, lowered, and supported on a vertical stainless steel guide rail system.

2.2 MATERIALS OF CONSTRUCTION

A. Unless otherwise specified elsewhere, all non-clog submersible pumps shall be constructed of the following materials:

Item	Material	Construction
Pump Casing	Casing and motor housing shall be close-grain cast iron conforming to ASTM 35B standards. Insert rings shall be made of Hard-Iron™ (ASTM A-532 (Alloy III A) 25% chrome cast iron)	Casing shall form the volute and shall be a single piece with smooth flow passages. A replaceable bottom plate assembly shall be used to seal between the impeller and the casing. The casing shall have a

Item	Material	Construction
		centerline discharge to allow for guide rails.
Connections	Machined metal-to-metal quick disconnect type	The pump(s) shall be automatically and firmly connected to the discharge connection, guided by no less than two parallel guide bars extending from the top of the station to the wet well mounted discharge connection. The material of the guide bars shall Stainless steel AISI 316.
Impeller	Impeller shall be of Hard-Iron™ (ASTM A-532 (Alloy III A) 25% chrome cast iron)	Impellers shall be dynamically balanced, semi-open, multi-vane, back swept, screw-shaped, non-clog design. The impeller shall have vanes hardened to Rc 60 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter found in wastewater.
Shaft	ASTM AISI 431	The shaft shall be totally isolated from the liquid being pumped and shall have a maximum deflection at the lower seal of .002 inches.
Shaft Seals	Stainless steel, Tungsten carbide or silicon carbide rings	The pump shall have two mechanical shaft seals. The upper seal shall be a corrosion resistant Tungsten carbide WCCR mechanical seal running in an oil bath below the stator housing. The lower seal shall be the primary seal and consist of a corrosion resistant Tungsten carbide WCCR mechanical seal. Seals shall contain one stationary and one positively driven tungsten-carbide seal ring. A separate seal leakage chamber shall be provided so that any leakage that may occur past the upper, secondary mechanical seal will be captured prior to entry into the motor stator housing. Such seal leakage shall not contaminate the motor lower bearing. The leakage chamber shall be equipped with a float

Item	Material	Construction
		type switch that will signal if the chamber should reach 50% capacity.
Bearings		The pump shaft shall rotate on two bearings. Motor bearings shall be permanently grease lubricated and have a nominal L10 lifetime of 50.000 hours. The upper bearing shall be a single deep groove ball bearing. The lower bearing shall be a two row angular contact bearing to compensate for axial thrust and radial forces. Single row lower bearings are not acceptable.
Oil Chamber		To supply oil for lubrication and cooling of shaft seals. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside.
Pump Base	For each pump the contractor shall supply and install a discharge connection made of cast iron ASTM A-48, Class 35B	The sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal contact. Sealing of the discharge interface with a diaphragm, O-ring or profile gasket will not be accepted. The entire weight of the pump/motor unit shall be borne by the pump discharge elbow. No portion of the pump/motor unit shall bear on the sump floor directly or on a sump floor mounted stand.
Fasteners	Type 316 stainless steel	All exposed fasteners
Pump Coating	All castings must be blasted before coating. All wet surfaces are to be coated with two-pack oxyrane ester Duasolid 50. The total layer thickness should be at least 120 microns. Zink dust primer shall not be used.	All metal surfaces (except stainless steel) coming into contact with pumped media shall be protected by specified coating

Item	Material	Construction
Cable Entry		The cable entry shall consist of dual cylindrical elastomer sleeves, flanked by washers, all having a close tolerance fit against the cable and the cable entry. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.

2.3 COOLING SYSTEM

A. The motor shall be provided with an integral motor cooling system. A stainless steel cooling jacket shall encircle the stator housing, providing for dissipation of motor heat regardless of the type of pump installation. An impeller, integral to the cooling system and driven by the pump shaft, shall provide the necessary circulation of the cooling liquid through the jacket. The cooling liquid shall pass about the stator housing in the closed loop system in turbulent flow providing for superior heat transfer. The cooling system shall have one fill port and one drain port integral to the cooling jacket.

2.4 LIFTING SYSTEM

A. Provide dual 316 SS guide rails extending from the base to the top of the wet well to provide for removal of the pump by lifting the pump without entering the wet well. The guide rail system shall be non-sparking.

B. Each pump shall be furnished with a stainless-steel bracket permanently mounted to the top of the pump, with a large loop for accommodating a lift hook. Each pump shall be fitted with a stainless steel lifting chain or lifting cable of adequate length. The working load of the lifting system shall be 50% greater than the pump unit weight.

C. The guide rail system shall include a sliding guide bracket that allows removal of the pump without binding, and properly aligns the pump to automatically seat with the pump discharge connection. Each pump shall have permanently installed discharge elbow that seats against the pump discharge connection by a machined metal to metal contact. The use of a diaphragm, O-ring, or profile gasket will not be accepted.

2.5 ELECTRICAL REQUIREMENTS

A. Pump Controls

1. Provide outputs to PLC for leakage and high temperature detection for each pump.

B. Motor

1. Pump motors shall be of explosion-proof design conforming to NFPA 70 requirements. In addition, pump motors shall conform to NEMA MG-1 Part 31 requirements and shall be a premium efficiency squirrel cage induction NEMA Design B electric motor conforming to the following:

Item	Value
Installation Environment	Submersible, Air Filled
Enclosure	Explosion Proof
Insulation Class	NEMA Class H or higher
Insulation	Non-Hygroscopic Polyester
Service Factor	1.15 Minimum
Synchronous Speed	1800 RPM Maximum (Variable)
Voltage	460
Phase	3
Frequency	60 Hz

C. Moisture Sensor

1. Provide moisture sensor in the seal oil chamber to detect moisture leakage through the outer shaft seal. The moisture sensor shall be wired to the seal leak relay.

2. Seal leak relay shall be Flygt MiniCASII.

D. Thermal Sensors

1. Thermal sensors shall be used to monitor stator temperatures by the use of 3 thermal switches embedded in the coils of the stator winding. The thermal sensors shall be wired to the seal leak relay.

2. Seal leak relay shall be Flygt MiniCASII.

E. Electric Cable

1. The pump motor cable and control cable shall be FM-approved for use with motors for Class 1, Division 1, Group C & D Locations.

2.6 SPARE PARTS

A. Parts to be furnished include

1. 2 sets of mechanical shaft seals

2. 2 sets of bearings each for pump and motor

3. 3 sets of O-rings

4. 1 submersible cable of required length

2.7 MANUFACTURER

A. Flygt

B. Or Approved Equal

PART 3 - EXECUTION

3.1 FACTORY TESTING

A. The pump shall be tested at the factory for capacity, power requirement, and efficiency at minimum head, rated head, shutoff head, and at as many other points as necessary for accurate performance curve plotting. All tests and test reports shall be made in conformity with the applicable requirements and recommendations of the Hydraulic Institute (HI) Standard 14.6 -2011.

B. 14.6.3.4 acceptance grade 2B. The acceptance ranges are as follows.

1. Rate of flow ±8% from values in initial submittal.

2. Total head ±5% from values in initial submittal

3. Pump efficiency -5% from values in initial submittal

3.2 DELIVERY AND STORAGE

A. All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt or dust, or other contaminants.

B. All parts shall be properly lubricated and protected so that no damage or deterioration will occur even during a prolonged delay from the time of shipment until installation is completed and the pumps are ready for operation. Pump impellers shall be rotated at least every 30 days.

C. Finished ferrous surfaces not painted shall be properly protected to prevent rust and corrosion.

D. The finished surfaced of exposed flanges shall be protected by strong wooden blind flanges.

E. Each pump shall be properly crated to protect against damage during shipment.

3.3 INSTALLATION

A. Install pump as shown in the drawings and as recommended by the Pump Manufacturer.

B. The Contractor shall ensure that anchor bolts are set only after the discharge piping has been properly installed, to ensure exact fit with embedded piping components.

3.4 SERVICES OF MANUFACTURER

A. Secure start-up service for the pump as specified below:

Schedule of Field Service Representative on Site Time		
Service	On Site Time (Days)	Trips to Site
Equipment delivery verification and installation instruction	1	1

Installation verification, start-up and instruction of the Owner's personnel	1	1

B. A "Day on Site" is defined as a conventional 8-hour workday excluding travel time. A "Trip to Site" is defined as complete round trip travel from the Manufacturer's factory. All expenses including salary, local/long distance travel, lodging, meals and any other per diem or miscellaneous expenses of the authorized service representative shall be the responsibility of the Contractor.

C. A factory representative of the pumping equipment shall be present to supervise start-up and ensure proper operation of all components. The Contractor shall obtain and pay for the factory representative start-up service.

D. The Contractor shall video tape the training session and provide a DVD to the Owner.

END OF SECTION 43 25 00

SECTION 43 41 43 - POLYETHYLENE TANKS (DOUBLE WALL)

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide one (1) cross linked, rotationally molded polyethylene tank and accessories, complete and in place, in accordance with the Contract Documents. The tanks shall be suitable for above ground, vertical, installation and capable of containing Liquid Caustic Soda at atmospheric pressure. The tank shall be a double walled system

B. Unit Responsibility: The Contractor shall assign responsibility for furnishing the tank system as indicated, including the level indication, to the tank manufacturer.

1.2 REFERENCE STANDARDS

A. Commercial Standards

1.	ASTM C 177	Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hat-Plate Apparatus
2.	ASTM C 273	Test Method for Shear Properties of Sandwich Core Materials
3.	ASTM D 638	Test Method for Tensile Properties of Plastics
4.	ASTM D 746	Test Method for Brittleness Temperature of plastics and Elastomers by Impact
5.	ASTM D 790	Test Methods for Flexural Properties of Unreinforced and Reinforced Electrical Insulating Materials
6.	ASTM D 883	Standard Definitions of Terms Relating to Plastics
7.	ASTM D 1505	Test Methods for Density of Plastics by the Density Gradient Technique
8.	ASTM D 1525	Test Method for Vicat Softening Temperature Plastics
9.	ASTM D 1998	Polyethylene Upright Storage Tanks
10.	ASTM D 1622	Test Method for Apparent Density of Rigid Cellular Plastics
11.	ASTM D 1623	Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics
12.	ASTM D 1693	Test Method for Environmental Stress-Cracking of Ethylene Plastics

13.	ASTM D 2856	Test Method for Open Cell Content of Rigid Cellular Plastics by the Air Pycnometer
14.	ASTM F412	Standard Terminology Relating to Plastic Piping Systems
15.	ANSI Standards	B-16.2, Pipe Flanges and Flanged Fittings
16.	UBC Code	Uniform Building Code, latest edition
17.	ARM	Low Temperature Impact Resistance (Falling Dart Test Procedure).
18.	IBC	International Building Code, latest edition

1.3 SUBMITTALS

A. Submit the following in compliance with Section 01 33 00 – Submittal Procedures.

B. Shop Drawings shall include, but not be limited to, the following items:

1. Tank manufacturer's data and dimensions showing locations of all openings, locations of level indicators, seismic support structure and anchoring system details, and location of tank accessories.

2. Details on inlet and outlet fittings, manways, flexible connections, vents and level indicators.

3. Tank pad requirements such as pads and blockouts.

4. Resin Manufacture Data Sheet.

5. Anchor and hoop calculations shall be stamped and signed by a registered, third-party engineer licensed in the State of Oregon.

a. Wall thickness: Hoop stress shall be calculated using 600 psi @ 100 degrees F.

b. Tank restraint system. Show seismic and wind criteria.

6. Manufacturer’s warranty.

C. Owner’s Manual: Provide technical manual that outlines recommended installation procedures, fitting installation and adjustment procedures and repair procedures for typical situations including small holes, pinholes, and minor cracks in the tank.

D. Documentation: Provide certification signed by the manufacturer that the tanks have been factory tested and meet the requirements indicated. Certification shall include calculations used to determine wall thickness, hoop stress shall be indicated and calculations shall be signed by a Registered Structural Engineer in the State of Oregon.

1. A representative of the manufacturer shall certify electronically or in writing that the tank has been installed in accordance with the manufacturer's recommendations and is chemically compatible with stored chemicals.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: The tank manufacturer shall have a record of at least ten installations during the previous 5 years for the tank sizes indicated. The manufacturer shall furnish names and telephone numbers of locations that can be visibly inspected.

B. Special Warranty Requirements: The tank shall be warranted for 5 years to be free of defects in material and workmanship.

C. Tanks shall be manufactured from virgin materials.

D. Factory Testing: Following fabrication, the tanks, including factory applied inlet and outlet fittings, shall be hydraulically tested with water per current ASTM D 1998 standards. The test duration shall be 24 hours. Following successful testing, the tank shall be emptied and dried prior to shipment.

1. Material taken from each tank shall be impacted tested per ASTM D 1998 requirements. Minimum tests results shall be greater than 120 ft-lb.

2. Degree of Crosslinking. Use Method C of ASTM D 1998-Section 11.4 to determine the ortho-xylene insoluble fraction of cross-linked polyethylene gel test. Samples shall test at no less than 60 percent.

3. Dimensions: Take exterior dimensions with the tank empty, in the vertical position. Outside diameter tolerance, including out-of-roundness, shall be per ASTM D 1998. Fitting placement tolerance shall be +/- 1/2-in vertical and +/- 2 degree radial.

PART 2 - PRODUCTS

2.1 GENERAL

A. Tanks shall be circular in cross-section, vertical, complete with piping inlets and outlets, drains, overflows, and anchoring system. Covered tanks shall be vented, and shall be provided with entrance manways, fill connection, and level indicators. Tanks shall be marked to identify the manufacturer, date of manufacture, serial number, and capacity. Tanks shall meet the requirements of ASTM D 1998 unless otherwise indicated.

2.2 DESIGN REQUIREMENTS

A. The minimum required wall thickness of the cylindrical sheet shall be determined per ASTM D 1998. The minimum required wall thickness of the cylindrical shell at any fluid level shall be determined by the following equation but shall not be less than 0.187 in. thick.

T	=	P x O.D./2 SD = 0.433 x S.G. x H x O.D./2 SD
T	=	wall thickness, in
SD	=	hydrostatic design stress, PSI
P	=	pressure (.433 x S.G. x H).), PSI
H	=	fluid head, ft.
S.G.	=	specific gravity. gm/cc
O.D.	=	outside diameter, ft.

1. The hydrostatic design stress shall be determined by multiplying the hydrostatic design basis, determined by ASTM 02837 using rotationally molded samples, with a service factor selected for the application. The hydrostatic design stress is 600 PSI at 73 degrees Fahrenheit for Type I 8 11 material. In accordance with the formula in 6.1, the tank shall have a stratiform (tapered wall thickness) wall.

2. The hydrostatic design stress shall be aerated for service above 100 degrees Fahrenheit and for mechanical loading of the tank.

3. The standard design specific gravity shall be 1.65.

B. The minimum required wall thickness for the cylinder straight shell must be sufficient to support its own weight in an upright position without any external support. Flat areas shall be provided to allow locating large filings on the cylinder straight shell. The bottom knuckle radius of flat bottom tanks shall be a minimum of 2 inches.

C. The top head must be integrally molded with the cylinder shell. The minimum thickness of the top head shall be equal to the top of the straight wall. The top head of tanks with 2,000 or more gallons of capacity shall be designed to provide a minimum of 1,300 square inches of flat area for fitting locations.

D. Tanks with 2,000 or more gallons of capacity shall have a minimum of 3 lifting lugs integrally molded into the top head. The lifting lugs shall be designed to allow erection of an empty tank.

E. The tie-down restraint system shall be designed to allow tank retention for seismic loading situation without tank damage. All tank tie-down restraint systems shall be compliant with current building code requirements and be stamped by a licensed Engineer in the State of Oregon.

F. All hardware shall be resistant to liquid chemical being stored and associated off gasses.

G. Unless otherwise indicated by Contract drawings, for indoor pneumatic fill, manways shall be 24-in diameter or greater and equipped with an emergency pressure relief device with pressure relief at 6” water column to prevent over-pressurization. The manway shall be chemically compatible with the chemical being stored. Gaskets shall be closed cell, cross-linked polyethylene foam, Viton, or EPDM materials.

H. Maximum diameter and heights are listed below.

1. 2,500-gallon

a. Maximum diameter (not including piping and appurtenances): 8.0 feet

b. Maximum height (not including piping and appurtenances): 10.5 feet

2.3 MATERIALS OF CONSTRUCTION

A. The tanks shall be a double contained system. The interior tank shall have a nominal volume of 2,500 gallons. The secondary containment tank shall have a minimum nominal volume of 3,100 gallons.

B. The material used shall be virgin polyethylene resin as compounded and certified by the Manufacturer. Resin used in the tank shall be High Density Cross-Linked polyethylene resin, or resin of equal physical and chemical properties, and shall contain a minimum of 0.25 percent ultraviolet stabilizer as recommended by the manufacturer.

C. The double walled tank shall be made of high-density cross-linked polyethylene that meets or exceeds the criteria listed in Table 1.

Table 1 – Materials

Parameter	Units	ASTM Test Method	Value
Density	gm/cc	D 1505	0.943 to 0.946
Tensile strength at yield	psi minimum	D 638	3290
Elongation at break	min percent	D 638	640
Stress-crack resistance	min hours for F_{50}	D 1693	1000
Vicat softening temperature	Deg F	D 1525	230
Brittleness temperature (Max)	Deg F	D 746	-180
Flexural modulus	Psi	D 790	88,700

2.4 OPERATING CONDITIONS

A. Chemical storage tanks shall be suitable for the operating conditions specified in Table 2:

Table 2 – Operating Conditions

Parameter	Units	TK-C26101
Chemical stored		Sodium Hydroxide (Liquid Caustic Soda)
Concentration	%	25%
Design specific gravity	at 60 deg. F	1.27
Solution pH	pH	12-14
Maximum fluid temperature	Deg. F	60
Minimum fluid temperature	Deg. F	35

Minimum ambient air temperature	Deg. F	60

2.5 TANK FITTINGS

A. Tank fittings shall be according to the fitting schedule below. Fittings shall be installed by tank manufacturer in the locations indicated on the Contract Drawings. Gasket material shall be EPDM or other equivalent material. PVC and CPVC fittings shall be compression type Schedule 80 long shank high-torque design with minimum of 85 percent threaded contact. Any screwed fitting shall use American Standard Pipe Threads. No metals shall be exposed to tank contents.

Table 3 – Tank Fittings

Parameter	Fitting Type[1]
	TK-C26101
Fill	2” PVC BF-H
Vent (minimum)[4]	4” PVC BF-H
Overflow	3” PVC BF-H
Outlet to Pumps	2” PVC[2]
Level Indication	Reverse Float Switch
Gasket Material	PTFE or Nitrile
Electronic Level Sensor	NPT Swivel[3]

Note 1: Refer to drawings for fitting size and location. Abbreviations for fittings are:
- BF-H: Bolted flanged with Hastelloy-C studs and polyethylene encapsulated heads.
- BF-SS: Bolted flanged fitting with 316 stainless steel studs, and polyethylene encapsulated heads.
- DB-SD: Double bolt with siphon drain, 316 stainless steel, and polyethylene encapsulated heads.
- PVC: Double-nut PVC fittings.

Note 2: Outlet to pump located 6” above floor with siphon leg to 3” above floor.

Note 3: Contractor to coordinate NPT swivel mount fitting with approved sensor.

Note 4: Final say on the vent size shall be determined by the tank manufacturer.

B. Bolted flange fittings shall be constructed of one 150 lb. flange with ANSI bolt pattern, one flange gasket and stud bolts with gaskets. Stud bolts to have chemical resistant polyethylene injection molded heads and gaskets to provide a sealing surface between the bolt head and the interior tank wall. Stud bolt heads are to be color coded for visual ease of identifying the bolt material by onsite operators. Green- 316 Stainless Steel, Black- Titanium, Red- Alloy C-276, Blue- Monel. All materials shall be compatible with chemical service and as indicated in the fitting schedule above.

C. Down Pipes and Fill Pipes: Down pipes and fill pipes shall be supported at 6-ft max intervals. Down pipes and fill pipes shall be PVC or material compatible with the chemical stored.

D. Vents: Each tank must be vented for the material and flow and withdrawal rates expected. Vents should comply with OSHA 1910.106(F)(iii)(2)(IV)(9). Vents sizes shall be confirmed with the above schedule by tank manufacturer prior to bid and meet the minimum size requirements of the schedule. If a larger vent is required, the manufacturer shall provide such vent size at no additional cost to the Owner.

E. On dual wall tank(s) greater than 1000 gallons, bottom fitting(s) must be designed to maintain 110% secondary containment integrity. Bottom outlet flange fitting must include PTFE expansion joint designed to accommodate movement of primary tank in design accordance with ASTM-D 1998 tolerances. All secondary containment fittings and parts shall be resistant to chemical fume corrosion. Fitting shall include the option to connect a secondary containment pipe over primary pipe.

F. All fittings on the 1/3 lower sidewall of tanks with capacities > 1000 gallons shall have 100% virgin PTFE expansion joint. Expansion joint to have 3 convolutions, stainless steel limit cables, FRP composite flanges and meet the following minimum performance specifications. Galvanized parts will not be accepted. Expansion joints to meet the following minimum performance requirements:

1. Axial Compression ≥ 0.67”

2. Axial Extension ≥ 0.67”

3. Lateral Deflection ≥ 0.51”

4. Angular Deflection ≥ 14º

5. Torsional Rotation ≥ 4º

2.6 LEVEL INDICATION

A. Reverse Float Level Indication: The level indicator shall be assembled on the tank to act inversely to the tank contents and at no time shall allow tank contents into the exterior sight tube. The indicator shall be neon orange for visual ease. The level indication assembly shall include a PVC float, neon orange indicator, polypropylene rope, 4-inch interior perforated pipe, PVC roller guide elbows, 2-inch clear UV resistant PVC EnviroKing® sight tube (C.F. Harvel) and all required pipe supports.

2.7 TANK ACCESSORIES

A. Restraint System: Metal components shall be galvanized and tension ring with stainless steel or galvanized cables and clamps. Professional Engineer stamped seismic calculations shall be required per part 2.02.E.

B. Manways shall be 19-in. diameter or greater and equipped with an emergency pressure relief device or SAFE-Surge™ Manway. The SAFE-Surge™ Manway shall relieve pressure at 6” water column to prevent over-pressurization. The SAFE-Surge manway shall be chemically compatible with the chemical being stored. Gaskets shall be closed cell, cross-linked polyethylene foam, PTFE, Nitrile, or EPDM materials.

C. Heating: Heating system for temperature maintenance shall be from SilcoPad® tank heating systems designed to maintain a desired product temperature, and not to exceed 100 degrees F. Each system shall include tank heating pads and a temperature controller. The quantity and type of SilcoPad® is determined by the size of the tank, the desired temperature maintenance, and environmental conditions. Systems shall be available in 30-, 60- or 100-degrees F. Tanks are supplied with heating panels and a controller installed by the manufacturer. Power supply to be the only field installation required.

1. Pads to operate on 120 vac single phase with a maximum power density of 0.5 watts/sq.inch.

2. Silicone pad heaters must fully comply with Article 427-23 (b) of the National Electric Code.

3. Temperature controller to be supplied with two electronic thermostats switching the heating system via one solid state relay. Primary thermostat to control desired product temperature and secondary thermostat to provide over temperature protection at 150 degrees F.

D. Insulation: Insulation used shall be polyurethane foam with a density of 2.5 lb/ft3 with a minimum an “R” value of 6.3/in. The foam shall be applied with a nominal thickness of 2” to the external tank surfaces except the tank bottom. Upon completion of application and curing of the insulation, 2 full coverage coats of latex mastic coating shall be applied to the surface of the insulation in such manner as to seal the insulation from the outside environment.

2.8 MANUFACTURER, OR EQUAL

A. Poly Processing

B. Snyder-Crown

C. Assmann

D. Equal must be pre-approved during bidding process

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the Manufacturer's recommendations.

B. Installation will be inspected by manufacturer to verify system flexible connections, venting and fittings are properly installed. In addition to on-sight inspection tank system(s) to be reviewed using tank manual check list as supplied by manufacture as listed below.

C. Manufacturer's trained technician to do an onsite inspection of installation. Inspection will verify chemical application, plumbing connections, venting, and applicable ancillary equipment such as ladders, restraints, etc. A verification of proper installation certificate will be supplied when equipment passes installation checklist.

D. Tank manuals will consist of installation check lists, tank drawing(s) as built, fitting drawings referencing nozzle schedule on tank drawing, materials of construction, and recommended maintenance program.

3.2 FIELD TESTING

A. After installation of tank and all fittings, the tank shall be water tested by filling the entire tank with water and monitoring the tank as well as all fitting connections for at least 24 hours. Any leaks shall be corrected prior to acceptance. Following successful field testing, the tank shall be completely emptied and dried.

END OF SECTION 43 41 43

SECTION 44 31 19 – PACKAGED BIOLOGICAL ODOR CONTROL SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This Section covers the Work necessary to provide a complete and properly functioning packaged 2-stage biological odor control system of unitary construction, including requirements for system construction, components, materials, functional testing, quality and use.

B. The contractor shall furnish all materials, equipment and incidentals required to install a packaged biological odor control system as shown on the drawings and specified herein.

C. The entire system shall consist of the following major components:

1. FRP Exhaust Fan
2. FRP Vessel with Extended Deck
3. Inorganic Biological Media (Stage 1)
4. Activated Carbon Media (Stage 2)
5. Air Distribution System
6. Media Irrigation System and Water Cabinet
7. FRP Electrical Control Panel
8. Nutrient Tank
9. Nutrient Pump
10. FRP Exhaust Stack

D. Inlet ductwork will be provided by the contractor to collect the foul air and deliver it to the fan inlet. The ductwork is specified elsewhere and is not part of this specification.

1.2 SYSTEM DESCRIPTION

A. The biological odor control system shall consist of an exhaust fan, FRP vessel, inorganic biological media, activated carbon media, air and irrigation system, control panel, exhaust stack, dampers, valves, piping and all other equipment and accessories for a complete system.

B. The complete odor control system shall be packaged and of unitary construction design. All components of the system shall be mounted on the vessel. No exception to this requirement is allowed.

C. The packaged biological odor control system shall be a once-through system. The system is equipped with an exhaust fan that continuously draws the odor-laden air from the process areas into the biological odor control system for treatment. The biological odor control system shall be a two-stage system. Stage 1 shall utilize an inert, porous, mineral, expanded clay material designed to remove hydrogen sulfide (H_2S) and resist compaction and degradation from the acidic sulfates of the biological oxidation of the hydrogen sulfide. Stage 2 shall utilize a pelletized coal activated virgin carbon media to remove any remaining hydrogen sulfide as well as other odorous organic compounds.

D. The first stage shall operate with an independently controlled irrigation process to provide Stage 1 media with adequate moisture to sustain bacterial growth and to remove toxic byproducts. The irrigation process shall be controlled by a programmed timing sequence that actuates a solenoid valve located on the water supply piping. Nutrients shall trickle down over the media to enhance and sustain the biological activity. The nutrients shall be housed in a tank and shall be dosed into the system by a nutrient pump. A pre-wired control panel shall be provided to ensure proper control and operation of the system. The cleaned air is discharged to the atmosphere through the stack (s) at the top of the unit.

E. The odor control system shall be designed for the following operating conditions:

Parameter	**Value**
Quantity	1
Airflow Rate, cfm	300
Avg. Inlet H_2S Concentration, ppm	10
Peak Inlet H_2S Concentration, ppm	20

F. The odor control system shall demonstrate the following performance:

INLET	**OUTLET**
1-10 ppm H_2S	0.1 ppm H_2S
>10 ppm H_2S	1.0% of inlet

G. The pressure drop across the biological odor control system shall not exceed 5.0” W.C. at the maximum airflow rate specified above.

1.3 REFERENCE STANDARDS

A. PS 15-69: National Bureau of Standards Voluntary Product Standard “Custom Contact Molded Reinforced Polyester Chemical Resistant Process Equipment.”

B. ASTM D-883: “Definition of Terms relating to Plastics.”

C. ASTM D-2583: “Test for Indentation Hardness of Rigid Plastics by Means of Barcol Impressor.”

D. ASTM D-2563: “Recommended Practice for Classifying Visual Defects in Glass Reinforced Plastic Laminate Parts.”

E. ASTM D-4097-82: “Standard Specifications for Contact Molded Glass Fiber Reinforced Thermoset Resin Chemical Resistant Tanks.”

1.4 QUALITY ASSURANCE

A. Manufacturer Requirements:

1. All equipment provided under this section shall be obtained from a single manufacturer, who shall:

a. Assume full responsibility for the completeness and proper operation of the biological odor control system.

b. Have experience; be reputable and qualified in designing and manufacturing biological odor control system equipment. The odor control system manufacturer shall show evidence of at least ten (10) identical 2-stage design installations of the type specified in wastewater plants with specified non-proprietary biofiltration media.

c. Supply units containing all necessary appurtenances and components for a complete and operating system conforming to this specification. The entire system shall be pre-assembled, piped, wired, and factory tested prior to shipment to facilitate installation and start-up at the jobsite. The overall system footprint, including the vessel, fan, nutrient tank, nutrient pump, water irrigation piping, water cabinet and accessories, control panel and appurtenances shall not exceed the dimensions shown on the contract drawings. The system equipment layout shall match site requirements. Any exception to this requirement is not acceptable.

d. Supply units with inorganic biological odor control media. Provision of organic biological media shall not be acceptable. Systems using any type of structured, synthetic media shall not be acceptable. Systems using any proprietary media shall not be acceptable.

e. The complete biological odor control system, including vessel, fan, media, nutrient tank, nutrient pump, water irrigation cabinet, piping and accessories, and controls shall be constructed to be a single piece of unitary construction. Any exception to this requirement is not acceptable.

2. To ensure quality and complete unit responsibility, the complete system must be assembled and tested by the manufacturer at its facility and be a standard and regularly marketed product of that manufacturer. The manufacturer must have a physical plant, technical and design staff, and fabricating personnel to complete the work specified.

3. The owner reserves the right to be present at the manufacturer’s facility for visual inspection of equipment to be supplied and to witness factory functional testing.

B. ACCEPTABLE MANUFACTURERS

1. Integrity Municipal Systems, LLC (IMS)

2. Or approved equal

C. WARRANTY

1. The manufacturer shall warrantee that the equipment provided shall be free of defects in material and workmanship for a period of 12 months from beneficial occupancy. The warranty period shall not extend beyond 18 months from delivery of the system to the jobsite. The warranty does not apply to the carbon media.

1.5 SUBMITTALS

A. Submit in accordance with Section 01 33 00 – Submittal Procedures. Submittals shall include but not be limited to the following:

1. Shop drawings and catalog literature showing dimensional information, details of piping and fabrication and erection of all materials and equipment furnished under this section.

2. Drawing of general arrangement and major system components.

3. Process and Instrumentation drawing.

4. Major system component information and descriptive literature for the following:

a. Exhaust fan

b. Nutrient pump

c. Water irrigation cabinet

d. Vessel fabrication

e. System controls and control panel details including power and control wiring diagrams, terminals, and numbers

f. Miscellaneous instrumentation and accessories

5. Installation instructions.

6. Operating weight of all equipment.

1.6 OPERATION AND MAINTENANCE DATA

A. Detailed operation and maintenance (O&M) manual for the system shall be provided by the manufacturer. A total of two (2) copies of O&M manuals are required. Manufacturer shall submit operation and maintenance data and equipment parts list in manual, in accordance with Section 01 78 23 – Operation and Maintenance Data.

1.7 MANUFACTURER SERVICES

A. The system manufacturer shall be present at the jobsite for the following time period after the system is installed, travel time excluded:

1. Sixteen (16) hours for system startup, certification of proper installation and training of Owner's staff in operation of the system.

2. Provide one trip for 2 days for these tasks.

PART 2 - PRODUCTS

2.1 BIOLOGICAL ODOR CONTROL SYSTEM

A. The odor control gas treatment system shall be a once-through biologically active odor removal system treating the odorous air from the contaminated process areas. The system shall be designed for continuous and automatic operation as well as manual operation as required.

B. The biological odor control system shall be a two-stage system. The system shall consist of one biological treatment stage (Stage 1) followed by an activated carbon polishing stage (Stage 2) in series. The first stage shall be wetted with fresh potable or reuse make-up water. The first stage shall include a spray header to distribute liquid evenly over the media.

C. FRP vessel, inorganic biological media, activated carbon media, exhaust fan, exhaust stack, nutrient tank, nutrient pump, water irrigation system, air distribution system, control panel and all other required appurtenances shall be pre-assembled as complete 2-stage biological odor control system package. Components of the biological odor control system shall comply with this specification. The entire system shall be pre-assembled, piped, wired, and factory tested prior to shipment.

2.2 FRP VESSEL

A. The biological odor control system shall consist of a fiberglass reinforced plastic (FRP) vessel with extended deck. The vessel shall be of unitary construction. No modular construction or flanged pieces are allowed for the vessel itself.

B. The system vessel shall have all components pre-mounted and piped. The system vessel shall be shipped as one piece. The system shall be included with all piping, valves and internals. The system top shall be removable for access to the top of the vessel's second stage.

C. The biological odor control system shall be manufactured with the following material of construction according to following fabrication method:

1. Vessel and accessories shall be contact molded manufactured in accordance with NBS PS15-69, ASTM 4097 for contact molding.

2. Resin used in fabrication shall be a premium vinyl ester resin such as Hetron 922 or Derakane 411 by Ashland Chemical, Vipel F010 by AOC or approved equal. The resin shall be reinforced with an inner veil of suitable synthetic organic fiber such as Nexus 111-00010. Any material of construction other than FRP with premium grade resin shall not be acceptable.

3. Reinforcement: Glass fiber reinforcement used shall be commercial grade corrosion resistant borosilicate glass.

4. Fabrication: Fabrication shall be in accordance with NBS PS 15-69, ASTM D 3299 and ASTM D-4097. All non-molded surfaces shall be coated with resin incorporating paraffin to facilitate a full cure of the surface. All cut edges, bolt holes, secondary bonds shall be sealed with a resin coat prior to the final paraffinated resin coat.

   a. Corrosion Liner: The inner surface of all laminates shall be resin rich and reinforced with one NEXUS 111-00010 with a minimum thickness of 10 mils. The interior corrosion layer shall consist of two layers of 1 1/2 oz. per sq. ft. chopped strand mat. The total corrosion liner thickness shall be a minimum of 100 mils.

   b. Structural Laminate: Structural laminates shall consist of alternating layers of 1-1/2 oz per sq. ft mat of chopped glass and 24 oz per sq. yard woven roving applied to reach a designed thickness. The exterior shall be surface coated with white gel coat containing ultraviolet light inhibitors.

D. Access Manways: The vessel shall be provided with access manways to allow access to the internals of the odor control system. As a minimum, access manways shall be provided between stages.

E. Media Support and Screen: The system vessel shall be provided with an HDPE and FRP support system with polypropylene screen to accommodate the biological media and carbon media beds.

F. Vessel Accessories: The system shall be provided with all piping, valves and internals. Air inlet, air outlet, spray headers, drain and all vessel fittings shown on the drawings shall be provided by the Manufacturer.

G. Hardware and Gaskets: All hardware and anchor lugs shall be 316 stainless-steel. All bolts shall be designed for the specified loads. Gaskets shall be a minimum of 1/8” thick, full face, EPDM, suitable for the intended service.

H. Neoprene Pad: A ¼” thick, 60 durometer neoprene pad must be placed underneath the scrubber vessel during installation.

2.3 ODOR CONTROL MEDIA

A. The system shall use in stage 1 an inorganic expanded clay biological media as the support substrate for selectively growing sulfur-oxidizing autotrophic bacteria. The media shall be randomly dumped in the vessel to allow a low pressure drop. The media is porous and is resistant to hydrogen sulfide (H_2S) and acidic conditions. The media shall be non-proprietary and commercially available.

B. The system shall use in stage 2 a coal based activated carbon media to adsorb residual H_2S and other odor compounds. This stage shall provide final removal of odors to specified level.

C. Overall media depth shall be a minimum of 48 inches.

2.4 EXHAUST FAN

A. General: Fan shall be centrifugal design manufactured of FRP with a radial blade wheel. No other material of construction is acceptable. The wheel shall be statically and dynamically balanced. The fan inlet shall be slip type and the fan outlet shall have a flanged nozzle. The fan will be provided with a double lip type shaft seal.

B. Fan shall be supplied with a TEFC motor with 1.15 service factor suitable for 3ph/60Hz/480V service. The fan shall be direct driven. The motor shall be inverter-duty.

C. Performance: The fan shall be tested and rated in accordance with AMCA and shall bear the AMCA seal.

D. The fan shall be New York Blower, Hartzell or equal.

E. The fan shall be designed for the following specifications:

Parameter	**Value**
Airflow Rate, cfm	300
S.P. up to System Inlet, in W.C	2.0
Total Pressure Drop, in W.C	5.0
Motor, HP	1.0

2.5 FRP EXHAUST STACK

A. The scrubber system shall be provided with an exhaust stack manufactured of FRP.

B. The exhaust stack shall be contact molded and manufactured in accordance with NBS PS15-69 and ASTM D-4097 for contact molding. The resin used in the fabrication of the exhaust stack shall be the same as that used for the main vessel such as Hetron 922 or Derakane 411 by Ashland Chemical, Vipel F010 by AOC or approved equal.

2.6 SYSTEM ELECTRICAL CONTROL PANEL

A. The electrical control panel shall house all required controls for the entire system. The electrical control panel is pre-mounted on the system and pre-wired at the factory.

B. The control panel enclosure shall be rated NEMA 4X and shall be made of FRP. The control panel shall be factory tested to full operation with all other components prior to shipment.

C. The control panel shall provide electrical control for the entire system with as a minimum the following switches, alarms and accessories:

1. “On-Off” switch for Exhaust Fan
2. Remote start command contact.
3. “Exhaust Fan Running” indicator light and dry contact.
4. VFD for exhaust fan
5. Exhaust fan fail dry contact.
6. “Hand-Off-Auto” switch for Nutrient Pump
7. “Nutrient Pump Running” indicator light and dry contact.
8. “Nutrient Tank Low” indicator light and dry contact.
9. Push button switch with status lights for water valve
10. Timer relay for on/off control of water valve
11. Control Transformer (480V to 120V)

2.7 INSTRUMENTATION AND WATER CONTROLS

A. The water irrigation controls shall be mounted in a completely separate FRP water cabinet on the vessel and shall consist of the following components:

1. Ball valves
2. Pressure reducing valve
3. Pressure gauge
4. Solenoid valve
5. Gate control valve
6. Rotameter- Variable area type with a Teflon float, EPR O-rings and PVC fittings. The rotameter shall have a direct reading scale.
7. Nutrient injection connection
8. Water fill piping for nutrient

9. Nutrient pump

B. An independent media irrigation system is incorporated into Stage 1 to provide the biological media with adequate moisture. The system shall be designed to irrigate the top of the first media bed with complete and even coverage via spray nozzles. Potable water or plant effluent water can be used provided that residual chlorine concentrations are less than 5 ppm.

2.8 PIPING

A. All make-up water and drain piping shall be SCH 80 PVC.

2.9 INTEGRATED NUTRIENT RESERVOIR AND NUTRIENT PUMP

A. Nutrient Addition: The packaged biological odor control system uses a non-proprietary, commercially available fertilizer to provide essential nutrients to optimize the growth of sulfur-oxidizing bacteria. Nutrients supplied as a coating to the support media or proprietary nutrients shall not be allowed. The system shall be equipped with a nutrient addition system that provides a controlled dosage of nutrients that is automatically fed to the irrigation water during each irrigation cycle with the help of a nutrient pump.

B. The Nutrient reservoir shall be integral to the system and mounted on the system deck. The nutrient reservoir shall be made of FRP. The nutrient reservoir shall have a float-type level switch to detect a low level. Loose nutrient tanks shall not be acceptable.

C. The Nutrient pump shall be solenoid type and shall be mounted in the water cabinet.

2.10 FREEZE PROTECTION

A. The system shall be equipped with freeze protection features as follows:

1. A heating strip shall be provided in the water cabinet on the system

2. The nutrient reservoir shall be heat traced and insulated

B. The appropriate controls for the above-mentioned freeze protection features shall be provided in the local control panel.

C. The contractor shall be responsible for the heat trace and insulation of all water piping from the water source to the system and for all exposed piping provided on the system. All associated controls for heat trace shall be the responsibility of the contractor.

PART 3 - EXECUTION

3.1 FACTORY ASSEMBLY AND TESTS

A. Each system shall be pre-assembled at the manufacturing location.

B. System(s) shall be tested at the location of assembly to assure they are in full operational and working order per the requirements of the specific design(s) for the project as described in this specification.

C. Engineer and/or Owner reserve the right to be present at the manufacturer's testing facility to witness the factory functional testing. Engineer and/or Owner shall provide intent to witness functional testing at the time of the design submittal review and approval, and manufacturer shall provide notice to Engineer and/or Owner regarding the scheduled time of the functional testing at least five business days in advance of the proposed functional testing.

D. Factory testing shall include visual inspection of all equipment, complete assembly and functional operating testing of components including piping and equipment check, and verification of control panel wiring and operation.

3.2 DELIVERY AND INSTALLATION

A. System(s) shall be packaged and shipped so as not to incur damage to any portion of the system through handling and installation of the system itself.

B. System(s) shall be installed per the manufacturer's guidelines and recommendations. Installation shall include the re-assembly of any items separately packaged for protection during shipment. Site preparation, utility service and installation are not provided by the Manufacturer under these specifications.

C. It is the contractor's (or owner's) responsibility to provide:

1. FRP inlet piping from pick-up point source to fan inlet connection.

2. Wiring to/from system control panel to remote-mounted equipment, plant SCADA, etc.

3. Power to system control panel (480V, 3 ph, 60 Hz, 25 Amps).

4. Suitable concrete mounting pads and other incidentals as necessary to complete the installation.

5. Drain – a minimum of 1 inch PVC gravity drain to sewer with a barometric trap.

6. Water Supply – a ¾ inch water supply with backflow preventer is required. The nominal water requirements are at a rate of 6.0 gpm and a pressure of 30 psi. Hardness shall not exceed 200 mg/l as calcium carbonate.

3.3 FIELD START-UP

A. A factory representative from manufacturer shall be present at the jobsite for initial system start-up of equipment as specified in Section 1.7. Factory representative will ensure that system is properly installed, will start-up the system and train owner's personnel.

END OF SECTION 44 31 19

SECTION 46 21 35 - ROTATING DRUM IN-TANK SCREEN

PART 1 - GENERAL

1.1 SCOPE

A. The Contractor shall furnish, install and place into satisfactory operating condition one (1) fully automatic, self-cleaning, tank mounted rotating drum screen with a manual screen bypass chamber for wastewater applications and associated controls for removing floating, particulate, or fibrous material and to transport washed and dewatered screenings to an auger conveyor as shown on the Drawings and described in the Specifications.

B. All equipment called for under this Section shall be supplied by a single manufacturer. The in-tank rotating drum screen and manual bypass screen shall be supplied in one piece requiring no field assembly. The rotating drum screen manufacturer shall take sole responsibility for the screen supplied.

C. The NEC classification for the Screen Equipment is Class 1, Division 2 Hazardous location. Equipment and accessories shall be rated for this environment.

1.2 REFERENCES

A. AISI (American Iron and Steel Institute)

B. ABMA (American Bearing Manufacturers Association)

C. AGMA (American Gear Manufacturers Association)

D. NEMA (National Electrical Manufacturer’s Association)

E. NFPA (National Fire Protection Association)

F. ASTM (American Society for Testing and Materials)

G. WSC (American Welding Society Code)

H. ASME (American Society of Mechanical Engineers)

I. NEC (National Electrical Code)

J. UL (Underwriters Laboratory Standards)

K. Anti-Friction Bearing Manufacturers Association (AFBMA) Publications:

1. Standard 9-90 Load Ratings and Fatigue Life for Ball Bearings.

2. Standard 11-90 Load Ratings and Fatigue Life for Roller Bearings.

L. American Institute of Steel Construction (AISC) Publications

M. American Welding Society (AWS) Publications

N. American Structures Painting Council (ASPC) Publications

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 00 – Submittal Procedures. Submittals shall include but not be limited to the following:

1. A complete set of drawings, specifications, catalog cut-sheets, and detailed descriptive material. This information shall identify all technical and performance requirements stipulated on the drawings and in the specification.

2. Detailed information shall be submitted for all items such as hardware, motors, reducers, motor controllers and instrumentation (field devices, major control panel devices, and anticipated control panel layout).

3. Vendor data shall be furnished to confirm the torque and thrust rating of the drive.

4. List showing materials of construction of all components.

5. Manufacturer's recommended spare parts.

6. Information on equipment field erection requirements including total weight of assembled components and weight of each sub-assembly.

7. A maintenance schedule showing the required maintenance, frequency of maintenance, lubricants and other items required at each regular preventive maintenance period, including all buy-out items.

8. Process equipment electrical requirements and schematic diagrams.

9. Functional description of controls.

10. Submit anchoring calculations in accordance with Section 43 05 50 – Equipment Mounting sealed by a civil or structural engineer currently licensed in the State of Oregon.

11. Complete list of deviations from the drawings and specifications.

B. Submit Operation and Maintenance Data in accordance with Section 01 78 23 – Operation and Maintenance Data.

1.4 FEATURES

A. The rotary perforated plate screen shall be a rotary basket, perforated plate screen with an integral screw conveyor and press. The perforated plate screen shall use a single drive for screening, conveying, dewatering and compressing screening material. Systems other than rotary perforated plate screens with integral screening, screenings washing, transport, and compaction/dewatering using a single motor drive system, will not be considered for this project.

B. The screen design shall minimize solids deposition in the tank.

C. Operation of the rotating basket perforated plate screen and spray bar shall be automatically initiated at a preset high liquid level. Screens which operate continuously or via timer only will not be acceptable. The brush and/or spray bar which are mounted above the rotating basket shall remove solids from the screening basket and deposit them into the concentric screw conveyor trough as the basket rotates. The screenings shall be transported up the screw conveyor and through a compression chamber.

D. The screen basket shall be intermittently cleaned as required by the upstream water level in order to always present a clean screening surface to the flow to ensure minimum headloss and rapid cleaning of the screen. All open spaces of the screen shall be positively cleaned via spray nozzles or brush bristles which pass through the full depth of the perforations during the continuous cleaning cycle.

E. The control system shall be designed so that the cleaning characteristics of the screen and wash systems can be changed via the programmable controller. Systems which do not offer this feature will not be considered for this project.

F. Enclosures

1. To minimize odors and nuisance insect populations, the rotary perforated plate screen transport system and compaction/dewatering system shall be completely enclosed. A foul air connection shall be provided to connect the tank to a foul air treatment system. Connection shall be 4” diameter and shall be able to be connected to foul air piping via standard flexible connectors.

2. The spray wash systems shall be completely enclosed to prevent spray, aerosols, and leakage from coming in contact with the operating floor.

1.5 QUALITY ASSURANCE

A. The equipment manufacturer shall, in addition to the Contractor, assume the responsibility for proper installation and functioning of the equipment.

B. The Contract Documents represent the minimum acceptable standards for the screening equipment for this project. All equipment shall conform fully in every respect to the requirements of the respective parts and sections of the drawings and specifications. If not named, equipment which is a "standard product" with that manufacturer shall be modified, redesigned from the standard mode, and shall be furnished with special features, accessories, materials of construction or finishes as may be necessary to conform to the quality mandated by the technical and performance requirements of the specification. The entire unit shall be manufactured from AISI 316 stainless steel shapes.

C. Manufacturer shall provide screen, wash press, motors, gear reducers, controls, control panels, and lifting attachments as a complete integrated package to ensure proper coordination, compatibility, and operation of the system. The manufacturer shall test-run the fully assembled machine in his factory before shipment.

D. A written manufacturer warranty shall be provided. The warranty shall be for a minimum period of one (1) year from the date of start up. Manufacturer shall repair or replace all defects of materials or workmanship in the equipment during the warranty period. Corrections shall be completed within five (5) days after notification.

E. All Equipment shall be the product of a manufacturer having at least 10 years of experience manufacturing this product and 50 installations in satisfactory operation for at least five years. A list of installations shall be furnished upon request.

F. The Rotating Drum Screen shall be shipped to the site fully assembled.

G. Screenings Capture Rate (SCR) / Efficiency: Percentage of material larger than screen perforation size captured by the screen as documented by the National screen evaluation facility at Chester Lee Street in England by TRPM and Northumbrian Water. The documented report of the test which shows the result of screenings capture rate (SCR) must be provided with submittals.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. The rotary perforated plate screen unit shall consist of a rotating screen basket, basket cleaning brush and/or basket cleaning spray bar, concentric screw conveyor, dewatering screw, gear reducers, support leg, anchor bolts, and screening press with controls and drive unit.

B. The screening system shall be complete with local controls, main control panel, and level sensor.

C. All fabricated parts of the screen shall be stainless steel unless noted otherwise.

D. Screen Design Summary (based on SAVECO SAVI Flo-Drum Tank Mounted Rotating Drum Screen Model VSA 800/6-T with Manual Screen Bypass):

1.	Number of Mechanical Screens	1
2.	Number of Manual Bypass Screens	1
3.	Influent Type	Municipal Wastewater
4.	Maximum Influent Solids Concentration, mg/l	400
5.	Maximum Flow per screen, gpm	660
6.	Maximum Downstream Water Level, inches	8”
7.	Minimum Downstream Water Level, inches	0”
8.	Screening Perforation size, inches	0.25” (6 mm)
9.	Nominal Screening Basket Diameter, inches	31

10.	Drive Motor Size, hp	1.5
11.	Tank Length, ft	6.9
12.	Tank Width, ft	3.1
13.	Tank Height, ft	5.6
14.	Screenings discharge height from mounting floor, ft	5.2
15.	Influent Flange Size, in	10
16.	Effluent Flange Size, in	12
17.	Minimum Screenings Capture Ratio (SCR)	66%
18.	Wash Water Flow Rate, gal/min	20
19.	Maximum Wash Water Pressure, psig	72

2.2 GENERAL

A. The in-tank rotating drum screen shall be designed to handle the maximum flow rate noted in paragraph 2.1.D.5 with the maximum downstream liquid level noted in paragraph 2.1.D.6.

B. Equipment provided shall be fully automatic, self-cleaning, perforated plate rotating drum screen(s). Screen(s) will be provided with an angle-of-inclination of 35˚ from horizontal.

C. Each rotating drum screen unit shall be provided with a rotating screen basket, basket cleaning spray bar(s), basket cleaning brush, concentric screw conveyor with integral screenings washing, dewatering and screenings compaction zone with single motor drive system.

D. The average in-tank rotating drum screen flow through velocity shall not exceed 3.3 ft/sec (1.0 m/sec) under any flow condition up to the maximum hydraulic capacity noted in paragraph 2.1.D.

E. The screen shall be designed so that there are no metal on metal wearing surfaces in the screening, transport and compaction/dewatering zones of the screen. The spiral shall be supported between the gearbox and the bottom bearing and shall not rely on the anti-rotation bars for support. Units requiring wear liners or wear bars shall not be accepted.

F. The screening equipment shall produce dewatered screenings capable of passing the EPA Paint Filter Test as described in Method 9095 of EPA Publication SW-486.

G. The rotating drum screen shall be capable of presenting a clean filtration surface to the oncoming liquid stream at all times during operation.

2.3 TANK ASSEMBLY

A. The tank shall be constructed from type 316L stainless steel. The tank shall be designed to withstand the hydrostatic load from the process flow through the unit and provide support of the screenings basket area. The tank is supplied with footings for anchoring the unit and lifting lugs for installation. The tank shall be supplied with flanged inlet and flanged outlet connections as per Part 2.1.

B. The top of the tank shall be enclosed by type 316L stainless steel cover, including hinged and removable access covers.

C. A separate support stand shall be constructed from type 316L stainless steel and provide support of the conveyor tube extension.

2.4 DRUM SCREEN BASKET

A. The Drum Screen Basket shall be designed and built to withstand the maximum possible static hydraulic forces exerted on the screen by the liquid flow (including the tank being completely filled with liquid). Structural and functional parts shall be sized to prevent deflections or vibrations that may impair the screening, conveying, washing and compacting operations.

B. The drum screen basket shall be of a cylindrical shape with perforations around the entire basket.

C. The drum screen basket shall be perforated plate with maximum openings of 6 mm. Bar screens, wire mesh or wedge wire will not be acceptable screen media.

D. The top end ring and the bottom drive ring inclusive of support arm(s) shall each be made from a single plate from stainless steel. Units which use multiple pieces for each end and that are welded or otherwise affixed shall not be accepted.

E. A support arm hub shall be welded directly to the support arm(s). The hub shall be machined complete with keyway from a single piece of stainless steel. The hub shall be sized to support the drum screen basket without deflection or distortion.

F. The drum screen basket shall have shaped lifting vanes to retain loose solids during rotation and lift them up and into the screw auger trough. Helical shaped vanes which can tumble screenings rather than lift screenings shall not be accepted.

G. A one piece stainless steel seal plate shall be provided to direct water flow into the circular drum screen basket in the channel. The seal plate shall be sufficient to prevent bypassing of flow around the screen basket at the maximum screen hydraulic capacity.

H. The drum screen basket shall be provided with a triple face seal system, incorporating an internal brush to minimize bypassing of hair and other fine particles, one HDPE seal creating a labyrinth through a ring welded on the drum screen, and an external rubber seal pressing on the external part of the drum ring preventing laminar bypass. Any unit which does not incorporate this design will not be accepted.

I. The upper portion of the drum screen basket shall have a brush seal to prevent screenings from being carried into the channel from splashing inside the drum.

J. The drum screen basket and screw conveyor shall be fixed to the same shaft and driven by a common drive.

K. The drum screen basket shall be supported by the drive end with a reinforced support arm and by nylon rollers at the opposite end. Each of the rollers shall use two ball bearing assemblies mounted to the stainless steel shaft. The rollers and bearings shall require no lubrication. A preload adjustment system shall be included for the rollers. Screens using wear shoes or glides to guide or support the basket shall not be accepted.

2.5 DRUM SCREEN BASKET CLEANING BRUSH AND SPRAY BAR(S)

A. The rotating drum screen basket assembly shall be cleaned by a high pressure stainless steel spray bar with stainless steel spray nozzles and a stainless steel backed polypropylene brush. The drum screen basket shall continuously rotate in one direction during the cleaning cycle and pass through the topmost portion where it is cleaned by the spray bar and brush.

B. The drum screen basket shall incorporate a brush and spray wash located above the basket to remove solids from the screening basket and direct them into the concentric screw conveyor trough as the basket rotates.

C. The cleaning brush shall be mounted on a holding device which keeps the brush in constant contact with the screen basket and can be adjusted to compensate for brush wear.

D. The drum screen basket shall have a stainless steel backed brush attached to sweep materials from the edge of the screw conveyor trough.

2.6 SCREENINGS CONVEYOR AND DEWATERING ZONE

A. The transport tube shall be provided with anti-rotation bars bolted from the outside along the longitudinal axis. The screenings screw conveyor shall not be dependent on the anti-rotation bars for support during normal operation.

B. The screenings shafted screw conveyor shall be constructed of an epoxy coated high strength alloy steel for maximum torsion resistance in the screw. The screw shall be near-white blasted, primed with an inorganic zinc primer and coated with a two part epoxy in the factory and no field coating shall be applied without manufacturer’s consent.

C. The screen basket rollers and screenings collection hopper shall be attached to the screenings transport tube by a basket support flange. The drive assembly shall be attached via a drive support flange welded to the upper end of the screenings transport tube. The basket shall be mounted to the unit with a solid support arm hub at the lower end of the basket. The support arm hub shall be bolted directly to the concentric screw shaft.

D. The concentric transport/dewatering screw shall be designed to transport and dewater the screened material. The unit shall be provided with screw flights of constant pitch approaching the compaction zone in order to prevent clogging in the compaction zone. Designs incorporating a decreasing pitch screw will not be accepted.

E. The screenings screw conveyor shall be supported by a sealed, self-lubricating lower bronze bushing. The shaft in contact with the bushing shall be protected by chrome a plated sleeve. The lower bushing shall be designed such that it does not take any thrust load from the screw conveyor. Designs requiring bearings of any type or externally lubricated bushing(s) or water injection into the housing shall not be accepted.

F. The lower bearing shall have a 10-year or 55,000 hours of bearing life. Bearings unable to meet this service life will not be accepted.

G. The stainless steel lower bearing shaft and arm(s) shall be designed to minimize material wrapping around the shaft. A stainless steel seal plate shall be provided to mate between the stationary lower bearing support and the rotating arm(s) to prevent material intrusion into the bearing seals.

H. The compaction zone shall be integral to the screenings screw conveyor and compaction tube. The compaction zone shall be designed to form a screenings plug and return water released from the screened material back to the channel through circular holes that are machined into the screenings compaction tube.

I. The screw conveyor shall transport the screenings to the compaction/dewatering chamber. After compaction and dewatering, the screenings shall be discharged with the aid of a serrated blade.

J. The compaction zone housing shall be fabricated entirely of 316L stainless steel. The lower body shall be a welded construction with a minimum of 10 mm end plates for maximum torsion resistance. The bottom of the compaction zone shall be curved to promote maximum cleaning and minimum depositing of materials. Units utilizing a fiberglass reinforced compaction zone housing will not be accepted.

K. The compaction zone shall be furnished with a latched, hinged access cover with a gasket. The access cover shall incorporate a motor cut-out switch to prevent operation of the unit with the access cover open. Units which require the use of any tools to gain access to the compaction zone will not be accepted.

2.7 SPRAY WASH SYSTEM

A. Automatic spray wash systems for the screen shall be furnished with automatic controlled valves and constructed of stainless steel piping and fittings, flexible reinforced hoses and stainless steel spray nozzles. Spray wash system shall operate only when the screen basket is rotating.

B. A lower wash system shall be located over the rotating basket which utilizes a spray bar(s) with adequate spray nozzles to ensure a consistent spray pattern over the entire length of the basket. For maximum wash water flow rate and pressure the spray bar will be controlled with an electric actuated full port stainless steel ball valve. Full port ball valve shall have a maximum Cv rating of 60.

C. A screenings spray wash system shall be located in the lower section of the transport tube to break up and return organic materials to the flow stream and to ensure maximum screenings washing.

D. A compaction zone wash system shall be provided which periodically cleans the compaction and dewatering zone via a stainless steel wash header located in the uppermost end of the compaction/dewatering chamber. The header shall be designed to completely wash the full surface of the transport tube drainage area. Wash water to the compaction zone will be controlled with a brass body solenoid valve.

E. The electric actuated full port stainless steel ball valve shall be 120V AC rated and operated via the programmable controller and/or manually.

F. Solenoid Valves: Provide one (1) solenoid valve to control flow to the compaction zone spray wash assembly. Each valve shall have a brass body. Each valve shall be 120 volt, single phase, 60 Hz. Valves shall be suitable for area classification.

G. Electric Actuated Ball Valve: Provide one (1) electric actuated full port 316 stainless steel ball valve to control flow to the basket spray wash assembly. Each full port ball valve shall be 2-piece body, threaded ends, cast body from CF8M, 316 stainless steel, ball and stem from 316 stainless steel, and RTFE seats. Each valve shall be controlled by a NEMA 7 electric actuator with a housing from cast aluminum with thermally bonded polyester powder coating, stainless steel output shaft, stainless steel fasteners, 115 volt, single phase, 60 Hz, two SPDT limit switches, and visual indication on valve position. Electric actuator shall be suitable for area classification.

2.8 MANUAL SCREEN BYPASS

A. Bypass chamber shall be provided to allow peak flow to bypass the mechanical screen. The bypass chamber shall be supplied with a 1/2-inch manual bar rack and access cover to allow inspection and cleaning. The chamber shall be designed to only receive flows when the mechanical screen is unable to process the design flows due to mechanical, electrical or other failure.

2.9 DRIVE

A. Drive unit shall be rigidly supported so that there is no visible “wobble” movement under any operating condition.

B. The basket mechanism and transport screw shall be driven by a shaft-mounted geared motor.

C. Gear reducer shall be a helical gear type as manufactured by NORD or approved equal. Provide a cast iron frame; design in accordance with AGMA recommendations for wastewater service.

D. The gear reducer shall be bolted to a machined flange welded to the upper end of the transport tube.

E. The gear reducer shall be driven by a 1.5 HP, TEFC, 3 phase, 60 Hertz, 460 volt, Class 1, Division 2, Group D, totally-enclosed, fan-cooled motor.

F. Chain drives, belt drives, hydraulic drives or designs incorporating a separate upper bearing for the transport screw will not be accepted.

2.10 ELEVATED PLATFORM

A. The rotary perforated plate screen shall be mounted on stainless steel supports provided by the screen manufacturer. The supports shall be designed to be anchored in concrete on the platform below the tank. The Manufacturer shall be responsible for providing a design adequate to support all live loads encountered during operation.

2.11 CONTROL SYSTEM

A. All controls necessary for the fully automatic operation of the screen shall be provided by the Manufacturer including a 480/3/60 primary control panel with a type 316 SS NEMA 12 enclosure, and a NEMA 4X local control station. The control strategy shall be as described in Section 40 61 96 – Control Strategies.

B. The electrical control system shall provide for automatic control of the screen via a high liquid level using a differential liquid level control system in connection with an adjustable time clock. The screen shall operate at a high liquid level or a pre-determined time sequence to provide a variable time between cleaning operations.

C. The rotating drum screen control system shall incorporate a programmable relay/(programmable logic controller and integral operator interface) which can change the cleaning characteristics of the screen and spray wash systems.

D. The main control panel shall be wall mounted in the electrical room and include the following items to control the screen:

1. Main fused disconnect with through door interlock handle.

2. Control transformer 480/120.

3. Branch circuit protection.

4. Screen motor soft starter.

5. Emergency stop pushbutton.

6. HOA switch for each motor.

7. Open-Close-Auto switch for screen wash water electric actuated ball valve.

8. Open-Close-Auto switch for compaction zone wash water solenoid valve.

9. Hour meter for each motor.

10. Run indicating lights.

11. Alarm lights indicating overcurrent and starter overload.

12. Alarm reset pushbutton.

13. Programmable logic controller (PLC) for screen and compactor control logic functions. PLC shall be ethernet/IP capable.

14. Universal transmitter for level relay.

15. Run and alarm auxiliary contacts.

16. Intrinsically safe relay for level sensor.

17. UL Label.

E. An annotated copy of the software program shall be provided to the Owner. The copy shall be fully documented, un-password protected and contain HMI objects and screens to allow proper SCADA integration by the integration contractor.

F. Motor Cut-out Switches: Three (3) 120 volt interlock switches shall be factory mounted to the hinged tank and compaction/discharge zone access doors. Interlock switches shall prevent operation of the screen while a door is open. Switch housings shall be rated for NEMA 4X.

G. Local Control Station: Provide a local control station in a NEMA 4X enclosure rated for Class 1, Division 2 environments, including the following operators:

1. Drum screen LOR switch

2. Emergency stop pushbutton

H. Level Probe: Provide one (1) non-contacting radar transmitter for operation of the unit by screen start level and high level. Unit shall not be affected by FOG, debris or foam. The radar unit shall provide a 4-20mA level signal and be rated for installation in a Class 1, Div. 1/Div. 2 area when using an intrinsically safe circuit. The sensor shall be supplied with 33 feet of integral cable. Float switches, single point multiple number conductivity probes, and ultrasonic sensors shall not be permitted.

I. Motor starter shall meet the requirements of Section 26 29 13.16.

2.12 SEQUENCE OF OPERATIONS

A. Refer to Section 40 61 96 for control strategies.

2.13 ANCHOR BOLTS

A. Equipment manufacturer shall furnish all anchor bolts of ample size and strength required to securely anchor each item of equipment. Anchor bolts, hex nuts, and washers shall be 316 stainless-steel unless noted otherwise. Anchor bolts shall be wedge or epoxy type.

B. The contractor shall furnish all anchor bolts of ample size and strength required to securely anchor each item of equipment. Contractor shall place equipment on the foundations, ensure that it is leveled, shimmed, bolted down and grouted with a non-shrinking grout.

2.14 SHOP SURFACE PREPARATION AND PAINTING

A. Electric motors, speed reducers, and other self-contained or enclosed components shall have manufacturer’s standard coating.

B. The stainless steel parts of the unit specified in this Section shall be fully submerged into a pickling bath for at least 8 hours to remove welding spots and to protect the stainless steel against corrosion.

2.15 SOURCE QUALITY CONTROL

A. All structural stainless steel components shall be fabricated according to ISO 9001 and ISO 14001.

B. Fabricate all parts and assemblies from sheets and plates of 316 stainless-steel with a finish conforming to AISI 316 and ASTM A240 or A666, unless noted otherwise. Fabricate all rolled or extruded shapes to conform to ASTM A276. Fabricate all tubular products and fittings to conform to ASTM A269, A351 or A403.

C. All welding in the factory shall use shielded arc, inert gas, MIG or TIG method. Add filler wire to all welds to provide for a cross section equal to or greater than the parent metal. Fully penetrate butt welds to the interior surface and provide gas shielding to interior and exterior of the joint.

D. Bolts, nuts and washers shall be AISI 316 stainless steel furnished.

E. All surfaces that are specified to be machined shall be designed and fabricated to provide a run out of not more than 0.005 inches and concentricity to within 0.005 inches.

2.16 SPARE PARTS

A. 1 Complete bottom bearing assembly

B. 1 set of basket cleaning brushes

C. 1 solenoid valve

D. 1 solenoid valve rebuild kits

E. 3 Plastic rollers

F. 1 Nylon wheel kit with ball bearing complete with nuts and bolts

G. 1 Filter seal kit complete with nuts and bolts

2.17 MANUFACTURER, OR EQUAL

A. SAVÉCO North America, Inc.

B. Equal must be pre-approved during bidding process.

PART 3 - EXECUTION

3.1 FIELD PREPARATION AND PAINTING

A. Each rotary perforated plate screen shall be supplied complete with supports suitable for mounting as shown on the contract drawings. Supports shall be shop fabricated from 316L stainless steel shapes and plates. Supports shall be assembled and fitted to the screen prior to shipment.

B. Finish field preparation and painting shall be performed as specified by the manufacturer.

C. The Contractor shall touch-up all shipping damage to the paint and stainless steel as soon as the equipment arrives on the job site.

D. The Contractor shall supply paint for field touch-up and field painting.

E. The Contractor shall finish paint electrical motors, speed reducers, and other self-contained or enclosed components with oil-resistance enamel.

F. Prior to assembly all stainless steel bolts and nut threads shall be coated with a non-seizing compound by the Contractor.

3.2 INSTALLATION, START-UP AND OPERATOR TRAINING

A. Contractor shall verify all dimensions in the field to ensure compliance of equipment dimensions with the drawings. Contractor shall notify Engineer of significant deviations.

B. Installation of the equipment shall be in strict accordance with the contract documents and the manufacturer's instructions and shop drawings. Manufacturer shall supply anchor bolts for the equipment. Contractors shall install the anchor bolts in accordance with the manufacturer's recommendations.

C. Perform Level 2 Testing in accordance with Section 43 05 60 – Process Equipment Testing.

D. Manufacturer shall furnish the services of an authorized Manufacturer North America representative for one (1) trips including two (2) days to inspect the installation, carry-out the equipment start-up procedures, and provide training to the operators in how to effectively operate and maintain the equipment.

1. Equipment shall not be energized, or "bumped" to check the electrical connection for motor rotation without the service engineer present.

2. The service engineer shall make all necessary adjustments and settings to the controls. In particular, the service engineer shall verify the measurement relay setting and the initial water level setting for the screen.

3. The service engineer shall demonstrate proper operation of screen and screenings washer. The screen shall operate automatically based on the water level.

4. Training shall be for a minimum of 3 hours and shall cover standard operating and preventive maintenance procedures. The Contractor shall videotape the training and provide a copy to Owner on DVD.

END OF SECTION 46 21 35

SECTION 46 23 23 –GRIT REMOVAL SYSTEM

PART 1 - GENERAL

1.1 SCOPE

A. Work described in this section includes furnishing all labor, equipment, materials, tools and incidentals required for a complete and operable installation of the grit removal system as shown on the drawings and specified herein. The manufacturer shall supply the equipment and the general contractor shall install the equipment.

B. All equipment installed in the Headworks (Grit classifier and pump) shall be rated for a Class 1, Division 2 Hazardous location as shown on the drawings.

1.2 DESIGN REQUIREMENTS

A. The Grit Removal and Dewatering System shall:

1. Removal efficiency, as outlined in each components section below, shall be based on the following gradation:

% Passing Cumulative									
Micron	75	106	150	212	300	425	600	1000	
Western US	2.0	7.4	16.3	28.2	43.3	51.3	59.9	75.6	Physical Average
Western US	2.3	11.0	32.5	52.7	78.6	91.1	96.8	99.9	SES Average

B. The Grit Removal System shall be comprised of the following components:

1. Grit Separator
2. Grit Pump
3. Grit Dewatering Classifier
4. Motor Control Panel (by Contractor)

C. The Grit Separator shall consist of internal components installed into a concrete tank and receive the incoming screened flow. The Grit Separator shall remove the specified grit particles from the specified peak flow and collect them in a sump at the bottom of the unit. The de-gritted effluent from the Grit Separator shall be discharged via an overflow circular opening as shown on the drawings.

D. The Grit Separator shall be all-hydraulic, self-activating and shall not require instrumentation, internal moving parts or external power.

E. The Grit Separator shall be self-cleaning and consist of corrosion resistant components.

F. The Grit Pump shall convey the concentrated grit slurry from the underflow of the Grit Separator to the Grit Dewatering Classifier.

G. The Grit Dewatering Classifier shall receive the underflow from the Grit Separator unit and allow the grit to settle in its integral clarifier. A slow moving auger shall carry the grit to the point of discharge allowing it to dewater during transport. The dewatered grit shall be discharged to a dewatering grit receptacle with a drain supplied by others. The de-gritted overflow shall be discharged upstream of the primary grit removal equipment.

H. The Grit Removal System and all appurtenances shall be supplied by a single supplier.

I. The Grit Separator technology shall be designed utilizing Computational Fluid Dynamics (CFD) and field data to verify its flow regime, headloss and grit removal characteristics. Upon request, data on the computation methods used and generic simulation results shall be made available to the engineer.

1.3 SUBMITTALS AND OPERATION AND MAINTENANCE MANUALS

A. Complete fabrication, assembly, support and installation drawings, together with detailed specifications and data covering materials, parts, devices, and other accessories forming a part of the equipment furnished, shall be submitted for approval in accordance with Section 01 33 00 – Submittal Procedures.

B. The submittal shall include all necessary information for the proper determination of the acceptability of the proposed equipment and shall not necessarily be limited to the following:

1. Complete description of the equipment, system, process, or function, including a list of system components and features, drawings, catalog information and cuts, Manufacturer's specifications, including materials of construction, weights, principal dimensions, and other important details.

2. Performance data, curves and horsepower requirements. Manufacturer shall submit pump sizing calculations based on the drawings to confirm pump size and horsepower.

3. Outside utility requirements, such as water, power, air, etc.

4. Functional description of any internal instrumentation and controls supplied including list of parameters monitored, controlled, or alarmed.

5. Complete data on motors and gear reducers.

6. Anchoring calculations in accordance with 43 05 50 – Equipment Mounting. Calculations shall be sealed by a licensed Professional Engineer in the State of Oregon.

7. Addresses and phone numbers of nearest service centers and a listing of the Manufacturer’s or Manufacturer's representative’s services available at these locations, including addresses and phone numbers of the nearest parts warehouses capable of providing full parts replacement and/or repair services.

8. A list of five installations in the state where similar equipment by the Manufacturer is currently in similar service; including contact name, telephone number, mailing addresses of the municipality or installation, Engineer, Owner, and installation

contractor, if five installations do not exist, the list shall include all that do exist, if any.

9. All differences between the specifications and the proposed equipment shall be clearly stated in writing under a heading of "differences".

C. The Contractor shall submit Operation and Maintenance Manuals in accordance with Section 01 78 23 – Operation Maintenance and Data.

1.4 QUALITY ASSURANCE

A. Manufacturer Experience: All equipment furnished shall have a record of at least 10 years of successful, operation in similar applications from the same manufacturer. The manufacturer's experience shall include grit removal efficiency test results from a minimum of 5 similar installations.

B. Warranty: A written manufacturer warranty shall be provided. The warranty shall be for a minimum period of one (1) year from the date of Substantial Completion. Manufacturer shall repair or replace all defective materials or workmanship during the warranty period.

1.5 ACCEPTABLE MANUFACTURERS

A. Hydro International

B. Or approved equal

1.6 REFERENCE STANDARDS

A. Reference Standards: Comply as a minimum with applicable provisions and recommendations of the following:

NEC	National Electric Code
NEMA	Standards of National Electrical Manufacturers Association
IEEE	Institute of Electrical and Electronic Engineers
AFBMA	Anti-Friction Bearing Manufacturers Association
ANSI	American National Standards Institute
SSPC	Steel Structures Painting Council
ASTM	American Society for Testing and Materials.

PART 2 - PRODUCTS

2.1 GRIT SEPARATOR
Design Data

1.	Number of Units:	1
2.	Size:	8’ Diameter
3.	Configuration:	In Situ
4.	Performance:	95% removal of grit (SG 2.65) ≥ 106 microns at peak flow
5.	Peak Flow/Unit:	0.936 mgd with 7" headloss
6.	Headloss at Peak Flow:	7”
7.	Depth of flow in the effluent pipe at Peak Flow:	7”
8.	Underflow Rate:	100 gpm
9.	Influent Connection:	8” Plain end pipe
10.	Effluent Connection:	24” circular outlet
11.	Underflow Connection:	3” flanged pipe
12.	Underflow Layout:	Dry Mount Pump
13.	NPW Connection:	1” NPT
14.	HDPE Components:	Dip plate, center shaft, cone
15.	304 SS Components:	Inlet pipe, deflector plate, fluidizing ring, support frame

B. Operation

1. The Grit Separator shall be designed to separate grit and sand from screened raw wastewater using Hydro-dynamic separation and boundary layer effects to aid gravitational forces.

2. All flow passages shall be self-cleaning and free of sharp projections or fittings that may snag stringy or fibrous materials.

3. The Grit Separator shall be characterized by a predetermined flow path caused by the vessel geometry and flow modifying components to maximize the concentration and removal of settleable solids.

4. The Grit Separator shall include a fluidizing system to prevent the collected grit from compacting in the collection area, release entrapped organics, and aid in transporting the accumulated grit to the Grit Dewatering Unit.

C. Construction

1. The internal components of the Grit Separator shall consist of a dip plate with

annulus baffle plate and overflow channel and a center shaft and cone fabricated from HDPE.

2. The center shaft and cone shall be mounted so that its edge is clear of the sloping base of the vessel. It shall be removable from the top of the unit.

3. All suspended components shall be attached to a support frame anchored to the concrete chamber walls.

4. A stainless steel fluidizing ring shall be mounted to the floor of the grit collection under the cone.

5. All flanges shall conform to ANSI B16.1 bolt patterns.

2.2 GRIT PUMP

A. Acceptable Manufacturers:

1. Trillium

2. Or equal

B. Design Data

1.	Number of Units:	1
2.	Type:	Self-Priming
3.	Flow Rate:	100 gpm
4.	Total Dynamic Head:	20 ft
5.	RPM:	940
6.	Suction Connection:	3”
7.	Discharge Connection:	3”
8.	Motor:	3 hp, 480V
9.	Seal:	Mechanical, Flushless
10.	Materials of Construction:	High Chrome impeller, Ductile Iron Casing & Coverplate

C. Operation

1. The grit pump shall operate intermittently whenever there is flow entering the Grit Concentrator unit.

D. Construction

1. Pumps shall be horizontal, self-priming, centrifugal type, designed specifically for handling raw, unscreened, domestic sanitary sewage.

2. Casing: Casing shall be 65-45-12 ductile iron with a minimum Brinell hardness of 150 and shall incorporate an integral volute scroll. The casing shall incorporate following features:

    a. Mounting feet sized to prevent tipping or binding when the pump is completely disassembled for maintenance.

    b. One 96 mm (3.75") diameter case fill/inspection port with a self-centering port cover shall be incorporated on pumps 3 inch in size or less. Pumps 4 inch in size or larger shall incorporate two case fill/inspection ports. The port may be opened after loosening a hand nut/clamp bar assembly. In consideration of safety, hand nut threads must provide slow release of pressure and the clamp bar shall incorporate two recessed areas which securely center it from coming loose prematurely while loosening the hand nut. A Teflon encapsulated Viton o-ring shall be utilized to prevent leakage and adhesion of the fill port cover to the casing.

    c. Casing drain plug shall be at least 1 inch NPT to insure complete and rapid draining of the pump volute.

3. Coverplate: The coverplate shall be 65-45-12 ductile iron with a minimum Brinell hardness of 150. The design must incorporate the following maintenance features:

    a. The coverplate must be 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 the suction or discharge piping.

    b. A replaceable wearplate made of High Chrome with a minimum hardness of 650 Brinell must be secured to the coverplate by 316 SS studs and hardware.

    c. In consideration for safety, a pressure relief valve shall be supplied in the volute. The pressure relief valve shall open at 150 PSI.

    d. Buna-N o-rings shall seal the coverplate to the pump casing.

    e. Two 304 stainless steel hand adjustment knobs to assist in removal of the coverplate.

    f. A convenience handle shall be mounted to the face of the coverplate.

4. Rotating Assembly: A rotating assembly, which includes impeller, shaft, mechanical shaft seal, 316 stainless steel shaft sleeve and seal hardware, lip seals, bearings, sealplate and bearing housing, must be removable as a single unit without disturbing the pump casing or piping. The design shall incorporate following features:

    a. The sealplate and bearing housing shall be High Chrome with a minimum Brinell hardness of 650.

b. Separate oil-filled bearing and seal cavities shall be vented to the atmosphere. Cavities must be cooled by the liquid pumped. Three lip seals will maintain the integrity of the atmospheric barrier and isolate the two oil cavities, preventing oil leakage.

1) The bearing cavity shall have an oil level sight gauge and fill/one way vent plug. The clear sight gauge shall provide easy monitoring of the bearing cavity oil level and condition, 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) The seal cavity shall have an oil level sight gauge and fill/one way vent plug. The clear sight gauge shall provide easy monitoring of the seal cavity oil level and condition without removal of the fill/one way vent plug. The check valve shall vent the cavity but prevent introduction of moist air to the mechanical seal chamber.

3) Double lip seal shall provide an atmospheric path to provide positive protection of the bearings and the capability for either external visual monitoring of drainage or with an optional seal leakage probe.

c. The impeller shall be High Chrome with a minimum hardness of 650 Brinell, two-vane, semi-open, non-clog, with integral pump-out vanes on the back shroud. The impeller shall thread onto the pump shaft and be secured by an impeller locking bolt made of Nitronic 60 with locking threads.

d. The shaft shall be 17-4 PH stainless steel with rolled threads for installation of the impeller. Machining of threads which weaken the structural integrity of the shaft will not be accepted.

e. The 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 which use the same oil to lubricate the bearings and shaft seal shall not be acceptable.

f. The mechanical shaft seal shall be of the oil lubricated type. The stationary and rotating seal faces shall be silicon carbide alloy. Each mating surface shall be lapped to within two light bands flatness (23.3 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, spring and shaft sleeve are to be 316 stainless steel. The seal shall be oil lubricated from a dedicated reservoir. The same oil shall not lubricate both shaft seal and shaft bearings. The seal shall be warranted in accordance with requirements listed under PART 1- General.

g. The pusher bolts must have capability to assist in the removal of the rotating assembly, and the threaded holes shall be sized to accept the same capscrew

as used for retaining the rotating assembly.

5. Adjustment of the impeller face clearance (distance between impeller and wearplate) shall be accomplished by external means.

   a. Clearances shall be maintained by an external shimless and tool-less coverplate adjustment using a hand knob design for incremental adjustment of clearances without requiring any tools. Requirement of realignment of belts, couplings, etc., shall not be acceptable. The coverplate shall be capable of being removed without disturbing clearance settings.

   b. 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 to assist in obtaining optimal efficiency while extending the life of the impeller and wearplate.

   c. Clearance adjustment which requires movement of the shaft only, thereby adversely affecting seal working length or impeller back clearance, shall not be acceptable.

6. 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 by blowing out if the internal volute pressure exceeds 180 PSI. Removal or installation of the check valve must be accomplished through the coverplate opening, without disturbing the suction piping. Sole function of the check valve shall be to save energy by eliminating the need to reprime after each pumping cycle. Pumps requiring a suction check valve to assist reprime will not be acceptable.

7. Spool flanges shall be one-piece ductile iron Grade 65-45-12 fitted to suction and/or discharge ports. The suction and discharge flanges shall have one 1-¼ inch NPT and one ¼ inch NPT tapped hole with pipe plugs for mounting gauges or other equipment.

8. Motor shall be 3 HP, 3 Phase, 60 Cycle, 460 Volt, 1800 RPM, and shall be connected to the pump by the drive method specified. All motors shall be of nationally known manufacture and shall conform to NEMA standards and specifications.

2.3 GRIT DEWATERING CLASSIFIER

A. Design Data

1.	Number of Units:	1
2.	Design Flow Rate:	100 gpm
3.	Maximum Grit Load:	0.75 cyd/hr
4.	Clarifier Size:	60” Wide
5.	Clarifier Surface Area:	14.5 sq.ft

6.	Spiral Diameter:	12”
7.	Max. Spiral Speed:	2 rpm
8.	Inlet Connection:	6” flanged pipe
9.	Overflow Connection:	6” flanged pipe
10.	Drain Connection:	3” threaded pipe
11.	Motor:	1.0 hp
12.	Material:	304 SS

B. Operation

1. The Grit Dewatering Classifier unit shall be designed to capture and dewater concentrated grit slurry from the Grit Separator unit.

2. The Grit Dewatering Classifier unit clarifier shall be designed based on a settling rate not to exceed 6.9 gpm/ft2.

C. Construction

1. The Grit Dewatering Classifier shall be provided with an integral clarifier which shall provide at least 3 inches of freeboard.

2. The conveying screw shall have 3/16 inch thick flights mounted on a 3 1/2 diameter schedule 40 pipe.

3. The housing for the Grit Dewatering Classifier auger shall be fitted under the clarifier. The housing for the Grit Dewatering Classifier auger shall be stainless steel and shall be inclined at 25 degrees.

4. The clarifier and auger housing shall be fully covered. All covers and hardware shall be stainless steel. A foul air port shall be provided to allow connection to foul air piping system. Vendor shall identify port diameter, which shall be compatible with standard flexible connector sizes.

5. The auger housing shall be provided with one (1) threaded drain.

6. The Grit Dewatering Classifier unit support structure shall be as shown on the general arrangement drawing and anchored to a stable base.

7. All flanges shall be spinning flanges, a minimum of 1/2 inch thick, and drilled to match ANSI 150 lb. pipe flanges.

8. The Grit Dewatering Classifier unit shall be supplied as standard with access to ease maintenance:

   a. Externally accessible bearing unit.

b. Clarifier observation and maintenance hatches.

c. Rodding/Flushing water access point opposite of the unit drain.

D. Drive Unit

1. The Grit Dewatering Classifier shall be provided with a drive unit consisting of the motor and the helical gear reducer, mounted as a single integrated unit.

2. The motor shall be 3 phase, 460 VAC, 60 Hz, NEMA Design B, TENV enclosure.

3. The helical gear reducer shall have hardened alloy steel gears accurately cut to shape.

2.4 CONTROLS AND INSTRUMENTATION

A. Controls shall be provided by the contractor. Vendor shall provide a full sequence of operation narrative for the contractor/engineer's use in programming the contractor-supplied PLC.

2.5 UTILITY REQUIREMENTS

A. WATER

1. The Grit Separator shall require an intermittent supply of 50 gpm clarified non-potable water at 50 psig supplied to the grit fluidizing pipe via a NPT connection. No other utility water shall be required.

B. ELECTRICAL

1. Motor starters shall be provided by the contractor.

2. Motors shall meet the applicable requirements of Division 26 and Division 40 of the specifications.

2.6 MATERIALS AND FINISHES

A. MATERIALS

1. All stainless steel used for the fabrication of the equipment shall conform to the following standards:

Plate and Sheet	ASTM A 167
	ASTM A 240
Bar	ASTM A 276
	ASTM A 479
Tube	ASTM A 312

B. EXTERIOR SURFACES FINISHES

1. All surfaces shall be free of sharp edges, weld spatter and residue. All welds shall be ground smooth.

2. All stainless steel surfaces shall be acid washed.

PART 3 - EXECUTION

3.1 DELIVERY AND INSTALLATION

A. The equipment and material shall be shipped complete except where partial disassembly is required by transportation regulations or for protection of components.

B. Spare parts shall be packed in containers bearing packing lists clearly designating contents and pieces of equipment for which they are intended.

C. The CONTRACTOR shall inspect equipment prior to unloading and notify the MANUFACTURER of any damage to equipment within 5 days to effect proper remedial action. Failure to notify the MANUFACTURER of damage to equipment prior to unloading shall void all warranties pertaining to subject equipment.

D. The CONTRACTOR shall unload, store and safeguard equipment, materials, and spare parts in accordance with MANUFACTURER'S recommendations.

3.2 START-UP, TRAINING AND MANUFACTURER'S SERVICES

A. A factory trained representative for the equipment specified herein shall be present at the jobsite and/or classroom designated by the Owner for a maximum of four (4) 8-hour man-days (two (2) visits) for installation inspection, plant startup, functional testing, and operator instructions; travel time excluded. A minimum of 30 days notice is required to schedule manufacturer's services. Any services with less than 30 days notice shall be billed for service time and actual travel costs.

3.3 FUNCTIONAL TESTING

A. Prior to plant startup, all equipment shall be inspected for proper alignment, operation, connection, and satisfactory operation by means of a functional test. It is the General Contractor's responsibility to duly notify the MANUFACTURER of any inabilities to perform functional testing prior to operator training.

3.4 MANUFACTURER'S CERTIFICATE(S)

A. Provide MANUFACTURER'S certificate of installation and commissioning following functional testing and startup.

END OF SECTION 46 23 23

SECTION 46 30 00 – CHEMICAL FEED EQUIPMENT, GENERAL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide chemical solution feed equipment, complete and operable, in accordance with the Contract Documents.

B. Equipment shall be from manufacturers with several years of experience in the manufacture and assembly of similar products, with a record of successful installations. Such manufacturers shall maintain a well-established, authorized, local service agency with sufficient spare parts and personnel to respond within 48 hours to any service calls.

C. Unless indicated otherwise, the requirements of this Section apply to all chemical feeding equipment in the Contract Documents.

D. The skid for caustic soda dosing shall be provided by the vendor. The skid for methanol dosing shall be provided by the contractor.

1.2 SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Shop Drawings: Complete fabrication, assembly, foundation, and installation drawings, together with detailed specifications and data covering materials used, parts, devices, supports, and other accessories forming a part of the equipment.

C. Certification: The supplier shall obtain written certification from the manufacturer, addressed to the Owner, stating that the equipment will efficiently and thoroughly perform the required functions in accordance with these Specifications and the Drawings, that the materials are best suited for the chemicals handled, and that the manufacturer accepts joint responsibility with the supplier for coordination of equipment, including motors, variable speed drives, controls, and services required for proper installation and operation of the completely assembled and installed unit.

D. Technical Manuals: Furnish complete operations and maintenance manuals prior to start-up. Printed instructions relating to proper maintenance, including lubrication, and parts lists indicating the various parts by name, number, and diagram where necessary, shall be furnished with each unit or set of identical units.

E. Spare Parts List: The supplier shall obtain from the manufacturer a list of suggested spare parts for each piece of equipment subject to wear, such as seals, packing, gaskets, nuts, bolts, washers, wear rings, etc.

F. Field Procedures: Instructions for field procedures for erection, adjustments, inspection, and testing shall be furnished prior to installation of the equipment.

1.3 QUALITY ASSURANCE

A. After completion, the supplier shall furnish to the Owner the manufacturer's written guarantees that the equipment will operate with the published efficiencies, heads, criteria, and flow ranges and meet these specifications. The supplier shall also furnish the manufacturer's warranties as published in its literature.

PART 2 - PRODUCTS

2.1 GENERAL

A. Wherever it is required, a single Manufacturer shall be responsible for the compatible and successful operation of the various components of any equipment unit. It shall be understood to mean that the supplier shall provide only such equipment as the designated manufacturer will certify is suitable for use with its equipment and with the further understanding that this in no way constitutes a waiver of any indicated requirements.

B. Manufactured items provided under this Section shall be of current manufacture, and shall be the products of reputable manufacturers specializing in the manufacture of such products.

C. Where two (2) or more units of the same type or size of equipment are required, all such units shall be produced by the same manufacturer.

D. Chemical dosing equipment shall be skid mounted as indicated in the Construction Drawings. Skid components shall be provided as outlined in this Section.

2.2 MATERIALS

A. General: Materials employed in the equipment shall be suitable for the intended application; materials not specifically called for shall be high-grade, standard commercial quality, free from defects and imperfections that might affect the serviceability of the product for the purpose for which it is intended.

B. Corrosion Resistance: Materials used in the construction of chemical feeding equipment shall be resistant to corrosive attacks from the chemicals. The following lists some of the suitable materials for the construction of the corresponding chemicals. Unless the manufacturer proposes more suitable materials, the list shall be adhered to:

Chemical	Suitable Handling Material
Sodium Hydroxide	316 Stainless Steel Hastelloy C (fair) Titanium (fair) PVC FRP (suitable grade) Saran Teflon
Methanol	316 Stainless Steel PVC, CPVC

Chemical	Suitable Handling Material
	EPDM PTFE Nitrile (Buna N) Neoprene

2.3 CHEMICAL DOSING SKID SYSTEM

A. Refer to specific dosing pump specifications and construction drawings for more information. See Section 46 33 44 - Peristaltic Metering Pumps.

B. Nameplate: Each piece of equipment shall be provided with a stainless-steel nameplate, indicating equipment characteristics, capacity, manufacturer, model number, and serial number.

C. Equipment Supports: Chemical feeding equipment and piping shall be firmly anchored. Fabricated supports exposed to chemical spills shall be of FRP. All anchor bolts, nuts, and washers of such supports shall be of non-metallic type. The containment shall be self-supporting and capable of being wall, shelf or floor mounted as indicated in the Construction Drawings.

D. Piping: The sodium hydroxide dosing system shall be pre-plumbed with all piping, valves and fittings to provide a complete and operable system. Piping shall be sized appropriately based on demand.

E. Skid Connections: Skid shall be provided with the number of inlets and outlets as indicated in the Construction Drawings. Connections shall be union type. Seals may be EPDM, PTFA, nitrile, or neoprene for methanol dosing, and PTFE or nitrile for sodium hydroxide dosing. Provide a Y-type strainer near all inlet connections.

F. Pump Connections: Shall be flexible, reinforced braided PVC tubing rated for 200 psi maximum continuous duty and terminated to half unions with stainless steel hose clamps. The tubing shall be NSF listed.

G. Flow Indicator: Provide flow indicator for each pump. Indicator shall be clear PVC with a ball indicator and shall be securely mounted to the skid.

H. Spill Containment: shall be provided with a drain port to drain fluid.

I. Valves: Provide isolation and check valves for each pump in the skid as indicated in the Construction Drawings.

J. Pressure Relief: Provide pressure relief valves on the discharge of each pump discharge line. A relief line shall connect to the low-pressure side of the pump. Relief valve shall be adjustable at increments from 10 to 150 psi.

K. Pressure Gauges: All chemical metering pumps, and other equipment, where shown, shall be equipped with pressure gauges with diaphragm seals in accordance with Division 40 that the size of gauges on small metering pumps may be smaller than specified in the above section.

L. Safety Equipment: Where required by Code, all chemical unloading, storage, and feeding equipment shall be furnished with the necessary safety devices and warning signs, clearly visible.

M. Calibration Columns: Provide Calibration Columns as indicated on the Contract Drawings. Each Calibration Column shall be an acrylic tube with PVC heads. The columns shall be calibrated for 30 second sampling periods and shall have the capacity as indicated by the manufacturer and shall have a maximum height of 30 inches. Each column shall be securely supported at both top and bottom.

2.4 CHEMICAL STORAGE

A. Chemical Tank Pipe Connection Expansion Joints: Provide a custom flexible connection for each chemical tank horizontal connection shown on the contract drawings. The flexible connection shall be manufactured by Harrington Plastics or equal. The flexible connection shall consist of all nonmetallic materials: polypropylene braided overwrap, convoluted PTFE liner, and PVDF flanges. The flexible connection shall be a minimum length of 6-inches and shall allow for minimum horizontal and vertical deflection of 4%.

B. Flexible Tubing: Provide a custom flexible connection with quick connects as shown on the contract drawings. The flexible connection shall be manufactured by Harrington Plastics or equal. The flexible connection shall consist of all 316 stainless steel: polypropylene braided overwrap, convoluted PTFE liner, and quick connects. The flexible connection shall be a minimum length of 3’-6” and shall allow for minimum horizontal and vertical deflection of 4%.

2.5 TOOLS AND SPARE PARTS

A. Tools: Special tools necessary for maintenance and repair of the equipment and one pressure grease gun for each type of grease required for the equipment shall be furnished as a part of the Work; such tools shall be suitably stored in metal tool boxes, and identified with the equipment number by means of stainless steel or solid plastic name tags attached to the box.

B. Spare Parts: Furnish spare seals, and gaskets, as required by the feed equipment sections.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Chemical feeding equipment shall be installed in accordance with governing safety standards, the Shop Drawings, and as indicated.

B. Test all chemical feed equipment in accordance with manufacturer recommendations prior to placing in service.

END OF SECTION 46 30 00

SECTION 46 33 33 – LIQUID POLYMER BLENDING SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Contractor shall furnish all labor, materials, equipment and appurtenances required one (1) polymer blending unit (PBU) with a progressive cavity pump together with all drives, motors, pumps, valves, piping, supports, tanks, wiring, and controls for complete and operable systems, in accordance with the requirements of the Contract Documents.

B. The polymer dilution and feed system shall be capable of effectively activating and fully blending with water a homogenous polymer solution ranging from 0.1% to 1% concentration of emulsion polymers with active contents up to 75%.

C. The polymer blending unit shall be supplied by the Volute Dewatering press supplier.

D. The requirements of Section 43 05 01 - Equipment General Provisions apply to this section.

1.2 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01 33 00 – Submittal Procedures.

B. At a minimum, shop drawings shall include complete fabrication, assembly, foundation, and installation drawings, together with detailed specifications and data covering materials used, parts, devices, supports, and other accessories forming a part of the equipment. In addition, shop drawings shall include the following information:

1. Polymer metering pump performance data showing head, capacity, horsepower demand, NPSH required, and pump efficiency.

2. Assembly and installation drawings including shaft size, seal, coupling, bearings, anchor bolt plan, part nomenclature, material list, outline dimensions, and shipping weights. Assembly and installation drawings

3. Elevation of proposed local control panel showing panel-mounted devices, details of enclosure type, single line diagram of power distribution, and current draw of panel, and list of all terminals required to receive inputs or to transmit outputs from the local control panel.

4. Wiring diagram of field connections with identification of terminations between local control panels, junction terminal boxes, and equipment items.

5. Complete electrical schematic diagram.

C. The dilution water and post dilution water requirements shall be identified by the Manufacturer.

D. Owner's Manual: Provide operation and maintenance manuals in accordance with Section 01 78 23 – Operation and Maintenance Data.

E. Spare Parts List: A spare parts list shall contain the required information for each pump section.

1.3 QUALITY CONTROL

A. Warranty: The polymer blending system shall be covered by a minimum One (1) YEAR conventional warranty. The mixing chamber shall be covered by a LIFETIME warranty covering the repair or replacement of the mixing chamber or any part of the mixing chamber which fails for any reason, excluding weather related or over-pressure failures. In addition, the mixing chamber shall be warranted against plugging for any reason. If plugging occurs the mixing chamber shall be repaired or replaced at no cost to the owner. Metering pumps, options and accessories shall be covered by a minimum conventional one-year warranty. The full warranty shall be valid regardless of whether potable or non-potable dilution water having high solids content is used. The start of the warranty is from the date of Substantial Completion.

B. Manufacturer Qualifications: The polymer activation/feed system manufacturer shall have a record of at least ten installations during the previous 5 years.

C. Pre-assemble and factory test system to ensure compliance with pressure and operational requirements.

D. The approved system shall produce a completely homogenous polymer and water solution free of visible polymer agglomerations, or "fish-eyes".

PART 2 - PRODUCTS

2.1 GENERAL

A. The polymer mix/feed units shall be integrated equipment packages to automatically meter, dilute, mix, activate, and feed liquid/emulsion polymer and water. Concentrated polymer and water shall be blended in a completely back-mixed environment with a minimum 3 seconds of detention time at maximum throughput. Each unit shall include progressive cavity type polymer metering pumps, capable of pumping liquid or emulsion polymers with viscosities up to 75,000 cps. At no time shall the polymer be exposed to a rotating centrifugal pump impeller or other excessive shear.

B. The system shall be designed for use with either potable or non-potable dilution water. Where non-potable water is to be provided, supplier shall identify all water quality requirements necessary to produce a satisfactory polymer/water solution.

C. All components that require periodic maintenance shall be readily accessible.

D. Each polymer mix/feed unit shall be sized according to the following design criteria:

1. Neat Polymer Flow Rate: 0.05-1.0 gph

2. Dilution Water Flow Rate: 12-120 gph

2.2 MATERIALS OF CONSTRUCTION

A. The following material requirements will be strictly adhered to:

1. System skid: 304 stainless steel
2. Hardware: Type 18-8 stainless steel
3. Inlet and Outlet fittings: 304 stainless steel
4. Piping & pipe fittings: schedule 80 PVC
5. Tubing and tube fittings: polyethylene, polypropylene, stainless steel and Viton
6. Water solenoid valve: brass
7. Pressure gauges: stainless steel, liquid filled
8. Pressure switches: NEMA 4, brass connection
9. Flow meter: acrylic, stainless steel, PVC and or polypropylene
10. Water control valve: stainless steel with stainless steel seat
11. Mixing chamber body / flanges: stainless steel
12. Mixing chamber cover / chamber: clear polycarbonate
13. Mixing Chamber Discharge: stainless steel
14. Impeller: 304 stainless steel
15. Impeller shaft seal: Viton, stainless steel, ceramic, carbon
16. Mixing chamber pressure relief valve: stainless steel
17. Metering pump wetted parts: stainless steel & Viton
18. Metering Pump Shaft Seals: Viton, stainless steel ceramic, carbon
19. Control enclosure: FRP

2.3 POLYMER ACTIVATION & BLENDING CHAMBER:

A. These specifications are based on a multi-stage, multi-zone, Hydro-Mechanical polymer activation & blending technology. Alternate technologies will only be considered if proven to provide an equal level of performance, versatility, reliability and quality, otherwise the following technology will be provided without exception.

B. In order to provide control and versatility to optimize the performance of the wide range of polymers available and to optimize system reliability, a multi-stage Hydro-Mechanical polymer blending technology shall be provided with both a non-mechanical and mechanical mixing stage:

1. Non-Mechanical Stage: To optimize reliability, the device shall be capable of activating and blending polymer based on plant water pressure alone at 30 psid or greater. Polymer shall be injected directly into a water jet by means of an injection quill positioned such that the non-mechanical mixing energy is in no way diminished prior to polymer and water contact. The non-mechanical zone shall be designed such that the velocity of the mixing energy producing water jet is maintained or increases as flow decreases.

2. Hydro-Mechanical mixing Stage: In order to provide optimal polymer performance under all operating conditions and to provide total control over mixing energy, in addition to the non-mechanical mixing stage the device shall be capable of producing its mixing energy independent of plant water pressure through a variable intensity, controllable stainless steel hydro-mechanical mixer. The mixing impeller shall be fully controllable and capable of inducing ultra high, non-damaging mixing energy at all flow rates. This shall be accomplished by controlling mixing intensity and preventing over exposure to, or damaging recirculation through the impeller. The polymer mixing impeller shall be designed to produce both axial and radial flow to optimize mixing effectiveness and to effectively inducing high, non-damaging mixing energy over the systems full flow range.

3. Mixers that rely solely on plant water pressure and or flow for mixing energy will not be acceptable. Mixers where performance is affected by flow rate and therefore retention time resulting in under or over exposure to mixing energy, or which rely on constant speed impellers or that rely on close tolerances for blending shall not be acceptable.

C. In order to prevent polymer build-up, the mixing chamber shall maintain high velocity in the entire chamber - at no time shall there be low velocity within any portion of the mixing chamber.

D. The mixing impeller shall be controlled by a VFD motor controller and driven by a wash-down duty motor. The motor shall be mounted horizontally or above the mixing chamber. Motors mounted under the mixing chamber where seal failure or leaks can damage the motor shall not be acceptable.

E. The mixer drive shaft shall be sealed by a mechanical seal which shall have an integrally mounted and factory plumbed seal flush. A drain hole behind the seal shall be provided in the mixing chamber to drain the polymer solution in case of a seal failure. The seal shall be easily accessible for replacement. Systems without a seal flushing system shall not be considered. Systems with holes in the mixing impeller to “pull” polymer away from the seal shall not be acceptable or used, as this feature fails to prevent polymer from coating the shaft seal face. All bearings shall be external from the mixing chamber. Internal bearings shall not be acceptable.

F. Both mechanical and non-mechanical mixing zones shall be clear polycarbonate to view the mixing action and blending effectiveness. Acrylic chambers prone to becoming brittle over time and cracking, or opaque pipe shall not be acceptable to meet this requirement. The clear cover shall have a stainless steel reinforced gusseted flange with a stainless steel discharge connection in order to handle maximum operating pressures.

G. The mixing chamber shall have a maximum rated pressure of 100 psi. Provide a pressure relief on the mixing chamber factory set at 75 psi.

H. Provide a neat polymer check valve specifically designed to isolate neat polymer from dilution water. The valve shall be designed with an open, unobstructed path to the valve seat. To minimize check valve plugging due to normally occurring polymer agglomerations, the minimum open area up to and including the valve seat shall be 3/16" without exception. The valve body shall be constructed of Teflon with Viton seals. The valve poppet and spring shall be stainless steel. The spring shall be outside of the polymer flow path to prevent build-up and plugging. The locking pin used to hold the valve in place shall be attached to the mixing chamber with a lanyard. The valve shall be readily accessible for cleaning and shall not require tools for removal, cleaning or replacement. Conventional check valves, valves that rely on ball seals, and or check valves that are installed inside the mixing chamber, or which require mixing chamber disassembly for servicing will not be accepted.

2.4 DILUTION WATER ASSEMBLY:

A. The dilution water flow rate shall be monitored by a Rotameter flow meter having the range as specified under paragraph 1.02 above. Unions or flanges shall be provided on the flow meter to allow easy removal for cleaning.

B. The unit shall have an electric solenoid valve for on/off control of total dilution water flow.

C. A differential pressure type low water differential pressure alarm shall be provided. The switch shall be adjustable between 9 and 60 psid. Static working pressure, 500 psi. The pressure switch shall be as manufactured by Ashcroft.

D. Provide a 2-1/2" stainless steel liquid filled pressure gauge to monitor dilution water inlet pressure.

2.5 PROGRESSIVE CAVITY NEAT POLYMER METERING PUMP

A. The unit shall have one (1) neat polymer metering pump(s) integrally mounted on the systems skid. The metering pump(s) shall have a range as specified under paragraph 1.02 above. The pump shall be a positive displacement type constructed of stainless steel and Viton. The shaft seal shall be an adjustable packing type. Mechanical seals shall not be used. A 240/480 VAC wash-down duty motor shall drive the pump. A gear reducer shall be provided to produce a maximum pump shaft speed of not more than 545 RPM. The motor shall be controlled by a VFD motor controller located in the system control panel.

B. Provide a calibration column with two full port PVC ball valves having Viton o-rings. The column shall be calibrated for a one minute draw-down at maximum pump rate and read in GPH and milliliters. The calibration column shall be rigidly mounted to the systems frame with a minimum of two heavy duty brackets. Mounting the calibration to the neat polymer inlet piping shall not be acceptable. Provide a breather plug in the top of the calibration column designed to allow adequate displacement of air during calibration while preventing water or other foreign material from entering the calibration column.

C. Provide a pressure relief valve on the discharge of the metering pump, adjustable between 25 and 100 psi. The valve shall be factory plumbed to the suction of the pump. The valve shall have a stainless steel or PVC body with stainless steel, Viton and Teflon internals. Brass pressure relief valves shall not be acceptable.

2.6 SOLUTION DISCHARGE ASSEMBLY:

A. Provide a 2-1/2” stainless steel liquid filled pressure gauge to monitor system discharge pressure.

2.7 CONTROLS:

A. Junction Box integral to the systems frame shall be provided. The enclosure shall be rated NEMA 4X and constructed of FRP. The control panel and all components shall be industrial duty. All skid mounted electrical components interconnected to the control panel shall terminate at numbered and labeled terminal blocks. The terminal blocks shall be sized for 14 ga. wire. Wires shall be neatly run through wire race-way and numbered with shrink tubing type labels. Adhesive labels shall not be used. The junction box shall be positioned such that there are no obstructions in front of the junction box per related NFPA requirements.

B. Junction Box Features:

1. NEMA 4X FRP junction box

2. Numbered terminal block

3. Terminal block legend

4. Numbered wires

5. Connections for:

a. Dilution water solenoid valve

b. Motor (230/480 AC mechanical mixing chamber)

c. Motor (230/480 AC motor for progressive cavity pump)

d. Differential pressure switch (loss of water pressure)

e. Loss of polymer flow (low polymer flow)

f. Ground terminals

2.8 SYSTEM SKID:

A. The system's frame shall be of rugged 304 stainless steel construction. No mild steel shall be used. All piping shall be rigidly supported.

B. Under no circumstance shall the pump suction exceed 5” from the bottom of the skid for progressive cavity pumps.

C. The skid shall have an integral stainless steel drip pan located under the neat polymer metering pump. Provide one dozen absorbent pads designed for oil and sized to fit within the drip pan.

D. The overall system footprint shall not exceed 40”W x 24”D X 42”H.

2.9 SPARE PARTS

A. All polymer mix/feed pumps shall be furnished with the following spare parts:

1. One (1) progressive cavity pump shaft seal.

2. One (1) banding clamp tool for replacement of the progressive cavity metering pump pin joint banding clamps.

3. One (1) neat polymer check valve, complete.

2.10 MANUFACTURERS, OR EQUAL:

A. Velodyne

B. Engineer Approved Equal

PART 3 - EXECUTION

3.1 INSTALLATION

A. The polymer mix/feed pumps shall be installed in accordance with approved procedures submitted with the shop drawings and per Screw Press Manufacturer’s written instructions, unless otherwise approved.

3.2 SERVICES OF MANUFACTURER

A. Inspection, Startup, and Field Adjustment: An authorized service representative of the Screw Press and/or Polymer Mix Manufacturer shall visit the site for one day to witness the following and to certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation:

1. Installation of the equipment

2. Inspection, checking, and adjusting the equipment

3. Startup and field-testing for proper operation

4. Performing field adjustments to ensure that the equipment installation and operation comply with the specified requirements.

B. Field Services:

1. All field services required for start-up, optimization, and training will be included with start-up of the Volute Dewatering Press.

C. For the purposes of this paragraph, a workday is defined as an eight-hour period, excluding travel time.

END OF SECTION 46 33 33

SECTION 46 33 44 - PERISTALTIC METERING PUMPS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall assemble and install chemical peristaltic metering pumps, pump skids, and appurtenances, complete and operable, in accordance with the Contract Documents.

B. Methanol Dosing Pumps:

1. Three methanol dosing pumps to be supplied.

2. Methanol dosing pumps shall be positive displacement peristaltic type complete with spring-loaded pumphead, integral variable-speed gearmotor, and flexible extruded tube.

3. The methanol dosing pumps shall be dry self-priming, capable of being run dry without damaging effects to pump or tube and shall have a maximum suction lift capability of up to 30' vertical water column. Maximum pressure rating: 30 psi.

4. Pumps shall be capable of pumping both liquids and gases without vapor locking

5. The methanol pumps shall use no check valves or diaphragms and shall require no dynamic seals in contact with the process fluid. Process fluid shall be contained within pump tubing and shall not directly contact any rotary or metallic components. Upon failure, the process fluid shall be completely contained within the pump head to prevent hazardous exposure to operators. Manufacturers that do not offer a completely contained pump head are not acceptable.

6. Methanol pumps to be the manufacturer’s standard product. Manufacturer of tubing pumps must have at least ten operating installations in the United States over a period of at least five years in the same service and size as specified. Pumps must be manufactured under ISO 90001-2000.

C. Caustic Soda Dosing Pumps:

1. Three caustic soda pumps to be supplied.

2. The caustic soda dosing pumps shall be positive displacement type with peristaltic pumphead technology or Conveying Wave Technology (CWT) cartridge-style pumphead, consisting of an eccentrically driven rotor which occludes a membrane against a track and self-contained variable speed drive.

3. The caustic soda dosing pumps shall be capable of pumping at 100 psi continuously and up to 145 psi intermittently.

4. Pumps shall be capable of pumping both liquids and gases without vapor locking

5. The caustic soda pumps shall not require the use of back pressure valves, suction foot valves, strainers, pulsation dampeners, or auto degassing valves and shall not require dynamic seals in contact with the pumped fluid. Process fluid shall be contained within pump tubing and shall not directly contact any rotary or metallic components during operation. Upon failure, the process fluid shall be completely contained within the pump head to prevent hazardous exposure to operators. Manufacturer's that do not offer a completely contained pump head are not acceptable.

6. Caustic soda pumps to be the manufacturer's standard product. Manufacturer of tubing and pumps must have at least ten operating installations in the United States over a period of at least five years in the same service and size as specified. Pumps must be manufactured under ISO 90001-2000,

1.2 SUBMITTALS

A. Submit certifications and testing consistent with Section 01 33 00 – Submittal Procedures and Section 43 05 01 – Equipment General Provisions.

B. At a minimum, shop drawings shall include complete fabrication, assembly, foundation, and installation drawings, together with detailed specifications and data covering materials used, parts, devices, supports and other accessories forming a part of the equipment. In addition, shop drawings shall include the following information:

1. Pump name, identification number, and specification section number.

2. Performance data curves showing head, capacity, horsepower demand, NPSH required, and pump efficiency over the entire operating range of the pump.

3. Assembly and installation drawings including shaft size, seal, coupling, bearings, anchor bolt plan, part nomenclature, material list, outline dimensions, and shipping weights.

4. Elevation of proposed local control panel showing panel-mounted devices, details of enclosure type, single line diagram of power distribution, and current draw of panel, and list of all terminals required to receive inputs or to transmit outputs from the local control panel.

5. Wiring diagram of field connections with identification of terminations between local control panels, junction terminal boxes, and equipment items.

6. Complete electrical schematic diagram.

C. Technical Manual: The Technical Manual shall contain the required information for each pump section as specified in Section 01 33 00 – Submittal Procedures.

D. Spare Parts List: A spare parts list shall contain the required information for each pump section.

1.3 QUALITY CONTROL

A. Factory Test Data: Signed, dated, and certified factory test data for each pump system which requires factory testing, submitted before shipment of equipment.

B. Pump shall be 24-hour continuous duty rated.

C. Manufacturer's Experience: The chemical feeding equipment shall be the product of a manufacturer who has designed and manufactured similar equipment and has a record of at least 5 years of successful operation of this type of process. The Supplier may be required to submit evidence to this effect together with a representative list of installations. The pump manufacturer shall maintain a permanent, local service department and a spare parts department.

D. Pumps shall be manufactured in compliance with ISO 9001-2008 standards and meet CE and applicable electrical standards.

E. To ensure proper function and quality, pumphead, tubing, and drive shall be manufactured by the same company. Tubing purchased by the pump manufacturer from a third party is not acceptable.

1.4 WARRANTY

A. A written manufacturer warranty shall be provided. The warranty shall be for a minimum period of three (3) years from the date of Substantial Completion. The manufacturer shall provide parts to replace all defects of materials or workmanship in the equipment during the warranty period.

PART 2 - PRODUCTS

2.1 GENERAL

A. The pumps shall be positive displacement type complete with self-contained variable speed drive as specified. Pumps shall be self-priming and shall have a maximum suction lift of up to 30 feet vertical water column.

B. Pump Schedule:

Chemical	Equipment Number	Feed Range (gph)	Continuous Operating Pressure (psi)
Methanol (100%)	PMP-C161X2	0.7-7.4	30
Sodium Hydroxide (35%)	PMP-C261X1	0-31.7	100

X = 1,2,3

2.2 OPERATING CONDITIONS

A. The work of this section shall be suitable for long-term operation under the conditions listed in the table below:

Equipment Number	PMP-C161X2*	PMP-C261X1*
Chemical	Methanol (100%)	Sodium Hydroxide (25%)

Ambient Environment	Outdoors	Outdoors
Ambient Temperature. (deg F)	32 to 90	32 to 90
Ambient Relative Humidity, (%)	20 to 100	20 to 100
Fluid Temperature, (deg F)	35 to 60	35 to 60
Fluid pH Range	N/A	12 - 14
Specific Gravity	0.795 @ 68 Deg F	1.27
Project Elevation, (ft)	860	860
Minimum Suction Lift, (ft)	4	4

* X = 1, 2, or 3 (Three pumps Total)

2.3 PERFORMANCE REQUIREMENTS

A. The pumps specified in this section shall satisfy the performance requirements listed in the table below:

Chemical	Methanol
Duty	Continuous
Drive	Variable
Pump Head	Closed Coupled Peristaltic Std. pump head for max performance
Continuous Operating Pressure (psi)	100
Tubing Material	Marprene

Chemical	Sodium Hydroxide
Duty	Continuous
Drive	Variable
Pump Head	Peristaltic Std. pump head for max performance
Continuous Operating Pressure (psi)	30
Tubing Material	Santoprene

2.4 CONSTRUCTION

A. For both methanol and caustic soda dosing pumps, all wetted parts to be compatible with chemical being used.

B. Methanol pumps shall consist of the following:

1. Pumphead shall consist of a fixed track, a hinged guard door, two spring-loaded tube clamp mechanisms, and spring-loaded roller rotor assembly. Pump tubing shall be in contact with the inside diameter of the track through an angle of 180 degrees and be held in place on the suction and discharge by a spring loaded self-adjusting clamp mechanism. At all times, one roller shall be fully engaged with the tubing providing complete compression and preventing back flow or siphoning. Tube occlusion and spring tension shall be factory set to accommodate 2.4mm wall thickness tubing and shall not require adjustment for accommodating tubing of 1.6mm to 9.6mm ID.
    a. Pumphead Assembly
        1) Pump Track Geometry must have a minimum 96.6mm swept diameter through a minimum track angle of 180 degrees
        2) When closed, pump door shall seal against the pump track for leak containment.
        3) Provide high corrosion/impact materials as specified
            a) Track Construction: polyphenylene sulfide (PPS)
            b) Guard Construction: hinged impact-resistant polycarbonate breakaway guard, tool un-lockable for operator safety.
            c) Rotor Construction: polyphenylene sulfide (PPS)
    b. Tube Retention
        1) Pump shall be supplied with LoadSure tubing element with molded fittings, which shall be self-locating when fitted into the pumphead.
    c. Rotor Assembly
        1) Provide rotor assembly that ensures gradual tube occlusion and compensates for tube tolerance:
            a) Twin spring-loaded roller arms located 180 degrees apart, each fitted with stainless steel helical springs and compressing roller for occlusion of the tube twice per rotor revolution
                1) Compressing Rollers: 316SS with low friction stainless steel bearings and PTFE seals, minimum diameter of 18mm
            b) Provide non-compressing guide rollers constructed of corrosion resistant Nylatron
        2) Clutch: Equip rotor with a central handgrip hub and manually activated clutch to disengage the rotor from the drive for manual rotor rotation during tube loading. Clutch shall automatically reengage rotor to gearbox upon one complete revolution.
        3) Mounting: To prevent slip, the rotor assembly shall be axially secured to the dogged output shaft of the gearmotor via a slotted collet and central retaining screw.
        4) Pumpheads requiring disassembly or special tools for tube changing are not acceptable.
2. Tubing shall be supplied with LoadSure tubing element with molded fittings, which shall be self-locating when fitted into the pumphead. Pumphead shall accept tubing sizes 1.6mm, 3.2mm, 4.8mm, 6.4mm, 8.0mm and 9.6mm with 2.4mm wall thickness and materials including, Marprene, Bioprene, Silicone, Sta-Pure & Chem-Sure. Pumps

that require tools for adjustment or changing pumpheads to accept different tubing materials or sizes are not acceptable.

3. Molded Fittings: Quick connect type integral to tubing element that seals leak tight to pumphead.
4. Pump tubing shall be constructed of Marprene II, a thermoplastic elastomer with 64 Shore A durometer and minimum 2.4mm wall thickness. If required for chemical compatibility, pump manufacturer shall recommend an alternate tubing material.
5. Supply One (1) meter of reinforced transparent PVC flexible hose for connection of the pump to suction and discharge process lines. Flexible hose shall have quick connect ends for mounting to pump and process piping.
6. The gearmotor shall consist of the gearing and motor as a single configured unit with UL listing. Gearing shall be double reduction helical in-line design with a housing constructed of SAE Class 30 cast iron and fitted with a Viton seal. Gearbox output shaft and face shall accept the direct coupling of the peristaltic pumphead. Gearing shall be manufactured to AGMA Class 10 requirements with an overall rating of AGMA Class II under continuous operation and a minimum efficiency of 95%. Integral speed motor shall include a 4-pole TEFC motor construction, Design B with Class F insulation, and 40 deg C ambient rating. Motor shall have an ingress protection rating of NEMA 4X.
7. Variable Speed Drive - Variable speed controller shall incorporate PWM type AC variable speed circuitry and shall be preprogrammed for optimum performance with a peristaltic pump.
8. Mounting: Drive shall be mounted to epoxy-coated aluminum baseplate.
9. Paint: Pumphead shall be paint free. Gearmotor shall be painted with epoxy corrosion resistant finish.

C. Caustic soda pumps shall consist of the following:

1. Pumphead
   a. Technology: Provide tool-free ReNu cartridge-style peristaltic pumphead technology. For operator safety, pumphead shall be serviceable as a single replaceable component. Pumps that require an operator to open the pumphead for tube replacement, cleaning, or rebuilding or that require tools for maintenance are unacceptable.
   b. Max rating: Qdos 20, with SEBS pumphead – 5.3 GPH at 55 rpm and 100 psi of discharge pressure

      7.93 GPH at 125 rpm and 100 psi of discharge pressure.
   c. Housing construction: corrosion resistant and high impact resistant glass filled PPS or PPE/PS.
   d. Geometry: Pumphead shall consist of sealed track housing with in-line porting. Suction and discharge ports shall be 180 degrees apart with bottom suction and top discharge.
   e. Rotor: Pumphead rotor shall be constructed of glass filled Nylon, sealed within the track housing, and supported by its own bearings. Peristaltic occlusion level shall be factory set to ensure flow accuracy of +/- 1% and repeatability performance of +/- 0.5% and shall not require any field adjustment.
   f. Leak containment/detection: In the event of peristaltic element failure, the leak sensor shall shut the pump down immediately with all process fluid contained within the sealed pumphead.
   g. Sensor type: Utilize non-contacting optical sensor. Sensor shall not come

in contact with the process fluid, shall contain no moving parts, shall not depend on the capacitance of the process fluid, shall not require fluid to leak out of the pump housing for engagement, nor shall require any sensitivity or calibration adjustment.

h. Alarm: Sensor shall shut down the pump, give a visual indication on the drive controller, and if specified shall provide an output general alarm signal.

i. For operator and environmental safety, pumps which do not have leak containment, leak sensor, and shutdown are not acceptable. For additional overpressure safety, sealed pumphead shall have a controlled drain-to-waste port.

2. Port connections: Pumphead shall utilize polypropylene compression fittings which shall mate to 10mm ID reinforced, transparent PVC interface hose. Provide polypropylene compression by ½" NPT adaptors for connecting interface hose to process line.

2.5 ACCESSORIES

A. Accessories shall be provided as outlined in Section 46 30 00 - Chemical Feed Equipment, General.

2.6 SPARE PARTS

A. Provide manufacturer's recommended spare parts, including at a minimum:

1. A complete set of extra compression fittings shall be furnished with each pump.

2. One (1) replacement tube for each pump.

3. One spare pumphead for each pump skid.

2.7 PUMP DRIVE

A. Mounting: Where motors or starters are an integral part of the pump, components shall be self-supporting and not require anchoring.

B. Each pump shall be provided with the following drives:

Rating	Continuous 24-hour operation, 110°F maximum ambient temperature
Supply	120V 60 Hz; 1-Phase
Enclosure	NEMA 4X

Housing	Impact resistant engineering plastic, 20% glass filled PPE/PS. Polyester powder-coated aluminum is acceptable for the pump housing.
Drive Motor	Direct coupled pumphead with fully protected drive. Brushless DC motor with integral gearbox and closed loop tachometer feedback. Motor shall include overload protection.

2.8 PUMP CONTROLS

A. Operator membrane keypad:

1. Increase/Decrease Speed
2. Start/Stop
3. Auto/Manual selector
4. Programmable keypad disabled to prevent changes from incidental contact.
5. Programmable automatic restarting for resumed pumping after recovery from power interruption.
6. LED display of RPM

B. Remote Features:

1. Analog input of 4-20 mA for speed control in Auto mode. Signal response may be scaled over any part of the drive speed range. Contractor to ensure analog signals being sent to the pump for automatic speed control from other devices are isolated signals. An analog input of 4-20 mA is acceptable for speed control.
2. The SCADA system will provide run and speed signals to the chemical dosing pumps based on flow meter signals from the influent pump station or according to operator dosing inputs for caustic soda dosing.
3. For methanol dosing, the SCADA system will provide run and speed signals based on flow meter signals, nitrate levels, and dissolved oxygen levels measured in the secondary effluent line, or according to operator dosing inputs.
4. Dry contact closure input for remote start/stop - functional in both the Auto and Manual modes.
5. Discrete output for running indication and alarm faulting.
6. Analog output of 4-20 mA to provide pump speed for use by SCADA to calculate flow in gph.

2.9 MANUFACTURERS OR EQUAL

A. Watson-Marlow

B. Equal must be pre-approved during bidding process.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Chemical feed systems shall be installed in accordance with accepted procedures submitted with the shop drawings and as indicated on the drawings, unless otherwise accepted.

3.2 FIELD QUALITY CONTROL

A. Manufacturer shall employ and pay for services of their field service representative(s) to:

1. Inspect equipment covered by these Specifications.

2. Supervise pre-start adjustments and installation checks.

3. Conduct initial startup of equipment and perform operational checks.

4. Provide a written statement certifying that manufacturer's equipment has been installed properly, started up and is ready for operation.

B. Instruct Owner personnel for 8 hours at the job site per Section 01 78 23 – Operation and Maintenance Data. Contractor shall video training and provide a copy on thumb drive to Owner.

END OF SECTION 46 33 44

SECTION 46 66 56 – OPEN-CHANNEL LP/HI UV TREATMENT EQUIPMENT

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Vendor shall furnish an open channel, gravity flow, low-pressure high intensity ultraviolet (UV) disinfection system complete with an automatic mechanical/chemical cleaning system and variable output electronic ballasts. The UV system to be complete and operational with all control equipment and accessories as shown and specified herein. The system shall be furnished complete with UV banks, system control center, electrical cabinets housing the electronic ballasts, power distribution, and system controls, UV detection system, support rack(s), level controller(s), automatic wiping system, spare parts, and associated instrumentation.

B. The system described herein shall be capable of disinfecting effluent to meet the water quality standards listed in this Section.

1.2 REFERENCE STANDARDS

A. Products and their installation shall be in accordance with the following trade standards and recommended practices as applicable:

1.	National Water Research Institute	Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse (2012)
2.	EPA 815-D-03-007	Ultraviolet Disinfection Guidance Manual, United States Environmental Protection Agency
3.	EPA 625/1-86/021	EPA Design Manual Municipal Wastewater Disinfection
4.	NSF/ANSI 55	2002 NSF International Standard, American National Standard for Drinking Water Treatment Units - Ultraviolet Biological Water Treatment Systems, NSF International
5.	ONORMm5873.1e	Plants for the Disinfection of the Water using Ultraviolet Radiation, Requirements and Testing, Low Pressure Mercury Lamp Plants, ONORM
6.	ANSI C62-41 (IEEE 587)	Transient Protection
7.	ANSI/NFPA 70	National Electric Code

8.	ANSI C78.1	Lamp Starting
9.	ANSI C82.1	Lamp Starting
10.	UL 935	Standard for Fluorescent-Lamp Ballasts

1.3 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01 33 00 – Submittal Procedures.

1. The Contractor shall submit a copy of the equipment specification section with all addenda and all referenced specification sections. Each paragraph shall be check-marked to indicate specification compliance or marked to indicate deviations from the specification requirements. Check marks shall indicate complete compliance with the paragraph requirements. The manufacturer shall prepare a detailed justification for each deviation. Failure to include the required specification sections and justification for deviations will indicate non-compliance and shall be rejected without further consideration.

2. Provide complete description in sufficient detail to permit an item comparison with the specification. Submittal shall include descriptive information including catalog cuts, shop drawings, manufacturer's specifications for all major components, and weight of each bank.

3. The UV Manufacturer shall submit:

   a. Bioassay Validation Report for the proposed system as per paragraph 2.4.

   b. SCADA detailed tag list for all of the points outlined in Section 40 61 96 - Control Strategies including functionality of each point. The intent of this submission is to provide the SCADA integrator information for integrating the UV system into the SCADA system.

4. Provide overall layout dimensions, required clearances and general description of the equipment, including location of electrical equipment, control panels and other auxiliary equipment. Disinfection system must fit in the structure as shown on the drawings.

5. Provide electrical single line diagrams, schematics diagrams, interconnection diagrams, and internal wiring diagrams of UV System. Include operating characteristics of all electrical and control equipment including power consumption, operating voltage and amperage tolerances, and ancillary electrical services required.

6. Provide hydraulic calculations demonstrating the hydraulic characteristics for plug flow, dispersion, and retention time for each of the design conditions specified, and system headlosses.

7. Provide complete data on materials to be used for fabrication.

8. Provide disinfection performance guarantee and warranty letters.

B. Submit Operation and Maintenance Manuals in accordance with Section 01 78 23 – Operation and Maintenance Data.

1.4 QUALITY ASSURANCE

A. Guarantee: The UV manufacturer must provide a written guarantee that the installed ultraviolet system will produce an effluent that meets the bacteriological requirements of this specification, based on the specified wastewater quality entering the UV process if maintained and operated in accordance with the manufacturer's recommendations.

B. Qualification of Manufacturer: Supply products that are produced by a manufacturer who is regularly engaged in the manufacture of open channel low-pressure high output UV disinfection for a minimum period of ten (10) years, and with a history of at least fifty (50) successful UV municipal wastewater treatment installations of similar size and type to be provided.

C. Independent certification of fouling factor and lamp aging factor must be submitted if values other than the specified default values are being proposed.

D. Documentation of UV manufacturer's service capabilities including location and experience.

E. Warranty: The Manufacturer shall execute and deliver to the Owner all manufacturers' warranties applicable to the equipment or any part thereof.

1. The equipment shall be guaranteed against defects in material and workmanship for a period of two (2) years, and ballasts to be warranted for five (5) years from the date of Substantial Completion.

2. The UV lamps shall be warranted against lamp failure for a minimum of 12,000 operating hours. Lamp failure is a total loss of light output from the lamp.

3. In case of premature lamp failure, the UV manufacturer shall offer the following:

a. Lamp failure before 9,000 hours - send a replacement lamp free of charge

b. Lamp failure after 9,000 hours - issue a credit proportional to the hours not used

4. The UV manufacturer shall ensure disposal of returned lamps (old/used) at no cost to the Owner upon receipt of the returned lamps at the manufacturing headquarters. Shipping costs shall be borne by the Owner.

5. Ballasts/Lamp Drivers shall be warranted for 5 years, prorated after 1 year.

6. UV intensity sensors shall be warranted for 5 years without prorating.

PART 2 - PRODUCTS

2.1 GENERAL

A. The UV disinfection unit shall deliver the minimum UV inactivation dose at maximum flow capacity, minimum operating temperature, and the minimum design UV transmittance, with lamp output adjusted to account for the combined lamp degradation factor to simulate the end of lamp life condition.

B. The end of lamp life is based on a lamp aging factor either determined from independent testing following NWRI guidelines and guaranteed by the UV manufacturer or the minimum lamp aging factor of 50%. Regardless of test results provided, the lamp aging factor shall not exceed 0.85. The minimum end of lamp life is of the nominal lamp output, which is defined as the full power amp output after 100 hours of lamp operation.

C. The UV disinfection system fouling factor shall be a factor determined from independent testing in accordance to the NWRI guidelines and guaranteed by the UV Manufacturer. Regardless of independent test results provided, this factor shall not exceed 0.9.

D. If no independent third-party testing has been conducted, the default factors as described in the NWRI guidelines must be used: Aging Factor = 0.50, Fouling Factor = 0.80.

E. The system shall be able to continue providing disinfection while replacing UV lamps, quartz sleeves, ballasts and while cleaning the UV lamp sleeves.

F. The UV disinfection system supplied shall be UL-listed, or equivalent label and listed.

2.2 DESIGN CRITERIA

A. The UV Manufacturer shall provide equipment which shall disinfect a tertiary wastewater effluent with the following characteristics:

No.	Item	Unit	Value
1	Peak Flow	MGD	0.682
2	Minimum Flow	MGD	0.10
3	Total Suspended Solids, Average	mg/L	5
4	pH		6.5 – 9.0
5	Water Temperature	Deg C	8.0 – 25.4

B. Disinfection Requirements: The UV disinfection system shall provide an effluent with no greater than the following fecal coliform count levels with one bank out of service:

No.	Item	Unit	Value
1	Maximum for any one sample*	per 100 ml	< 23
Effluent standards shall be guaranteed regardless of influent count to UV system.			

*4 of 7 non-detect of consecutive daily effluent grab samples

C. Provide a UV system that satisfies the following system requirements:

No.	Item	Unit	Value
1	Min. Ultraviolet Transmittance at 254 nm	%	65
2	Minimum Dose at Peak Disinfection Flow and End of Lamp Life	mJ/ cm2	100
3	Maximum Headloss at Peak Disinfection Flow	inches	0.35
5	Available Electrical Service		480V, Three Phase

D. Redundancy shall be included in the design, such that a bank can be taken offline while the remaining banks are sufficient to deliver the required dose.

E. Dosage Requirements: The UV disinfection system will provide the listed dosage at peak flow with one unit out of service at end of lamp life after reductions for UV sleeve fouling.

2.3 SYSTEM CONFIGURATION

A. The UV structure will be built to accommodate the UV equipment as shown on the drawings. The UV system shall be designed for complete indoor installation and shall conform to the following configuration:

1. Total number of channels: 1
2. Overall channel length: See Drawings
3. Channel width: See Drawings
4. Channel depth: See Drawings
5. Nominal water depth in channel: See Drawings

2.4 PERFORMANCE REQUIREMENTS

A. The UV disinfection system will produce an effluent conforming to the microbiological discharge limit as specified in this Specification. Grab samples will be taken in accordance with the Microbiology Sampling Techniques found in *Standard Methods for the Examination of Water and Wastewater, (latest edition)*.

B. Design the UV system to deliver a minimum MS2 RED 100 mJ/cm^2 at peak flow, in effluent with a UV Transmission of 65% at end of lamp life (EOLL) after reductions for quartz sleeve fouling. The basis for evaluating the RED will be the independent third-party bioassay, without exception. Bioassay validation methodology to follow applicable protocols described in 2006 USEPA UVDGM.

C. The RED will be adjusted using the aging factor listed in 2.1 to compensate for lamp output reduction over the time period corresponding to the manufacturer's lamp warranty. The use of a higher lamp aging factor will be considered only upon review and approval of independent third party verified data that has been collected and analysed in accordance with protocols described in the NWRI *Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse* (May 2012) but shall not exceed the maximum lamp life factor specified in section 2.1.

D. The RED will be adjusted using the quartz sleeve fouling factor listed in 2.1 to compensate for quartz sleeve transmission reduction due to wastewater effluent fouling. The use of a higher quartz sleeve fouling factor will be considered only upon review and approval of independently verified data that has been collected and analysed in accordance with protocols described in the NWRI *Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse* (May 2012) but shall not exceed the maximum fouling factor specified in section 2.1. The data recorded for the determination of the validated fouling factor must be obtained by testing in secondary wastewater effluent utilizing the same lamp, quartz sleeve and cleaning system proposed by the UV Manufacturer.

E. Independent validation for use of higher factors (lamp aging and sleeve fouling) must be submitted to the Engineer for consideration a minimum of fifteen (15) days prior to bid. The independent validation shall have oversight by a qualified registered professional engineer with knowledge and experience in testing and evaluation of UV systems as defined in the EPA UVDGM (Appendix C, Section C.3.3)

F. At a minimum the following parameters shall have been considered during validation testing:

1. UVT
2. Measured UV intensity
3. Flow rate per lamp
4. Power consumption
5. UV sensitivity of challenge organism
6. Head loss across UV banks

G. Validation testing that does not utilize all of the above parameters is considered inadequate as it does not allow for appropriate system sizing. Bids based on inadequate validation testing shall not be considered. To be acceptable, UV sensor data must be collected during the biodosimetry validation testing.

H. The UV system shall be capable of dose pacing to reduce electrical energy consumption in response to the disinfection demand based on a minimum of channel flow signal (provided by others through either SCADA communications or 4-20mA signal), the UV sensor signal(s) and the online measured UV transmittance.

I. For determining UV dose during operation and for dose pacing, the UV transmittance value shall be incorporated into the UV control system's validated operating equation, along with the upstream measured flowrate.

J. Lamp aging and sleeve fouling factors shall not be allowed in lieu of UV sensor signal(s) for determination of UV dose during operation.

K. Other modules within the system shall be able to continue providing UV treatment while replacing UV lamps, quartz sleeves, ballasts and while cleaning the UV lamp sleeves in a given module.

2.5 CONSTRUCTION AND MATERIALS

A. The system shall be designed for immersion of the UV lamps in the effluent within their protective quartz sleeve.

B. The UV lamp configuration shall be a horizontal, staggered arrangement, and parallel to each other and flow to assure best mixing and to minimize channel depth.

C. All metal in contact with effluent will be Type 316 stainless steel.

D. All materials exposed to UV light shall be 316 stainless steel, quartz glass, PTFE, FKM, or other suitable long-term UV resistant materials. Wiring shall be Teflon-coated.

E. All wiring connecting the lamps to the ballasts shall be enclosed inside the frame of the UV module and not exposed to the effluent.

2.6 UV LAMPS

A. Lamps shall be low-pressure mercury amalgam, high intensity type.

B. Lamp filaments shall be sufficiently rugged to withstand shock and vibration.

C. Lamp types with a polychromatic UV output or UVC output efficiency of less than 30% at 254nm are not acceptable.

D. Each lamp shall be tested in UV-output, lamp current and lamp voltage from the manufacturer. All results shall be stored in a database referencing to the individual batch number. The lamp batch number shall be printed on the lamp surface.

E. UV output energy of the lamp shall be variable for a minimum range of 60% -100% of UV-C ballast power input.

F. Useful lamp life shall be guaranteed at 12,000 operating hours for each lamp under normal operation conditions. Normal operation conditions include a maximum of ten (10) on/off cycles per 24 operating hours.

G. UV lamps shall not require a cool down period prior to re-start should the power to the UV system fail or be interrupted for a short period of time.

H. Each lamp base shall incorporate a dielectric barrier or pin isolator. The pin isolator shall consist of a non-conductive divider placed between the lamp pins to prevent direct arcing across the pins in moist conditions. The barrier shall be dielectrically tested for 2,000 volts RMS.

I. Each lamp plug (Type 6P) shall be accessible from the top of the UV bank to facilitate lamp removal without moving the banks. An integral safety interlock in the plug will prevent removal of energized lamps.

J. The UV Manufacturer shall ensure disposal of returned lamps (old/used) at no cost to the Owner upon receipt of the returned lamps at the manufacturing headquarters.

K. Lamp sleeves shall have a nominal wal thickness of 1.5 mm.

2.7 UV BANKS OR MODULES

A. The UV banks shall be designed for submergence without causing failures or damage to the system or components.

B. Each UV module will consist of UV lamps with an electric ballast enclosure mounted on a Type 316 stainless steel frame.

C. All electrical connectors and motors located on the module and above nominal channel water level shall either rated at IP67 or located within IP67 enclosures suitable for temporary submersion.

D. The UV bank design and mounting shall provide plug and socket quick disconnect facilities enabling non-technical personnel to carry out lamp replacement, wiper insert replacement, etc., without the need for any tools or specialist isolation procedures.

E. Each lamp assembly will be enclosed in its individual quartz sleeve, one end of which will be closed and the other end sealed by an integrated lamp connector.

F. The closed end of the quartz sleeve will be held in place by means of a retaining O-ring. The quartz sleeve will not come into contact with any steel in the frame.

G. Lamps shall be removable with the quartz sleeve and wiper system remaining in place.

H. The UV lamp sleeve shall be a single piece of clear fused quartz circular tubing, which shall not be subject to degradation over the life of the system.

I. The lamp socket shall be centered against the inside of the quartz sleeve and shall be retained by a cap nut with a ribbed exterior surface providing a positive handgrip for tightening / loosening without the need for any tools. This connection includes a self-contained o-ring, sealing the lamp and socket module (independently from the quartz sleeve).

J. Each UV module will be connected to a receptacle on the Power Distribution System

K. A portable crane system shall be provided by the supplier that is able to fully lift a UV module out of the channel for cleaning and replacement of bulbs as required. Components shall include the portable crane and mounting sockets, to be installed by contractor.

2.8 LEVEL CONTROL WEIR

A. A level control weir shall be provided by the manufacturer and located at the end of the UV channel.

B. The effluent level control weir shall be constructed of Type 304 stainless steel and designed to maintain a minimum channel effluent level as required to keep lamps submerged (see drawings).

2.9 WIPING SYSTEM

A. Each UV bank shall be equipped with an in-situ automatic wiping system with selectable wiping frequency. The cleaning system may use mechanical wiping or a combination of chemical/mechanical cleaning. Where the UV system only provides a mechanical wiping system, supplier shall include provisions for out of channel cleaning by supplying offline cleaning tank with appurtenances to provide ability to air scrub and supply with cleaning solution.

B. The cleaning system will be fully operational while UV lamps and modules are submerged in the effluent channel and energized.

C. The wiping system shall be controlled by the UV system controller and provide a fully automatic, unattended operation. The cleaning system will also be operable in remote manual mode.

D. Vendor shall provide cleaning solution for equipment start-up and testing until the system is accepted by Owner as being substantially complete.

E. The number of wiping strokes per interval shall be factory preset for optimum effect to 2 strokes per time interval, with time intervals being user adjustable.

F. Actuation mechanism(s) for the automatic wiping system shall be driven by an integral electric motor within the module or by means of an external hydraulic pump.

2.10 UV MONITORING SYSTEM

A. A submersible UV sensor shall continuously sense the UV intensity produced in each bank of UV lamp modules.

B. The sensor shall not degrade after prolonged exposure to the UV light or effluent.

C. The sensor shall measure only the germicidal portion of the light emitted by the UV lamps as measured at 253.7 nm. It shall have sensitivity at 253.7 nm of greater than 95%. Sensors whose sensitivity to other wavelengths amounts to more than 5% of the total sensitivity shall not be allowed.

D. The physical construction of the sensor shall be built and certified according to the DVGW W294 or O-Norm-M5873 standards or in accordance with the USEPA UV disinfection guidelines with calibration methods traceable to the US National Institute for Standards and Technology (NIST).

E. The measured UV intensity signal shall be fed into the UV System Controller and used for continuous monitoring. In automatic mode, the UV Control System shall automatically adjust to draw the minimum electrical power while maintaining the prescribed minimum dose required for disinfection. The UV dose shall be displayed on the operator interface.

F. The UV intensity monitoring system shall be factory calibrated. Calibration shall be valid for minimum of one (1) year unless otherwise specified. Submit calibration certificate to Engineer prior to start-up.

G. The UV sensor shall be automatically cleaned at the same frequency and methodology as the lamp sleeves to prevent fouling of the sensor and resulting false alarms for low intensity.

H. There shall be a minimum of one (1) UV sensor for each bank of lamps.

2.11 UV TRANSMITTANCE (UVT) MONITOR

A. A single UVT monitor shall be provided by the Contractor with channel mounting hardware and the UVT reading will be included on the HMI as described in Section 40 75 16.16 – UV Transmittance Process Measurement Devices. The UV Equipment Vendor shall accept the signal from this UVT monitor for us as described below:

1. The UVT measurement shall be used as part of the control strategy to account for changes in UVT of the secondary effluent. The controls shall include a means to specify a transmittance so that the system can continue to automatically operate should the UVT monitor need to be repaired or replaced. The UVT reading shall also be an output to the SCADA system for monitoring and trending via ethernet.

2.12 DOSE-PACING

A. A dose-pacing system will be supplied to modulate the lamp UV output in relationship to an ethernet signal from an effluent flow meter via the main plant PLC (by Contractor).

B. The system to be dose-paced such that as the flow and effluent quality change, the design UV dose is delivered while conserving power.

C. The dose-pacing system will allow the operator to vary the design dose setting. Logic and time delays will be provided to regulate UV bank ON/OFF cycling.

2.13 HYDRAULIC SYSTEM CENTER (HSC)

A. One (1) HSC will be supplied to house all components required to operate the automatic cleaning system.

B. Enclosure material of construction will be 304 Stainless Steel - Type 4X (IP66).

2.14 CLEANING SYSTEM

A. An automatic cleaning system will be provided to clean the quartz sleeves using both mechanical and chemical methods. Wiping sequence will be automatically initiated with capability for manual override.

B. The cleaning system will be fully operational while UV lamps and modules are submerged in the effluent channel and energized.

C. Cleaning cycle intervals to be field adjustable.

D. Remote Manual and Remote Auto cleaning control options will be provided.

E. The cleaning system will be provided with the required solutions necessary for initial equipment testing and for equipment start-up.

2.15 WATER LEVEL CONTROL

A. The Vendor shall provide finger weirs for UV channel water level control. The weirs shall be constructed of Type 304 or 316 stainless steel. The weirs shall maintain a water level within tolerances required to keep lamps submerged and to prevent an excessive water layer over top of the lamps (see drawings). The contractor shall be responsible to provide adequate supports for the finger weirs.

B. Low Water Level Sensor: One low water level sensor will be provided by the manufacturer for each channel. During manual, automatic and remote modes of the system operation, the water level sensor will ensure that lamps extinguish automatically if the water level in the channel drops below an acceptable level. The low water level sensor will be powered by a separate control box that is mounted near the channel. Power supply shall be 120V.

2.16 ELECTRICAL AND CONTROL SYSTEM

A. General

1. All controls necessary for the fully automatic operation of the screen shall be provided. The control strategy shall be as described in Section 40 61 96 – Control Strategies.

2. Electrical and control enclosures shall be installed in the building near the UV system.

3. The electrical system shall be designed to provide:

a. Maximum reliability of the UV disinfection system.

b. Segregation of plant services and supplies into sensible groups to allow for safe and simple maintenance or servicing while maintaining the required level of disinfection.

c. Plug and socket quick disconnect facilities enabling non-technical personnel to carry out lamp replacement without the need for any tools or special isolation procedures.

4. All heat sensitive components shall be adequately cooled with dry air utilizing forced ventilation. Indoor temperatures can range up to 104 degrees F.

5. Harmonic distortion correction equipment shall be provided by the UV Manufacturer as required to meet IEEE519-1992 of The Institute of Electrical and Electronic Engineers.

B. Electrical Enclosure

1. Each UV module within a bank shall be powered and controlled by one (1) Electrical Enclosure or powered by the bank's dedicated Power Distribution Center (PDC) and controlled by a System Control Center (SCC).

a. The UV manufacturer shall supply all cabling and conduit between the lamps and ballasts.

b. The UV manufacturer shall perform all terminators between lamps and ballasts.

c. Each electronic ballast within a UV module will operate two lamps.

d. Power factor will not be less than 98% leading or lagging.

e. Electrical supply to each PDC shall be 480/277V 60Hz, 3 Phase, 4 Wire + Ground, 6.20 kVA.

f. Electrical supply to the Hydraulic System Center will be 480V 60Hz, 3 Phase, 3 Wire + Ground, 2.5 kVA.

g. Electrical supply for the Level Control Panel will be provided by the PDC(s) and be 24 Volt DC.

h. Electrical supply to the System Control Center will be 120V 60Hz, 1 Phase, 2 Wire + Ground, 1.8 VA.

2. The electrical and control enclosures shall contain the proper control device, electronic ballasts, power distribution, and all necessary electrical components to operate the UV system.

3. A power supply of 480 volts, 3 phase, 60 hertz, 4 wire plus ground shall be provided to the Electrical Enclosure. Any transformers or other items required to provide adequate power to the electrical enclosures shall be provided by the manufacturer.

4. All enclosures shall be UL-Listed/ painted 304 stainless steel with suitable air conditioning units, if necessary. This includes the ballast cabinets and the control system panel.

C. Electronic Ballasts

1. The ballasts shall be electronic microprocessor controlled designed as slot cards fitting into a rack system with a plug connector for ease of maintenance or located inside 6P rated ballast enclosures above channel.

2. Each ballast shall drive a pair of lamps with independent control and monitoring circuits.

3. The ballast shall produce an earth free lamp power supply operating at above supply frequency and optimized to preserve lamp life.

4. The ballast shall incorporate a galvanic separation of the two circuits. In case of the secondary circuit operating in abnormal conditions regarding voltage and/or amperage, the ballast shall shut off the lamp concerned.

5. The operating power factor for the ballasts shall not be less than 0.94.

6. The ballast shall be capable of varying the lamp power between 60-100%, or greater, proportional to 4-20 mA control signal.

7. The configuration of ballast cooling shall include an independent air conditioning system to reduce risk of ballast overheating or located inside 6P rated ballast enclosures above channel cooled by convection.

D. Power Distribution Center

1. Power distribution will be through environmentally sealed receptacles on the PDC(s) to allow for local connection of UV modules.

2. Data concentration will be through integrated circuit boards located inside the Power Distribution Center.

3. PDC enclosure material will be Type 304 Stainless Steel - Type 4X (IP66).

4. All internal components will be sealed from the environment.

5. All Power Distribution Centers to be cULus listed listed to Canadian and USA safety standards, with a rating of Type 4X.

6. One separate sealed Power Distribution Center will be provided per bank of lamps.

E. Instrumentation and Controls

1. Local monitoring and control shall be configured to each power/control module (bank) with a local control selector (local-off-remote), power on display, status of each lamp, low UV intensity alarm, high water temperature alarm (if applicable), and lamp hours run counter.

2. Remote monitoring and control shall be configured to each power/control panel to accept the indicated inputs when remote control selected and to provide the indicated outputs at all times with an external, supervisory control system.

    a. Discrete Outputs (Message handler via ethernet signal): Power on display, chamber/cabinet, common alarm

    b. Alarms will be provided to indicate to plant operators that maintenance attention is required or to indicate an extreme alarm condition in which the UV treatment performance may be jeopardized.

    c. The 100 most recent alarms will be recorded in an alarm history register and displayed when prompted.

    d. Bank status will be capable of being placed either in Manual, Off or Auto mode.

    e. Elapsed time of each lamp will be recorded and displayed on the display screen when prompted.

    f. Message handler via ethernet will be provided to remotely indicate status and alarms such as:

        1) Alarm conditions (critical, major, minor, channel low-level)

    g. Data connection (if required) component installed within the UV systems control to enable plant staff to receive enhanced over-the-phone and online UV product support from OEM. OEM-provided app to enable UV system monitoring, product troubleshooting, and alarm notifications with cybersecurity verified by third-party and that is consistent with FCC.

F. Control Unit (PLC)

1. The control device shall be governed by Touch Smart Controller with Allen Bradley SCADA connectivity. The PLC shall be continuously monitoring and controlling the UV system's functions. Custom electronics and the UV sensor shall provide the control panel with the necessary indications of the system parameters. One (1) such PLC will be provided for the UV system.

2. Complete control and monitoring of the UV system shall be accomplished through the operator interface. The operator interface shall be a Touchsmart Color HMI, minimum 12" size.

3. The PLC shall be menu driven and shall display the following system information when prompted: bank status, individual lamp status, lamp operating hours, UV intensity, ON/OFF frequency, alarms, alarm history.

4. The PLC program shall control the On/Off cycling and lamp power of the UV banks based upon a Dose-pacing philosophy.

5. The PLC shall utilize a UV intensity sensor located within each UV bank to accurately sense any change in lamp power, effluent transmittance and compensate for any reduction in the UV-C output due to lamp aging.

6. The PLC shall receive inputs from the UV sensor, UVT monitor, and influent flow meter and shall automatically adjust the received UV Dose to maintain the required levels under all operation conditions.

7. A PLC that actively monitors only flow and uses independent transmittance for theoretical Dose paced control is not acceptable.

G. Safety Alarms

1. General alarms are as follows:

a. Lamp Failure Alarm

b. Multiple Lamp Failure Alarm

c. Low UV Intensity

d. Bank Communication Alarm

2. The PLC shall utilize a UV sensor located within the UV bank to accurately sense any change in lamp power, effluent transmittance and compensate for any reduction in the UV-C output due to lamp aging. The PLC shall receive inputs from the UV sensor and flow meter (provided by others) and shall automatically adjust the received UV Dose to maintain the required levels under all operation conditions.

3. Should there be any abnormalities or failure to the UV sensor, the following will occur:

a. UV Sensor Failure

b. Low UV Intensity

c. Low-Low UV Intensity

H. Major alarms shall be provided by the System Control Center or Local Operator Interface to indicate an extreme alarm condition in which the disinfection performance may be jeopardized. Alarms shall include the alarms listed under Section F and the following:

1. Flow Meter Failure shall indicate a failure to receive a signal from the effluent flowmeter.

2. PLC Power Failure alarm shall indicate loss of power to the PLC. If there is a loss of power to the PLC, the modules shall be turned on full power until PLC control is restored.

2.17 SPARE PARTS

A. The following spare parts and safety equipment shall be furnished:

1. Ten (10) percent of UV lamps

2. Ten (10) percent of sleeves

3. One (1) UV Ballast

4. 10% Wiper Rings

5. One (1) UV intensity Sensor

6. Two (2) face shields that blocks light between 200 and 400 nm.

2.18 ANCHORAGE AND FASTENERS

A. GENERAL

1. The Installation Contractor shall furnish all anchoring hardware for the supplied equipment in accordance with Section 43 05 50 – Equipment Mounting.

2. The Installation Contractor shall furnish all epoxy and dispensing equipment for chemical anchoring.

3. The Vendor shall provide anchor bolt calculations made and signed by a civil or structural engineer currently registered in the State of Oregon.

2.19 MANUFACTURERS OR APPROVED EQUAL

A. Trojan (Basis-of-Design)

B. Wedeco

C. Equal must be pre-approved during bidding process

PART 3 - EXECUTION

3.1 DELIVERY AND INSTALLATION

A. All components shall be handled with care during transportation, storage and installation. The Contractor shall follow the Manufacturer’s storage and handling instructions.

B. Installation of the UV equipment shall be by the Installation Contractor in accordance with the engineering drawings and instructions. The Manufacturer is to provide a factory-trained field representative to assist in and verify proper installation of the UV equipment. This can be included as part of the services identified in Part 3.2 below.

C. All required installation hardware, such as, but not limited to, support braces and saddles, bolts, washers, nuts, and jam nuts, shall be furnished by the Contractor.

3.2 MANUFACTURER'S SERVICES

A. Manufacturer's representative for the equipment specified herein shall be present at the jobsite for a minimum number of workdays for services listed below. Excluded from these time requirements shall be travel time spent, time spent during shipping of equipment, time spent at the jobsite correcting any fabrication or manufacturing errors, and time spent preparing and operating the equipment to meet performance requirements including all performance testing. The Bid shall include all associated expenses incurred by the technical representative during the jobsite visits. The following services will be provided:

1. Minimum one workday (8 hours) per channel for installation inspection.

2. Minimum of four workdays (8 hours each) for UV system start-up.

3. One workday (8 hours) for maintenance training, maintenance assistance, classroom and on-site equipment operation instructions, troubleshooting, and other post-startup services.

B. Minimum qualifications for field representative performing startup and training include previous startup experience at a minimum of five (5) projects that have included a similar UV system.

C. Startup services and training of Owner's personnel shall be at such times as requested by the Owner.

D. The factory representative is to provide instruction pertaining to operation, maintenance, and cleaning procedures, as well as provide a full functional demonstration of the system.

E. The Installation Contractor shall video tape all training sessions and provide a copy to the Owner to use such tapes for continuing operator training.

3.3 FIELD TESTING

A. Testing and start up shall be conducted as required in Section 01 75 00 – Equipment Testing and Startup Procedures.

B. Equipment Checks: Prior to the final acceptance field testing, the Manufacturer shall check that all equipment is installed properly and functions as specified herein. The equipment checks shall include, but not be limited to:

1. Proper installation and alignment of electrical wiring and connections.

2. Water tightness of all submerged equipment.

3. Proper operation of instrumentation, alarms, and operating indicators associated with the UV equipment.

4. Proper placement and operation of ballast, cooling fans, and other equipment in the electrical and control panels, and adequate ventilation in the enclosures.

5. Proper operation of lamp module shutoff switches and ground fault circuit interrupters.

6. Proper operation and communication between the ballast enclosures and PLC monitoring equipment.

C. Certification: Upon completion of equipment checks, the Manufacturer shall submit to the Owner written certification that all UV equipment and accessory equipment associated with the UV disinfection system have been properly installed, are in good condition, are functioning properly, and are in accordance with the Contract Documents.

D. The Manufacturer shall provide on-site performance testing. During performance testing, the peak hour flow shall be simulated to verify performance of the equipment provided. If the UV disinfection system fails to meet the wastewater plant's disinfection requirements when operating within the design parameters, the Manufacturer shall have 15 days to modify the disinfection equipment and the system shall be re-tested for compliance with the project requirements. This process shall continue until the equipment performs as specified.

END OF SECTION 46 66 56

SECTION 46 76 26.13 – VOLUTE DEWATERING PRESS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Vendor shall furnish volute dewatering press together with associated sludge conditioning tank, control panel, polymer dilution and injection system, flowmeter, sludge feed pump, cake conveyor and all appurtenances as specified in the Contract Documents and as required to meet the specified performance requirements and to provide a full and properly functioning sludge dewatering system.

B. The system shall function to dewater waste activated sludge from a sequencing batch reactor system. WAS will be stored up to 3-4 days in mixed and aerated holding tanks. From this tank, a suction line to the sludge feed pump will be provided. Dewater cake solids from the press will be discharged into a shaftless screw conveyor. Refer to the design drawings for additional information.

C. Unit responsibility: All equipment furnished under this section shall be the responsibility of a single Manufacturer to fabricate or procure, integrate, factory test, and deliver to the project site. It shall be the responsibility of the Manufacturer to coordinate all details and components required for a properly functioning system.

D. All equipment will be installed in an unclassified, conditioned building.

1.2 RELATED SECTIONS

A. Section 46 33 33 - Liquid Polymer Blending System

B. Section 43 23 57 – Progressive Cavity Pumps

C. Section 40 70 13 – In-Line Liquid Flow Measuring Systems

D. Section 41 12 13.36 - Screw (Shaftless) Bulk Material Conveyors

E. National Electrical Manufacturers Association (NEMA).

F. Underwriters Laboratory (UL).

1.3 SUBMITTALS

A. The submittal shall be made in accordance with Section 01 33 00 – Submittal Procedures:

1. General Assembly drawings of all equipment to be supplied detailing all relevant dimensions and connection sizes.

2. Electrical drawings for all control panels showing all necessary field connections to be made.

3. Manufacturer's catalog sheets showing specified equipment, control panel, connecting piping and valves, spare parts package, O&M Manuals, and warranty information

4. Installation instructions.

5. Equipment weights and lifting points.

6. List of installations.

7. Motor characteristics and performance information.

8. Parts list including a list of recommended spare parts and all components located within the control panel.

B. Operation and Maintenance Data: Submit operation and maintenance data and equipment parts list in manual, in accordance with Section 01 78 23 – Operation and Maintenance Data.

1.4 QUALITY ASSURANCE

A. All components of the sludge dewatering equipment shall be engineered for long, continuous, and uninterrupted service with minimal operator intervention. Provisions shall be made for easy maintenance, adjustment, or replacement of all parts.

B. To ensure unity of responsibility, the volute dewatering press, supporting frames, polymer mixing and feeding blend unit, and control systems shall be furnished and coordinated by a single Manufacturer. The Contractor shall assume full responsibility for the satisfactory installation and operation of the entire volute dewatering press system package.

C. Prior to shipment, the Volute Dewatering Press and control panel shall be factory tested at the place of assembly. Factory test each pre-assembled, pre-wired, Volute Dewatering Press and its associated control panel to be supplied to the job site. Prior to shipment, verify through a one-hour continuous operating test that the Volute Dewatering Press and associated equipment operate smoothly, noiselessly, vibration free, and without overheating of any bearing or motor.

D. Manufacturer shall have at least ten (10) full-scale systems utilizing the exact technology and equivalent equipment size proposed for this project operating successfully for at least five (5) years in North America at municipal wastewater treatment plants that were furnished under the manufacturer's own name.

E. A written manufacturer warranty shall be provided for all equipment supplied. The warranty shall be for a minimum period of one (1) year from the date of Substantial Completion. Manufacturer shall repair or replace all defects of materials or workmanship in the equipment during the warranty period.

1.5 MANUFACTURER OR EQUAL

A. Process Wastewater Technologies LLC

B. Or Approved Equal

1.6 DESIGN CRITERIA

A. Sludge Characteristics: Waste Activated Sludge

B. Feed Concentration: 0.7% - 2.0% DS

C. Feed Capacity: 44 gpm

D. Minimum Required Dewatered Cake Concentration: 16% DS

E. Capture Rate: ≥ 95%

F. Number of Dewatering Drums: 2

G. Maximum Polymer Dosage: 55 lbs of active polymer per dry ton of solids

1.7 SYSTEM PERFORMANCE

A. The sludge dewatering system will be capable of delivering and dewatering the feed sludge and producing a solids cake with no free water present. The system will be able to start up, operate as required and shut down in the absence of any operators.

B. The sludge dewatering equipment shall be designed to adequately condition and dewater the sludge such that a dewatered sludge cake is produced that easily discharges from the dewatering unit, without blinding or plugging, and that may be handled by solids conveying equipment.

C. Each unit shall be designed to operate in the environment for which it is intended, continuously or intermittently on demand, and shall perform the required dewatering operations without spillage of water or sludge beyond the nominal machine envelope. In addition, the unit will operate with no requirement for operator attention other than periodic inspection and chemical replenishment.

1.8 SYSTEM DESCRIPTION

A. The sludge dewatering system shall consist of One (1) Volute Dewatering Press and all appurtenances.

B. The Volute Dewatering Press shall be a complete prefabricated system consisting of:

1. Sludge conditioning system consisting of two-stage flocculation tanks with a mixing tank with gear motor and mixing impeller to allow efficient mixing of polymer in the sludge and a flocculation tank including gear motor and large cross-sectional area agitator.

2. Two (2) 300 series Dewatering drums including spray wash down system and gear drives.

3. Support structure for the Dewatering Drum including filtrate collection pan and outlet plumbing. Support structure will include capacity to add an additional dewatering drum and increase the throughput capacity of the unit by 100% with no structural modifications. All required mounting holes and brackets will be in place, drilled and tapped.

4. A self-contained electrical and control panel including control for all supplied equipment including sludge feed pump, polymer blending system and cake conveyor. Control panel will also have all components included and wired for additional future dewatering drums.

5. A stainless-steel hopper, with minimum thickness of ¼", shall be provided to connect volute press discharge chute to the conveyor.

6. One (1) polymer dilution and dosing equipment.

7. One (1) magnetic flow meter for sludge feed, meeting the requirements of Section 40 70 13, "In-Line Liquid Flow Measuring Systems".

8. All electrical components for supplied equipment, including controls and motor starters.

1.9 SPARE PARTS

A. Furnish the following spare parts:

1. Spray wash system solenoid valve.

2. All recommended spare parts for appurtenances for one year.

B. Spare parts shall be packaged with labels indicating the contents of each package and shall be delivered to Owner as directed.

1.10 PATENTS

A. Manufacturer warrants that the use of this system and its equipment, in the process for which the system has been expressly designed, will not infringe on any U.S. or foreign patents or patents pending. In the event of any claim of infringement the manufacturer shall defend and indemnify the owner free from any liabilities associated with the use of the patented equipment or process.

B. Contractor hereby grants to the owner, in perpetuity, a paid-up license to use any inventions covered by patent or patents pending, owned, or controlled by the Manufacturer in the operation of the facility being constructed in conjunction with the equipment supplied under this contract, but without the right to grant sublicenses.

PART 2 - PRODUCTS

2.1 MATERIALS AND COATINGS SCHEDULE

A. All materials utilized in the construction of the sludge dewatering equipment shall be entirely suitable in every respect for the service required. All metals in contact with polyelectrolyte or sludge, and all other metal components other than those specified in the table below shall be stainless steel, type 304 or 316. No carbon steel will be used for any part of the press.

Item of Equipment	Material
Tanks and support frame	Type 304 Stainless steel
Plumbing and Spray bars	Type 304 Stainless steel
Dewatering Drums	Type 304 Stainless steel
Dewatering Drum screw	Type 304 Stainless steel with flame coating 10Co-4Cr
Gear Motors	Die cast Aluminum and Type 304 Stainless steel
Gear Motor coating	Acrylic paint
Spray nozzles	Polypropylene
Electrical enclosure	Type 304 Stainless steel
Electrical wiring housing	Non-metallic flexible liquid-tight conduit and fittings
Valves – wetted sections	Stainless Steel, EPDM Seating

2.2 STRUCTURAL COMPONENTS

A. The structural support frame shall be fabricated of type 304 stainless steel members conforming to the latest ASTM Standard Specifications for Structural Steel, Designation A36. It will be a rigid structure, adequately braced to withstand intended loads without excessive vibration or deflection.

B. The framework shall be of welded and/or bolted construction. All welding shall conform with the American Welding Society Structural Welding Code.

C. The structure shall be designed for installation on a prepared concrete foundation, suitable flat concrete slab, or fabricated platform and secured with anchor bolts.

D. The construction shall allow easy access and visual inspection of all internal components.

2.3 DEWATERING DRUMS

A. The dewatering drums will be constructed of ATSM type 304 SS except for the rings in the thickening section of the drum which will be manufactured in a polycarbonate resin. All circular components will be laser cut to ensure maximum evenness of wear and therefore operating life.

B. Assembly will be undertaken in such a way that all fixed rings are concentric and parallel. All fixed rings will be equally spaced apart for each section of the dewatering drum. When mounted on the retaining rods and installed, all moving rings will move freely between the fixed rings.

C. Each Dewatering Drum shall be equipped with individual spray bars. Each spray bar shall consist of a spray pipe fitted with spray nozzles, located above the dewatering drum. The spray pipe and spray nozzle assembly shall be readily removable. Nozzle spacing and spray pattern shall be such that the sprays from adjacent nozzles overlap one another on the dewatering drum surface. The sprays will operate periodically and will remove solids built up externally on the drum such that over time no significant buildup of solids occurs on the drum.

D. Each Dewatering Drum will have a drive motor:

1. The Dewatering Drum drive motor will be a close coupled gearmotor. Gearmotors will be hollow shaft design designed to drive the dewatering drum screws with no additional couplings or joints. Motors will be filled with grease on assembly and sealed for life. Screw rotational speed shall be obtained through a hypoid reduction gear. Input power to the dewatering drum drive shall be supplied through an A.C. variable frequency drive unit.

2. Maximum horsepower of the motor will be 1 HP.

2.4 MIXING AND FLOCCULATION TANKS

A. Each Volute Dewatering Press shall have an integrated two-stage mixing system comprising of a flash/rapid mix tank and flocculation tank, each with mixers and drive motors. Tank sizing and design will ensure adequate residence times and mixing conditions to ensure complete flocculation and satisfactory dewatering performance. Tank design will minimize the possibility of any short circuiting of flow.

B. Design and manufacture of tanks and spill trays must ensure no leakage or spillage of fluids under normal working conditions.

C. Mixing and flocculation tanks will be manufactured in type 304 stainless steel and will be a minimum of 11 gauge (0.12”). Tanks and spill containment trays will be fully welded internally and externally.

D. Each Mixer will have a drive motor:

1. The mixer and flocculation tank drive motors will be a one piece gearmotor. Gearmotors will be hollow shaft design designed to drive the mixing impeller shafts with no additional couplings or joints. Motors will be filled with grease on assembly and sealed for life. Mixer rotational speed shall be obtained through a hypoid reduction gear. Input power to the dewatering drum drive shall be supplied through an A.C. variable frequency drive unit allowing variable mixing energy to be input to the system.

2. Maximum horsepower of the mixer motor will be 0.5 HP.

3. Maximum horsepower of the Flocculation tank motor will be 1 HP.

2.5 POLYMER PREPRATION SYSTEM

A. Each Volute Dewatering Press shall be supplied with an automated polymer system.

B. Polymer system will ship separately from the press and will be located near the press as shown in the drawings.

C. Polymer system will be controlled by the Volute Press Control Panel.

D. Polymer system shall meet the requirements of Section 46 33 33 – Liquid Polymer Blending System.

2.6 SLUDGE FEED PUMP

A. The sludge pump will pump the sludge out of the solids holding tank. Each Volute Dewatering Press shall be supplied with an appropriately sized sludge feed pump.

B. Sludge feed pump will be controlled by the Volute Press Control Panel.

C. Sludge feed pump shall be located in the same building as the volute press.

D. Sludge feed pump shall meet the requirements of Section 43 23 57 – Progressing Cavity Pumps.

2.7 VOLUTE PRESS CONTROL PANEL

A. Each Volute Dewatering Press shall have an integrated electrical and control system that will allow for safe, simple, and automated operation of the unit. All electrical work, motors and drives will comply with any relevant NEMA standards.

B. The electrical control system will be able to accept remote start and stop signals, and will have outputs for unit in operation, and unit alarms to an external SCADA system as shown on the drawings.

C. Control Panel Features:

1. Control Panel will be UL508 listed.

2. Enclosures: Control panel enclosures shall be wall mounted or free-standing, fabricated of type 304 stainless steel and shall be suitable for NEMA 4X service.

3. The control panel shall accept a 480 volt, 60 hertz, 3 phase ac power input. A main disconnect circuit breaker and operator mechanism shall be included. When the disconnect is in the open position, all power shall be removed from the control system.

4. IEC rated motor starters shall be provided for all non-VFD and DC motors.

5. Variable frequency drives (VFD) shall be provided for the dewatering drum drives, mixing and flocculation tank agitators as well as any pumps.

6. Standard SCCR rating of the panel will be 5kA Short circuit protection for system components shall be accomplished utilizing circuit breakers and fuses. Individual thermal overload protection shall be provided.

7. A transformer shall be included that will provide power for the control system.

8. A Programmable Logic Controller (PLC) will control all timing and switching functions

D. External Enclosure Features

1. The external door of the panel will have the following switches and indicators:

a. Main Isolating Switch (Circuit Breaker)

b. An emergency stop button which shall be a mushroom head style pushbutton that when depressed shall immediately de-energize all moving equipment in the system.

2. Within a widowed enclosure mounted on the panel door:

a. HMI Touch Screen

b. An H-O-A system switch to switch the system from Auto to off to manual modes

c. Power on Light (white)

d. An Operating Light -for when the unit is in operation - (green)

3. In addition to items located on the main enclosure door:

a. An Alarm Light - a flashing light located on the top of the panel (red)

E. Programmable Logic Controller (PLC)

1. Each Volute Dewatering Press will be provided with an Allen Bradley CompactLogix 5069-L306ER PLC with a PanelView 5310 10” HMI or equal, installed, wired and programmed to perform the following functions:

a. Control of all components of the Volute Thickener- system including the ability to set times and operating speeds for any pump installed, dewatering drums, mixers, polymer dosing system and wash-down sprays.

b. System Tuning - PLC will allow suitably qualified operators to adjust operating parameters such as delay timers for fault alarms and system calibration constants.

c. Monitoring Operation - PLC will allow the operator to inspect the operation of all the components including indicators such as output frequency, current draw, thermal condition, elapsed operating times, and any faults present. Operator will be able to view approximated readouts of all operational speeds and flowrates relevant to the operation of the system.

d. Manual operation of components - Operator will be able to manually operate each item of equipment from the PLC interface for inspection and maintenance reasons. For equipment located remotely, such as the feed pump, a local control station shall be provided with an HOA, E-stop and appropriate run, on and alarm lights.

e. Time Clocks - Operator will be able to set the unit to operate at specific time or on specific days with no operators present.

2.8 ELECTRICAL HARDWARE

A. Power wiring shall be 600 volt, type MTW or equivalent insulated stranded copper and shall be sized for the required load, 14 AWG minimum.

B. Control wiring shall be 250 volt, type MTW or equivalent insulated stranded copper and shall be sized for the required load, 18 AWG minimum.

C. Circuit breakers for the main disconnect shall be thermal magnetic molded case units. Circuit breakers shall be Square D, Class 650, Type HDL or equivalent.

D. Motor Control Relays shall be full voltage, non-reversing, IEC style across-the-line units. Coils shall be 120 volts ac. Square D Tesys D / Siemens type Sirius 3RT10 / or equivalent.

E. Motor Circuit Breakers shall be thermal magnetic units. Motor Circuit Breakers shall be Square D Tesys GV2 or equivalent.

F. Selector switches shall be heavy duty, corrosion resistant units rated for NEMA 4X service. Contact blocks shall be rated for 10 ampere continuous service. Selector switches shall be Idec Series TWTD or equal.

G. Pilot lights shall be heavy duty, corrosion resistant units rated for NEMA 4X service. Units shall be 120 VAC full voltage incandescent type. Pilot lights shall be Idec Series TWTD or equal.

H. Terminal blocks shall be high density, solderless box lug style, with 600-volt rating. Terminal blocks shall be Phoenix Contact Push In type, Allen Bradley 1492 type, or equivalent

I. Control relays shall be general purpose type with a 6 amp or greater contact rating, miniature square base or slim line base, with internal on status pilot light. Miniature square base relays shall be Allen Bradley Type 700-HF Series or equivalent. Slim line base relays shall be Schneider Electric Slim Interface Relay or equivalent.

J. Programmable Logic Controller (PLC) shall be an Allen Bradley CompactLogix 5069-L306ER PLC with a Panelview 5310 10.4" HMI.

K. Motor starters and VFDs shall meet the requirements of Sections 26 29 13.13, Section 26 29 23 and other applicable sections of Division 26.

L. Unmanaged Ethernet Switch shall be Moxa EDR-810-2GSFP.

2.9 FUNCTIONAL SPECIFICATION

A. The control panel will undertake the following operations:

B. Auto-Manual operation

1. The Volute Thickener-Dewatering Press system may be set to either Auto/Manual/Off on the control panel via a 3 position switch. This will be the "main switch" for the plant.

2. When set to manual, all items may be switched on and off at the control panel by the switches on the HMI unit.

3. When set to off, no items will work whether switched on or off either at the control panel or anywhere else.

4. When set to Auto, the system will start-up and shutdown based on the HMI. The system would also shut down based on a low level in the holding tanks.

5. An interlock shall be provided between the dewatering system control panel and the low water level in the solids holding tanks. This interlock shall cause the dewatering system to begin its shutdown cycle.

C. Clock Operation

1. The clock function will be controlled by the PLC in the control panel. Two clock functions will be allowed for in the program. The clock may be set to either "On" or "Auto/timer" via at the PLC. If the clock is set to "On" the plant will run for as long as the main switch is set to "Auto". When the clock is set to "Auto/Timer" the plant will operate in accordance with the clock settings.

2. Clock function settings will allow the operator to set the dewatering press and all associated equipment to switch on and off, at pre-designated times on pre-designated days with no operators being present. A minimum of two (2) different "clock programs" will be allowed for in the PLC program.

D. Sludge Feed

1. Sludge is fed to the dewatering unit by a pump controlled from the control panel. A VFD will control the speed of the pump. In the event of a pump overload or a VFD fault the dewatering unit will shut down and an alarm will occur.

2. A flow meter will monitor the sludge flow. The operator will be able to set the flow and the feed pump will operate to maintain that flow via a PID loop. Any variations from the preset flow will cause the system to shut down and an alarm to occur.

E. Polymer Feed

1. Polymer feed is achieved by the integral polymer preparation system connected to the dewatering unit. This system is controlled and powered by the control panel. Outputs from the control panel to the polymer preparation system will include power, start and stop signals, and variable speed control for the polymer feed pump.

2. Manual adjustment of the speed control for the polymer dilution mixing chamber will be make from the control panel. The control panel will also monitor the polymer preparation system for faults due to low water pressure, or no polymer flow and shut the system down with an alarm should this occur.

F. Flocculation Tank Agitation

1. Whenever the dewatering unit is operating 2 motorized agitators will operate continuously, stirring the contents of the flocculation tank. These are geared motors and will be controlled by a VFD in the control panel. The VFD will be adjustable from 5 Hz up to 75 Hz.

2. A high level sensor will detect any high fluid level in the flocculation tank and will shut the dewatering unit down and cause an alarm should this occur.

G. Dewatering Drums

1. The Dewatering Drums will operate whenever the system is operating. The motor is controlled by a single VFD. The Range of Adjustment for this will be 15 Hz to 60 Hz. When the system shuts down the dewatering drum will continue to operate for a pre-set time before they shut down. Sprays will periodically switch on while the dewatering drum is operating. The frequency and duration of the spray are adjustable in the PLC.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING OF EQUIPMENT

A. All equipment shall be shipped and delivered fully assembled, except where partial disassembly is required in order to conform to transportation regulations or for the protection of components.

B. Contractor shall be responsible for unloading of the machinery and shall have equipment on-site available at the time of delivery permitting proper handling of the equipment.

3.2 INSTALLATION

A. Contactor will undertake installation of equipment in this section as per the manufacturer's submitted instructions and in accordance with these specifications and associated plans.

B. Manufacturer will provide consultation as necessary to ensure correct installation and resolve any issues that arise during installation.

C. Manufacturer shall supply anchor bolts for the equipment. Contractors shall install the anchor bolts in accordance with the manufacturer's recommendations.

3.3 START-UP AND COMMISSIONING

A. Upon completion of the installation, and at a time that is deemed to be most appropriate by consensus of all parties, the services of the manufacturer's factory trained startup technician shall be provided at the project site for equipment start-up. The following tasks will be undertaken during this time:

1. Installation inspection to ensure all equipment is installed properly and is ready to be started up and operated.

2. Functional Startup of equipment, calibration and setting of equipment parameters.

3. Operational startup, optimization and data collection.

4. Operator Training

B. Service technician shall be onsite for a minimum of **Five workdays (0.5 day for installation inspection, 1 day for operation and calibration, and 0.5 day for operator training, 3 day for performance testing)** at startup to provide the following additional startup services.

1. Provide Operator training after successful startup of the equipment.

2. Installation Contractor shall videotape the manufacturer-led training session and provide to Owner. Allow for a minimum of one training session of a maximum of four (4) hours following a course outline acceptable to the Engineer. Training shall take place during regular work hours, Monday through Friday, excluding City holidays. Anticipated course outline could include the following subjects:

a. Startup procedures.

b. Shutdown procedures.

c. Troubleshooting.

d. Selection of proper polymer types and dosages.

e. Replacement of unit components.

f. Operating adjustments for performance optimization.

g. Preventive maintenance.

h. Maintenance procedures.

i. Emergency procedures.

j. Record keeping.

k. Mechanical unit function and description.

l. Variable frequency drives.

m. System controls.

3. Workday: A “workday” shall be defined as an eight (8) hour work period onsite, excluding all travel time to and from the site.

C. The Contractor shall provide manufacturer a minimum of two (2) weeks’ notice prior to onsite start up, functional testing, and manufacturer training services.

D. Contractor shall ensure that start up is not performed until there is a minimum volume of sludge to allow three (3) days of operation at dewatering system design capacity (assuming 6 hours/day of operation), plus sludge production rates sufficient to allow plant operators to operate the press on a regular schedule following start-up and training of plant staff.

3.4 PERFORMANCE TEST

A. A performance test shall be conducted following startup verifying that the unit meets the minimum performance requirements specified.

B. Performance test shall be three (3) days in duration, minimum of two (2) hours of operation each day.

C. Provide written test procedures including sampling frequency and analysis at least 30 days prior to start of testing. Provide recommended polymer and concentration.

D. The owner shall operate the equipment throughout the duration of the test, obtain the samples, and document the data needed to confirm the performance of the dewatering system.

1. Owner will conduct the laboratory tests.

E. One sample of the following flow streams shall be obtained for every hour of operation during the performance testing:

1. Feed sludge.

2. Pressate.

3. Dewatered sludge.

Once the operation has stabilized, the Owner may elect to reduce the number of samples to be analyzed each day.

F. Manufacturer's field technician shall optimize the polymer dosing by changing the dosage and collecting cake samples to determine the minimum dosage that provides a cake meeting the performance requirements.

G. The following process data shall be recorded and documented each ½ hour of the test:

1. Feed sludge flow rate.

2. Polymer dosage and feed rate.

3. Cumulative feed sludge flow each day of operation.

4. Alarm conditions.

5. Equipment problems.

6. Screw speed and drum speed (if applicable).

H. In the case of nonacceptable performance, the Manufacturer shall then have 15 days in which to perform at its sole expense, any supplemental testing, equipment adjustments, changes, or additions and request an additional retest of the nonacceptable system.

1. If the modified equipment does not meet the guaranteed performance requirements of this Section, all or part of the final payment of the total lump sum price shall be retained as damages, or

2. Owner may elect to have the manufacturer remove the unit and refund any monies paid.

END SECTION 46 76 26.13

Contract Review Sheet

Public Improvement Agreements **PW-5569-23 - EWA2**

Title: **ARPA - CMGC - North Santiam Canyon Sewer Project**

Contractor's Name: **Slayden Constructors, Inc.**

Department: **Public Works Department** Contact: **Alicia Jones**

Analyst: **Kathleen George** Phone #:

Term - Date From: Expires:

Original Contract Amount: **$ 375,218.00** Previous Amendments Amount: **$ 103,259.00**

Current Amendment: **$1,621,567. -** New Contract Total: **$ 2,100,044.00** Amd% **460%**

Incoming Funds ☑ Federal Funds ☐ Reinstatement ☐ Retroactive ☑ Amendment greater than 25%

Source Selection Method: **20-0260 Request for Proposal** RFP# **PW1258-23**

Description of Services or Grant Award

Construction Manager General Contractor (CM/GC), to engage in the following services: Construction management, constructability review, Value Engineering, CPM scheduling and schedule analysis, construction and construction procurement, bidding and administration of subcontracted work, commissioning and all related CM/GC services related to the North Santiam Canyon Sewer Project.

Early Work Amendment No. 1 adds $103,259.00 to original contract for clearing for surveying and test pits, excavation and backfill test pits.

1st Amendment to EWA No. 1 changes scope of work as stated in Early Work Amendment No. 1, no dollar change

Early Work Amendment No. 2 adds $1,621,567.00 for the procurement of long lead time essential plant equipment, including sequencing batch reactor, and upflow moving bed filter.

Desired BOC Session Date:	**11/13/2024**	Contract should be in DocuSign by:	**10/23/2024**
Agenda Planning Date	**10/31/2024**	Printed packets due in Finance:	**10/29/2024**
Management Update	**10/29/2024**	BOC upload / Board Session email:	**10/30/2024**

BOC Session Presenter(s) **Chris Einmo** Code: **Y**

REQUIRED APPROVALS

DocuSigned by: E4598AF8CAA542C...	10/28/2024	Signed by: Alicia Jones DA7EBBDCC1E7847C...	10/28/2024
Finance - Contracts	Date	Contract Specialist	Date
Signed by: Scott Norris 60C08A6F7083408...	10/28/2024	DocuSigned by: Jan Fritz DC18351348DE45C...	10/28/2024
Legal Counsel	Date	Chief Administrative Officer	Date

MARION COUNTY BOARD OF COMMISSIONERS

Board Session Agenda Review Form

Meeting date: 11/13/2024

Department: Public Works

Title: ARPA - North Santiam Canyon Sewer Project (NSCSP), Contract PW-5569-22, Early Work Amendment #2 (EWA2)

Management Update/Work Session Date: 08/20/2024 **Audio/Visual aids** ☐

Time Required: 10 minutes **Contact:** Chris Einmo **Phone:** 503-566-4119

Requested Action:

Consider approval of Contract PW-5569-23, Early Work Amendment #2, with Slayden Constructors, Inc. to purchase essential plant equipment, including a Sequencing Batch Reactor, Upflow Moving Bed Filter and related equipment, which will be used for construction of the proposed Mill City - Gates Wastewater Treatment Plant.

Issue, Description & Background:

Under Agreement SR2240, the State of Oregon awarded $50M in American Rescue Plan Act funds to Marion County for the purpose of constructing wastewater system improvements in the North Santiam Canyon. The Project is required to deliver a municipal wastewater treatment plant under aggressive funding deadlines. The Project team has identified long lead time equipment, including the equipment described above, that must be procured now to ensure early critical-path construction activities begin without delay. Lead times for municipal wastewater treatment equipment can be excessive and ARPA requires that all funds be expended by December 31, 2026. Therefore, the use of Early Work Amendments (EWAs) to procure long lead time equipment prior to establishing the Guaranteed Maximum Price is essential to project delivery.

Financial Impacts:

EWA 2 increases the value of Contract PW-5569-23 by $1,621,567, from $478,477 to $2,100,044. This is a budgeted expense in the current fiscal year.

Impacts to Department & External Agencies:

Equipment will be purchased entirely using federal American Rescue Plan Act (ARPA) funds provided under SR2240. This is a budgeted expense of the Project. This amendment does not result in impacts to other county departments or external agencies.

List of attachments: (1) Early Work Amendment E.2 (2) Specifications E.2.i

Presenter: Chris Einmo, Marion County Public Works

Department Head Signature: DocuSigned by: Brian Nicholas 9793BA7ACD6D443...

EXHIBIT E.2

MARION COUNTY
EARLY WORK AMENDMENT NO. 2 TO CONTRACT

THIS EARLY WORK AMENDMENT NO. 2 shall become effective upon execution by the Owner and CM/GC and receipt of any applicable approvals.

THIS AMENDMENT IS BETWEEN:

OWNER: Marion County, a political subdivision of the State of Oregon,

And

Slayden Constructors, Inc.
("CM/GC" and, in the Marion County
General Conditions for Public
Improvement Contracts,
September 1, 2014, Revised February 14, 2022 Edition, referred to as
"Contractor")

The Project is: North Santiam Canyon Sewer Project

The Engineer is:
Keller Associates, Inc.
245 Commercial St SE #210
Salem, OR 97301

Date of Original CM/GC Contract: September 13, 2023

Date of this Amendment: November 11.00**, 2024**

Owner and the CM/GC hereby amend the Contract as set forth below. Capitalized terms used but not defined herein shall have the meanings given in the Contract Documents. Except as amended hereby, the Contract remains in full force and effect.

1. Early Work. In accordance with Article 3.2 of the CM/GC Contract, which authorizes the CM/GC to perform Construction Phase services if an Early Work Amendment is executed, Owner and the CM/GC hereby agree that the CM/GC shall perform the Early Work generally described below and more specifically described in Attachment E.2.i. including any Early Work Plans and Specifications, which are incorporated herein by this reference.

2. Statement of Early Work. The CM/GC will provide all labor, materials, supervision, coordination, and equipment necessary to complete the following Early Work:

    a. Procure and deliver Sequencing Batch Reactor as per specification in attachment E.2.i.
    b. Procure and deliver Upflow Moving Bed Filter as per specification in attachment E.2.i.
    c. CM/GC shall deliver the equipment to the project location as directed by the Engineer.
    d. The final scope of work to be as directed by the Engineer but not to exceed quoted amendment value.

3. Maximum Early Work Price. The parties agree that the cost of the Early Work described in this amendment shall not exceed $1,621,567 including the Estimated Cost of Work (ECOW) and the CM/GC fee as established in Article 6 of this Contract. CM/GC shall submit invoices for the following not to exceed amounts:

Estimated Cost of Work (Not to exceed):	$1,472,295
CM/GC Fee (7.0% of ECOW):	$103,061
Early Work Cost (Subtotal of Above):	$1,575,356
General Liability (0.8% of EWC):	$12,603
P&P Bond (0.75% of EWC)	$11,815
Builder's Risk (0.8% of EWC)	$12,603
Net Cost:	$1,612,377
Oregon CATax (0.57% of Net Cost):	$9,191
Maximum NTE (Net Cost + CATax):	**$1,621,567**

4. Plans and Specifications. The specifications for the Early Work performed under this Amendment shall be Attachment E.2.i – Early Procurement Specifications for Sequencing Batch Reactor and Upflow Moving Bed Filter and Exhibit A of this Contract, Marion County General Conditions for Public Improvement Contracts, rev. February 14, 2022, and may be amended by the Engineer as required.

5. Substantial Completion Date. Unless directed by the Engineer to the contrary, the required date for Substantial Completion for this Early Work package is June 30, 2026.

6. Tax Compliance Certification. The individual signing on behalf of the CM/GC hereby certifies and swears under penalty of perjury that s/he is authorized to act on behalf of the CM/GC, s/he has authority and knowledge regarding the CM/GC's payment of taxes, and to the best of her/his knowledge, the CM/GC is not in violation of any Oregon tax laws. For purposes of this certification, "Oregon tax laws" means a state tax imposed by ORS 401.792 to 401.816, ORS 320.005 to 320.150 and 403.200 to 403.250, and ORS chapters 118, 314, 316, 317, 318, 320, 321 and 323; the elderly rental assistance program under ORS 310.630 to 310.706, and local taxes administered by the Department of Revenue under ORS 305.620.

THIS AMENDMENT except as expressly amended above, all other terms and conditions of the original contract are still in full force and effect. CM/GC certifies that the representations, warranties and certifications contained in the original Contract are true and correct as of the effective date of this Amendment and with the same effect as though made at the time of this Amendment.

ATTACHMENTS

Attachment E.2.i	Early Procurement Specifications for Sequencing Batch Reactor and Upflow Moving Bed Filter

Contract #PW-5569-23

SLAYDEN CONSTRUCTORS, INC. (CM/GC)

Authorized Representative of CM/GC: DocuSigned by: Jeffrey Wall 1BEF7150CE6945D... 11/11/2024
Date

Title Vice President

CCB Registration No.: 208848

MARION COUNTY (OWNER)

BOARD OF COMMISSIONERS

Chair 11.6.2024
Date

Commissioner 11/6/2024
Date

Commissioner 11/6/2024
Date

Authorized Signature: DocuSigned by: Brian Nicholas 9793BA7ACD6D443... 10/28/2024
Department Director or designee Date

Authorized Signature: DocuSigned by: Jan Fritz DC16351248DE4EC... 10/28/2024
Chief Administrative Officer Date

Reviewed by Signature: Signed by: Scott Norris 50C98A6F7082408... 10/28/2024
Marion County Legal Counsel Date

Reviewed by Signature: DocuSigned by: E4592AF8CAA542C... 10/28/2024
Marion County Contracts & Procurement Date

Attachment E.2.i – Early Procurement Specifications for Sequencing Batch Reactor and Upflow Moving Bed Filter

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SECTION 01 33 00 – SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Wherever submittals are required hereunder, all such submittals by the Contractor shall be submitted to the Engineer as delineated in this Section.

B. At the Pre-Construction Conference, the Contractor shall submit the following items to the Engineer for review:

1. A preliminary construction schedule.

2. A preliminary schedule of Shop Drawings, Samples, and proposed Substitutes ("Or-Equal") submittals listed in the Bid.

1.2 ENGINEER'S REVIEW PERIOD

A. For planning purposes, the Contractor shall assume a minimum of 14 days for review by the Engineer following receipt of submittal/resubmittal. If an expedited review is requested by the Contractor, the submittal shall identify the requested expedited review. The Engineer will attempt to accommodate the expedited review.

1.3 SUBMITTAL PROCEDURES

A. Verify that the material or equipment described in each submittal conforms to all requirements of the Specifications and drawings. Where the detailed specifications require specific submittal data, submit all data at the same time. The submittals are to be accompanied by the transmittal form attached at the end of this Section. The Engineer will return for resubmittal any information not accompanied by the specified transmittal form, properly completed.

B. Indiscriminate submittal of only manufacturer's literature is unacceptable and will be rejected.

C. The submittals shall be numbered as XXXXXX-YY-z., where XXXXXX is the specification section number, YY is the sequential number of the submittal, and Z is used for re-submittal labeled a through z. For example, the first submittal of an item from Section 32 13 13 – Concrete for Exterior Improvements would be numbered "32 13 13-01"; the first re-submittal of the submittal would be numbered "32 13 13-01-A".

D. A separate transmittal form shall be used for each specific item or class of material or equipment for which a submittal is required. Transmittal of a submittal of various items using a single transmittal form will be rejected. A multiple page submittal shall be collated into sets, and each set shall be stapled or bound, as appropriate, prior to transmittal to the Engineer.

E. Identify Project, Contractor, subcontractor or supplier, pertinent Drawing sheet and detail number(s), and specifications section number, as appropriate.

F. All Contractor shop drawings submittals shall be carefully reviewed by an authorized representative of the Contractor, prior to submission to the Engineer. Each submittal shall be dated, signed, and certified by the Contractor, as being correct and in strict conformance with the Contract Documents. In the case of shop drawings, each sheet shall be so dated, signed, and certified. No consideration for review by the Engineer of any Contractor submittals will be made for any items which have not been so certified by the Contractor. All non-certified submittals will be returned to the Contractor without action taken by the Engineer, and any delays caused thereby shall be the total responsibility of the Contractor.

G. Do not mark the submittals in red. Ensure that any marks are duplicated on all copies submitted. Outline the marks on reproducible transparencies in a rectangular box.

H. Coordinate submission of related items.

I. Identify variations from Contract Documents and product or system limitation which may be detrimental to successful performance of the completed Work.

J. Provide space for Contractor and Engineer Review stamps.

K. Electronic submittals:

1. Electronic submittals shall be submitted in PDF format and combined into a single file.

2. Engineer will return comments only.

3. Contractor is responsible for distributing copies of the submittal and Engineer's comments to concerned parties.

4. Engineer may require hard copies in lieu of an electronic submittal if, in the opinion of the Engineer, the electronic submittal is difficult to read.

L. Revise and resubmit submittals as required, identify all changes made since previous submittals.

M. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions.

1.4 DEVIATIONS FROM CONTRACT

A. If the Contractor proposes to provide material or equipment which does not conform to all of the Specifications and Drawings, the transmittal form accompanying the submittal copies shall indicate under "comments" the deviations.

1.5 SHOP DRAWINGS

A. The term "Shop Drawings" as used herein shall be understood to include detail design calculations, shop drawings, fabrication, and installation drawings, erection drawings, list, graphs, catalog sheets, data sheets, and similar items. Whenever the Contractor is required to submit design calculations as part of a submittal, such calculations shall bear the signature and seal of an engineer registered in the appropriate branch and in the state wherein the project is to be built, unless otherwise directed.

B. Except as may otherwise be indicated herein, the Engineer will return submittal to the Contractor with comments. The Contractor shall make a complete and acceptable submittal to the Engineer by the second submission of a submittal item.

C. If submittal is returned to the Contractor marked "NO EXCEPTIONS TAKEN," formal revision and resubmission of said submittal will not be required.

D. If submittal is returned to the Contractor marked "MAKE CORRECTIONS NOTED," formal revision and resubmission of said submittal will not be required.

E. If submittal is returned to the Contractor marked "AMEND-RESUBMIT," the Contractor shall revise said submittal and shall resubmit the required number of copies of said revised submittal to the Engineer.

F. If submittal is returned to the Contractor marked "REJECTED-RESUBMIT," the Contractor shall revise said submittal and shall resubmit the required number of copies of, said revised submittal to the Engineer.

G. Fabrication of an item shall be commenced only after the Engineer has reviewed the pertinent submittals and returned copies to the Contractor marked either "NO EXCEPTIONS TAKEN" or “MAKE CORRECTIONS NOTED". Corrections indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as the basis for changes to the contract requirements.

1.6 ORGANIZATION

A. A single submittal transmittal form shall be used for each technical specification section or item or class of material or equipment for which a submittal is required. A single submittal covering multiple sections will not be acceptable, unless the primary specification references other sections for components..

B. On the transmittal form, index the components of the submittal and insert tabs in the submittal to match the components. Relate the submittal components to specification paragraph and subparagraph, drawing number, detail number, schedule title, room number, or building names, as applicable.

C. Unless indicated otherwise, terminology and equipment names and numbers used in submittals shall match those used in the Contract Documents.

1.7 EFFECT OF ACCEPTANCE OF CONTRACTOR INFORMATION

A. Acceptance by the Engineer of any drawings, method of work, or any information regarding materials or equipment the Contractor proposes to provide shall not relieve the Contractor of his responsibility for any errors therein and shall not be regarded as an assumption of risk or liability by the Engineer or Owner, or by any officer or employees thereof, and the Contractor shall have no claim under the contract on account of the failure or partial failure or inefficiency of any plan or method of work or material or equipment so accepted. Such acceptance shall be considered to mean merely that the Engineer has no objection to the Contractor using, upon his own full responsibility, the plan or method of work proposed, or providing the materials or equipment proposed.

B. Approval of shop drawings by the Engineer is only for general conformance with the design concept of the project and general compliance with the information given in the contract documents. Any action shown is subject to the requirements of the Plans and Specifications. The Contractor is responsible for dimensions which shall be confirmed and correlated at the job site, fabrication process and techniques of construction, coordination of his work with that of all other trades and the satisfactory performance of his work.

1.8 PRODUCT DATA AND SAMPLES

A. Where required in the Specifications and as determined by the Engineer, test specimens or samples of materials, appliances and fittings to be used or offered for use in connection with the Work shall be submitted to the Engineer at the Contractor's expense. Specimen or sample submittals shall be made with information as to their sources, with all cartage charges prepaid, and in such quantities and sizes as may be required for proper examination and tests to establish the quality or equality thereof, as applicable.

B. All samples and test specimens are to be submitted in ample time to enable the Engineer to make any tests or examinations necessary, without delay to the Work. The Contractor will be held responsible for any loss of time due to the neglect or failure to deliver the required samples to the Engineer as specified.

C. Samples are also to be taken during the course of the Work, as required by the Engineer.

D. Laboratory tests and examinations that the Owner elects to make will be made at no cost to the Contractor, except that, if a sample of any material or equipment proposed for use by the Contractor fails to meet the Specifications, the cost of testing subsequent samples will be borne by the Contractor.

E. All tests required by the Specifications to be performed by an independent laboratory are to be made, and the samples therefore furnished shall be at the sole expense of the Contractor.

F. Material used in the Work is to conform to the submitted samples and test certificates as approved by the Engineer.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF SECTION 01 33 00

STANDARD SUBMITTAL FORM

Transmittal of Shop Drawing or Submittal

CONTRACTOR: <CONTRACTOR NAME>

Tracking No. XXXXXX

Item covered by this submittal _____

Refer to the following attachment(s) for a detailed description of the item.

Applicable specification section(s) _____

☐ First Submittal OR ☐ Resubmittal No. _____

☐ This item is as specified OR ☐ This item is a substitution/or equal

☐ Supplier/Subcontractor certifies:

- ☐ Conforms to contract
- ☐ Minor deviations as specifically noted
- ☐ Major deviations as specifically noted

Review Priority: ☐ 1 ☐ 2 ☐ 3

Due Date: XX-XX-XX (Engineer's standard review period is 14 days)

Notes to Engineer:

Date Received by Contractor: _____ Date Returned to Subcontractor/Supplier _____

Contractor Comments:

Deviations Specifically Noted

SECTION 01 42 19 - REFERENCE STANDARDS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Titles of Sections and Paragraphs: Captions accompanying specification sections and paragraphs are for convenience of reference only, and do not form a part of the Specifications.

B. Applicable Publications: Whenever Specification references are made to published specifications, codes, standards, or other requirements, it shall be understood that wherever no date is specified, only the latest specifications, standards, or requirements of the respective issuing agencies which have been published as of the date that the Work is advertised for bids shall apply. No requirements set forth herein or shown on the Drawings shall be waived because of any provision of, or omission from, said standards or requirements.

C. Specialists' Assignments: In certain instances, specification text requires specific work be assigned to specialists or expert entities who must be engaged for the performance of that work. Such assignments shall be recognized as special requirements over which the Contractor has no choice or option. These requirements shall not be interpreted so as to conflict with the enforcement of building codes and similar regulations governing the Work. In addition, these requirements are not intended to interfere with local union jurisdiction settlements and similar conventions. Such assignments are intended to establish which party or entity involved in a specific unit of work is recognized as "expert" for the indicated construction processes or operations. Nevertheless, the final responsibility for fulfillment of the entire set of contract requirements remains with the Contractor.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of other requirements of the Specifications, all work specified herein shall conform to or exceed the requirements of applicable codes and the applicable requirements of the following documents:

1. References herein to "Building Code" shall mean current International Building Code (IBC).

2. References to "Mechanical Code" or "Uniform Mechanical Code," "Plumbing Code" or "Uniform Plumbing Code," "Fire Code" or "Uniform Fire Code," shall mean International Mechanical Code, Uniform Plumbing Code and International Fire Code of the International Conference of the Building Officials (ICBO).

3. "Electric Code" or "National Electric Code (NEC)" shall mean the National Electric Code of the National Fire Protection Association (NFPA).

4. The latest edition of the codes as approved by the Municipal Code and used by the local agency as of the date that the Work is advertised for bids, as adopted by the agency having jurisdiction, shall apply to the Work herein, including all addenda, modifications, amendments, or other lawful changes thereto.

B. In case of conflict between codes, reference standards, drawings, and the other Contract Documents, the most stringent requirements shall govern. All conflicts shall be brought to the attention of the Engineer for clarification and directions prior to ordering or providing any materials or furnishing labor. The Contractor shall bid for the most stringent requirements.

C. The Contractor shall construct the Work specified herein in accordance with the requirements of the Contract Documents and the referenced portions of those referenced codes, standards, and specifications listed herein.

D. References herein to "OSHA Regulations for Construction" shall mean Title 29, Part 1926, Construction Safety and Health Regulations, Code of Federal Regulations (OSHA), including all changes and amendments thereto.

E. References herein to "OSHA Standards" shall mean Title 29, Part 1910, Occupational Safety and Health Standards, Code of Federal Regulations (OSHA), including all changes and amendments thereto.

1.3 REGULATIONS RELATED TO HAZARDOUS MATERIALS

A. The Contractor shall be responsible that all work included in the Contract Documents, regardless if shown or not, shall comply with all EPA, OSHA, RCRA, NFPA, and any other Federal, State, and Local Regulations governing the storage and conveyance of - hazardous materials, including petroleum products.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF SECTION 01 42 19

SECTION 01 75 00 – EQUIPMENT TESTING AND STARTUP (WWTP)

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Equipment testing and startup are requisite to satisfactory completion of the contract and, therefore, shall be completed within the contract time.

B. The Contractor shall coordinate with the Owner all work necessary for the successful operation of all equipment, including owner furnished equipment.

C. During all equipment testing plant/facility startup period and acceptance test periods, the Owner shall ensure that experienced, trained, and qualified personnel are onsite at all times to oversee and safeguard such testing and operations.

1.2 SUBMITTALS

A. Testing and Startup Plan: Not less than 60 days prior to startup, the Contractor shall submit for review a detailed Testing and Startup Plan. The Plan shall include schedules for equipment certifications, submittal of final Owner's Manuals, training of the Owner's personnel, electrical testing, and a detailed schedule of operations to achieve successful equipment plant testing, startup, performance and acceptance testing and activities to implement the 7-day and 30-day tests. The Plan shall include test checklists and data forms for each item of equipment and shall address coordination with the Owner's staff. The Contractor and Owner shall revise the Plan as necessary based on review comments.

B. System Outage Requests: Request for shutdown of on-line systems as necessary to test or start up the plant and equipment. Shutdown requests must be submitted at least two weeks prior to shutdown.

C. Records and Documentation:

1. Submit documentation that the equipment has been properly installed, is in accurate alignment, is free from undue stresses from connecting piping and anchoring, and has operated satisfactorily under full load conditions.

2. Testing and Startup Records as specified in Section 3.8.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION

3.1 GENERAL

A. Prior to scheduling any operations testing, the Contractor shall have previously furnished the Owner's Manuals required under Section 01 78 23 – Operation and Maintenance Data.

B. The Contractor shall coordinate the scheduling of all operations testing. The Contractor is advised that the Engineer and the Owner's operating personnel will witness operations testing and that the equipment supplier's representative shall be required to instruct the Owner's operating personnel in correct operation and maintenance procedures.

C. The Contractor shall notify the Engineer at least 7 days in advance for testing installed equipment.

3.2 FACTORY ACCEPTANCE TESTING

A. The Contractor shall be responsible for conducting a factory acceptance test and achieving Engineer approval as to the outcome of the test prior to the field installation of the equipment, if required by the specifications for the equipment.

B. The Contractor is advised that the Engineer and the Owner’s operating personnel may witness factory testing.

C. The Contractor shall be responsible for scheduling all factory acceptance testing. The Contractor shall coordinate the factory acceptance testing schedule with the Engineer at least 1 week in advance.

D. Factory acceptance testing shall be conducted per the requirements in the equipment specifications.

E. Factory acceptance testing shall involve the bench setup of RTU/PLC panels with interconnecting network connections when needed. This will be followed by a demonstration of OIT navigation menus, process data displays, alarm/status indication, and PLC implementation of control strategies described in Division 40. In addition, the Contractor shall demonstrate operation of RTU/PLCs for a minimum of eight continuous hours. Factory acceptance testing for SCADA computers requires that all software for the system be installed, configured, and operating with no errors or faults for 24 hours. The system will remain active throughout this test period. In addition, automatic windows updates must be disabled.

3.3 EQUIPMENT INSTALLATION AND TESTING

A. The Contractor shall coordinate directly with the Equipment Vendor to provide the services of an experienced and authorized representative of the manufacturer, who shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation.

B. The Contractor shall arrange to have the manufacturer's representative revisit the job site as often as necessary until any and all trouble is corrected and the equipment installation and operation are satisfactory to the Vendor and Engineer.

C. The Contractor shall require that each manufacturer's representative furnish to the Engineer a written certification addressed to the Owner certifying that the equipment has been properly installed and lubricated, is in accurate alignment, is free from any undue stress imposed by connecting piping or anchor bolts, and has been operated satisfactorily and tested under full-load conditions.

3.4 PROCESS SYSTEM TESTING

A. In addition to individual equipment and subsystem testing, the Contractor shall perform testing of all process control, electrical and other systems, as listed below and/or in the Contract Documents, to demonstrate proper operation with equipment operating over full operating ranges and under actual operating conditions, in all of the automatic and manual modes as specified in the control strategies and descriptions in the equipment specifications and Division 40.

B. The Contractor shall repeat the system tests as necessary to demonstrate proper operation to the satisfaction of the Engineer. The Contractor shall be back charged the cost of Owner's personnel and Engineer's personnel for all tests beyond the second test.

C. Prior to initiating the system testing, the Contractor shall submit the testing procedures to the Engineer for approval. Systems that are included in a 7-day test shall be tested and accepted prior to commencement of the 30-day startup test. The systems that shall be included in the 7-day and 30-day tests include the following and other systems as indicated in the Contract Documents:

1. Headworks systems including screening and lift station.

2. Grit removal system including grit chamber, grit classifier and grit pump.

3. SBR treatment basins, aeration system, and all associated components including but not limited to process blowers, DO probes, fine bubble diffusers, flow meters, electrically actuated valves, pressure sensors, and master dissolved oxygen control system.

4. Other mechanical equipment including mixers, ORP/temperature sensors, pH sensors, decanters, TSS sensors, ammonia sensors, and mixed liquor, WAS and EQ pumps.

5. UV disinfection system.

6. Power distribution, switchgear, standby generator and motor control equipment.

7. SCADA system.

8. Denitrifying sand filters and associated components.

9. Solids handling equipment including gravity belt thickener (if ABI 2 is added to contract), screw press, feed pumps, and polymer feed equipment.

10. Other systems as specified in the Contract Documents.

D. Systems that do not need a 7-day clean water test include:

1. Utility water system.

2. Generator.

E. System testing in general shall involve demonstration that all controls, instrumentation loops, alarm/status indication, and all controls described in Division 40 function properly. In addition, the Contractor shall demonstrate sustained equipment operation for a minimum of eight continuous hours when operated in conjunction with other system components. The Contractor shall schedule, provide, and coordinate the services of all manufacturers, suppliers, subcontractors, the Engineer, and the Owner for successful system testing.

F. All system testing activities shall follow detailed test procedures, check lists, etc., previously developed and submitted by the Contractor which have been reviewed by the Engineer. Completion of all system testing activities shall be documented by a certified report. Successful completion of the system testing is required prior to commencement of the 7-day test and 30-day test specified below.

G. The Contractor shall test and fully demonstrate proper operation of the utility, safety equipment, and other support systems before commencing the process system testing.

H. The Contractor shall give the Engineer written notice confirming the date of any system test at least (3) working days before the time the system is scheduled to be tested. The Owner's staff will observe system's testing.

I. Operational instruction for the controls and instrumentation shall occur before the test.

3.5 7-DAY CLEAN WATER TEST

A. The startup of the wastewater treatment process is a complex operation requiring the combined technical expertise of the Contractor, Owner, and the Engineer. The Owner shall provide the effective coordination of all parties necessary for a successful 7-day test.

B. The Owner and Contractor shall provide operating personnel for the duration of the 7-day test.

C. The 7-day test shall not commence until all required equipment tests have been completed to the satisfaction of the Engineer.

D. All defects in materials or workmanship which appear during this test period shall be immediately corrected by the Contractor.

E. During the 7-day test, the Owner and Contractor shall provide the services of authorized representative, in addition to those services required under operations testing, as necessary, to correct faulty equipment operation.

F. 7-Day Test: The Contractor shall be required to conduct the 7-day test, operate facilities being tested, and pass a 7-day test. All equipment must properly run continuously 24 hours per day for the test period at test flow rates. If any item malfunctions during the test, the item shall be repaired and the test restarted at day zero with no credit given for the operating time before the aforementioned malfunction.

1. The Owner shall lubricate and maintain the equipment in accordance with the manufacturer's recommendations.

2. Prerequisites: The following shall be completed before the 7-day testing begins.

a. All Owner's manuals information required by the Contract Documents has been furnished.

b. Provide all safety equipment, fire extinguishers, protective guards and shields, handrails, grating, safety signs, and valve and piping identification required by the Contract Documents. Devices and equipment shall be fully functional, adjusted and tested.

c. Manufacturer's certification of proper installation has been accepted.

d. Leakage tests, electrical tests, and adjustments have been completed.

e. Training of Owner's personnel on all equipment included in the 7-day test has been completed and copy of training on DVD and/or digitally provided to Owner.

f. The Engineer has approved the 7-day testing and startup Plan. The Plan shall include a check list documenting that all the prerequisites have been provided and/or completed.

g. Functional verification of the individual instrumentation loops (analog, status, alarm, and control).

h. Adjustment of the pressure switches, timing relays, level switches, temperature switches, HMI monitors, and all other control devices to the settings determined by the Engineer or the equipment manufacturer.

i. Functional verification of the individual interlocks between the field-mounted control devices and the motor control circuits, control circuits of variable-speed controllers, and packaged system controls.

3.6 30-DAY TEST AND PLANT STARTUP

A. The Contractor shall be required to incorporate the Plant improvements into the plant operation, operate it, and pass a 30-day test prior to acceptance. The new plant improvements shall be started up together after each has completed the 7-day test. All process equipment must properly run continuously 24 hours per day for the 30-day test period. If any item malfunctions during the test, the item shall be repaired and the test restarted at day zero with no credit given for the operating time before the aforementioned malfunction.

1. Prerequisites: The following shall be completed before plant testing and startup begins.

a. The 7-day clean water test shall be completed and accepted.

b. Clean water from the 7-day clean water test has been pumped out of the system. Contractor is responsible for emptying the system of clean water. Coordinate with the Owner for proper disposal of the water. It is expected that the clean water will be discharged from the treatment plant to the rapid infiltration basins.

c. The Engineer has approved the 30-day Testing and Startup Plan.

B. The startup of the wastewater treatment process is a complex operation requiring the combined technical expertise of the Contractor, Owner, and the Engineer. The Owner and/or Engineer shall provide the effective coordination of all parties necessary for successful 30-day test.

C. After approval of the 30-day Startup Plan and coordination with the Owner, the Contractor shall start the 30-day test by diverting the influent flow to the new headworks and fully treated effluent to the rapid infiltration disposal basins.

D. Throughout the 30-day test, all plant flow shall run through the new facilities.

E. All defects in material or workmanship which appear during the tests shall be immediately corrected by the Contractor.

F. The Owner and Contractor shall provide operating personnel for the duration of the 30-day test.

G. The Owner shall lubricate and maintain the equipment in accordance with the manufacturer's recommendations.

H. During the 30-day test, the Contractor shall provide the services of authorized representative, in addition to those services required under operations testing, as necessary, to correct faulty equipment operation.

I. Testing and startup records per Section 3.8.

J. After successful completion and acceptance of the 30-day test, the Contractor shall:

1. Complete closeout of the project per Section 01 77 00 – Closeout Procedures.

3.7 SUPPLIES

A. The Owner shall furnish all wastewater, treated wastewater chemicals, and all other necessary equipment, facilities, and services required for conducting the tests.

B. If the 7-day clean water test uses dewater, well water, or irrigation water, Contractor shall make arrangements and provide water.

3.8 RECORDS OF TESTING AND STARTUP

A. The Contractor shall maintain the following during the 7-day and 30-day testing and startup and submit originals to Engineer prior to acceptance of tests:

1. Lubrication and service records for each mechanical and electrical equipment item.

2. Hours of daily operation for each mechanical and electrical equipment item.

3. Equipment alignment and vibration measurement records.

4. Logs of electrical measurements and tests.

5. Instrumentation calibration and testing logs.

6. Testing and validation of status indications and alarms.

7. Factory and field equipment settings.

8. Log of problems encountered and adjustments made.

9. Other records, logs, and checklists as required by the Contract Documents.

10. Influent and effluent flow for each 24-hour period from midnight to midnight during the test.

11. Backwash flow for each 24-hour period from midnight to midnight during the test.

3.9 TRAINING

A. The Contractor shall coordinate the training periods with the Owner and manufacturer's representatives and shall submit a training schedule and detailed agenda for each piece of equipment or system for which training is to be provided. Said training schedule and agenda shall be submitted not less than 14 calendar days prior to the time that the associated training is to be provided. The Contractor shall confirm each training period a minimum of two days prior to scheduled time.

END OF SECTION 01 75 00

SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Comply with requirements stated in conditions of the contract and in Specifications for administrative procedures in closing out the Work.

B. Furnish lien waivers, bond extensions, and other required data.

C. Satisfy conditions of the contract, fiscal provisions, legal submittals and additional administrative requirements.

1.2 SUBSTANTIAL COMPLETION

A. Substantial Completion of a facility with operating systems (e.g., mechanical, electrical, HVAC) shall be that degree of completion that it may be used or occupied for its intended purpose and performance and acceptance testing has been successfully demonstrated to the Owner's Authorized Representative. All equipment contained in the Work, plus all other components necessary to enable the Owner to operate and maintain the facility in the manner it was intended, shall be complete on the Substantial Completion date. The contractor may request that a punch list be prepared by the Owner's Authorized Representative with submission of the request for the Substantial Completion notice.

B. When substantially complete, the Contractor shall submit to the Owner:

1. A written notice that the Work, or designated portion thereof, is substantially complete.

2. A list of items to be completed or corrected.

C. Within a reasonable time after receipt of such notice, Engineer will perform an inspection to determine the status of completion. If the Work is not deemed substantially complete, the following will occur:

1. Owner will promptly notify the Contractor in writing, giving the reasons therefore.

2. The Contractor shall remedy the deficiencies in the Work, and send a second written notice of Substantial Completion to the Owner.

3. Owner will request the Engineer to re-inspect the Work.

4. Once the Work is deemed substantially complete and after review and approval, the Engineer will execute and deliver to the Owner and the Contractor, the Certificate of Substantial Completion with a final list of items to be completed or corrected prior to release of final payment.

1.3 PROJECT RECORD DOCUMENTS

A. Maintain at Project site, available to Owner and Engineer, one copy of the Contract Documents, shop drawings and other submittals, in good order.

1. Mark and record field changes and detailed information contained in submittals and change orders.

2. Record actual depths, horizontal and vertical location of underground pipes, duct banks and other buried utilities. Reference dimensions to permanent surface features.

3. Identify specific details of pipe connections, location of existing buried features located during excavation, and the final locations of piping, equipment, electrical conduits, manholes, and pull boxes.

4. Identify location of spare conduits including beginning, ending, and routing through pull boxes and manholes. Record spare conductors, including number and size, within spare conduits, and filled conduits.

5. Provide schedules, lists, layout drawings, and wiring diagrams.

6. Make annotations with erasable colored pencil conforming to the following color code:

a. Additions - Red

b. Deletions - Green

c. Comments - Blue

d. Dimensions - Graphite

7. Make all annotations on one set of drawings.

B. Maintain documents separate from those used for construction.

1. Label documents “RECORD DRAWINGS.”

C. Keep documents current.

1. Record required information at the time the material and equipment is installed and before permanently concealing.

2. During progress meetings, record documents will be reviewed to ascertain that changes have been recorded.

D. Submit record documents for review. Submittal shall be in accordance with Section 01 33 00 – Submittal Procedures.

1.4 FINAL SUBMITTALS

A. The Contractor, prior to requesting final payment, shall obtain and submit the following items to the Engineer for transmittal to the Owner:

1. Written guarantees, where required.

2. Technical Manuals and instructions.

3. New permanent cylinders and key blanks for all locks.

4. Maintenance stock items; spare parts; special tools.

5. Completed record drawings.

6. Bonds for roofing, maintenance, etc., as required.

7. Certificates of inspection and acceptance by local governing agencies having jurisdiction.

8. Releases from all parties who are entitled to claims against the subject project, property, or improvement pursuant to the provisions of law.

9. Letter from bonding company stating that bonds will be extended for one year after substantial completion.

B. Owner will prepare a final Change Order, reflecting approved adjustments to the contract sum which were not previously made by Change Orders.

1.5 FINAL CLEANUP

A. The Contractor shall promptly remove from the vicinity of the completed Work, all rubbish, unused materials, concrete forms, construction equipment, and temporary structures and facilities used during construction. Final acceptance of the Work by the Owner will be withheld until the Contractor has satisfactorily performed the final cleanup of the Site.

1.6 MAINTENANCE AND GUARANTEE

A. The Contractor shall comply with the maintenance and guarantee requirements contained in the General Conditions.

B. The Contractor shall make all repairs and replacements promptly upon receipt of written order from the Owner. If the Contractor fails to make such repairs or replacements promptly, the Owner reserves the right to do the Work and the Contractor and its surety shall be liable to the Owner for the cost thereof.

1.7 FINAL PAY ESTIMATE

A. Submit final pay estimate and supporting data to Owner.

B. Final estimates shall reflect all adjustments to the contract sum:

1. The original contract sum
2. Additions and deductions resulting from:
    a. Previous Change Orders
    b. Allowances
    c. Unit prices
    d. Deductions for uncorrected work
    e. Penalties and bonuses
    f. Deductions for liquidated damages
3. Total contract sum, as adjusted
4. Previous payments
5. Sum remaining due

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF SECTION 01 77 00

SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall submit technical operation and maintenance information for each item of mechanical and electrical equipment in an organized manner in the Owner's Manual. It shall be written so that it can be used and understood by the Owner's operation and maintenance staff. The Owner's Manual information shall also be submitted in electronic format using a USB flash drive.

B. All manuals supplied to the Owner by suppliers of Owner-furnished equipment, shall be inserted into the Owner's Manual by the Contractor. The Contractor shall be responsible for providing all other information.

1.2 OWNER'S MANUAL

A. The Owner's Manual shall include the following for each item of mechanical and electrical equipment (as applicable):

1. Equipment Summary: A summary table shall include the equipment name and equipment number, the manufacturer's model number, serial number, and other nameplate information specific to the equipment provided.

2. Operational Procedures: Manufacturer-recommended procedures on the following shall be included:

   a. Installation

   b. Adjustment

   c. Startup

   d. Location of controls, special tools, equipment required, or related instrumentation needed for operation

   e. Operation procedures

   f. Load changes, Calibration, Shutdown

3. Troubleshooting, Disassembly, Reassembly

   a. Realignment

   b. Testing to determine performance efficiency

   c. Tabulation of proper settings for all pressure relief valves, low and high pressure switches, and other protection devices

d. List of all electrical relay settings including alarm and contact settings

4. Preventive Maintenance Procedures:

a. Procedures: Preventive maintenance procedures shall include all manufacturer-recommended procedures to be performed on a periodic basis, both by removing and replacing the equipment or component, and by leaving the equipment in place.

b. Schedules: Recommended frequency of preventive maintenance procedures shall be included. Lubrication schedules, including lubricant SAE grade, type, and temperature ranges, shall be covered.

5. Parts List and Drawings:

a. Parts List: A complete parts list shall be furnished, including a generic description and manufacturer's identification number for each part. Addresses and telephone numbers of the nearest supplier and parts warehouse shall be included.

b. Drawings: Cross-sectional or exploded view drawings shall accompany the part list.

6. Wiring Diagrams: Include complete internal and connection wiring diagrams for electrical equipment items.

7. Shop Drawings: Include approved shop or fabrication drawings, complete with dimensions. Include performance curves for pumps furnished.

8. Safety: This part describes the safety precautions to be taken when operating and maintaining the equipment or working near it.

9. Documentation: All equipment warranties, affidavits, and certifications required by the Technical Specifications shall be placed in this part.

10. Spare Parts: This part shall contain spare parts information for all mechanical, electrical, and instrumentation equipment. The spare parts list shall include the current list price of each spare part. The spare parts list shall be limited to those spare parts which each manufacturer recommends be maintained by the Owner in inventory at the plant site. Each manufacturer or supplier shall indicate the name, address, and telephone number of its nearest outlet of spare parts to facilitate the Owner in ordering. The Contractor shall cross-reference all spare parts lists to the equipment numbers designated in the Contract Documents.

B. If manufacturer’s standard brochures and manuals are used to describe operating and maintenance procedures, modify such brochures and manuals **to reflect only the model or series of equipment used on this project and features provided**. Cross out neatly or remove extraneous material, or otherwise annotate or eliminate.

1.3 TRANSMITTAL PROCEDURE

A. Provide three (3) original paper copies and one (1) electronic copy in PDF format of all operating and maintenance information. For ease of identification, label each manufacturer's brochure and manual with the equipment name. Organize the information in 3-ring binders and use an indexing feature within the PDF submission, in numerical order, per specification section number. Include in the manuals a table of contents and tab sheets to permit easy location of desired information. Each binder shall include a cover sheet and spine label giving the project name, Engineer's project number, Contractor name and contact information, applicable subcontractor name and contact information, and supplier name and contact information.

B. The Contractor shall submit to the Engineer three identical Owner's Manuals a minimum of 90 calendar days prior to the scheduled startup of the equipment.

C. The Engineer will review the Owner's Manuals within 30 days following their receipt by the Engineer. The Contractor shall then make any corrections and changes noted and compile all the corrected Owner's Manuals for final submittal to the Engineer.

1.4 PAYMENT

A. Acceptable operating and maintenance information for the project must be delivered to the Engineer prior to the project being 75 percent complete or at least two weeks prior to startup of any equipment. Progress payments for work in excess of 80 percent completion or 2 weeks prior to startup will not be made until the specified acceptable operating and maintenance information has been delivered to the Engineer.

1.5 FIELD CHANGES

A. Following the acceptable installation and operation of an equipment item, the item's instructions and procedures are to be modified and supplemented to reflect any field changes or information requiring field data.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF SECTION 01 78 23

SECTION 26 05 00 – ELECTRICAL, GENERAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to all of Division 26 Specifications. This Specification section applies to all Division 26 Specifications and Electrical Drawings.

B. Division 26 contractor shall review all other division specifications and drawings for additional requirements.

1.2 QUALITY ASSURANCE

A. Comply with latest NEC, NFPA, UBC, UFC, UL and applicable Local and State Codes. Also comply with Utility Company regulations and industry standards and these Drawings.

B. Work shall be done by only trained, licensed and experienced workmen familiar with the requirements.

C. All microprocessor-based equipment and software with equipment shall utilize 4 digits for the year part of all dates. A two-digit date shall be an option for printing at Owner's preference.

D. Hazardous Location Rating of Equipment: Equipment manufacturer shall reference the hazardous-area classification drawing in the Contract Documents and provide equipment in compliance with the defined NEC- classification requirements. It will be the manufacturer's sole responsibility to submit equipment in compliance with the Contract Documents, NFPA 820, and NEC requirements.

1.3 EXTENT OF DRAWINGS / SPECIFICATION

A. Drawings indicate intent and general layout of electrical systems for the Project. Drawings are partly diagrammatic and do not indicate all fittings and accessories which may be required. Provide such fittings and accessories as required to form a complete and operating system in general conformance with Specifications and Drawings.

1.4 PRIOR APPROVALS

A. Unless directed otherwise by Division 1, all products submitted for prior approval shall be received by the Engineer 10 business days prior to Bid. Supply technical data, photometrics and dimensional Drawings showing that substitutes are equal to product specified. Faxed prior approvals will not be accepted.

1.5 DISCREPANCIES

A. Prior to submitting Bid, Contractor shall refer any apparent discrepancies or omissions to Engineer for clarification. The more stringent provisions shall take precedence where codes, Specifications and Drawings differ with one another. The Contractor shall Bid the more expensive requirement, unless discrepancy is addressed by Addendum prior to Bid.

1.6 TEMPORARY LIGHTING/POWER

A. Provide temporary electrical power and lighting for all trades that require service during the course of this Project. Provide temporary service and distribution as required. Provide temporary power for all electrical equipment that will need to be installed due to the phased construction of this project. Comply with the NEC and OSHA requirements. Energy Costs by General Contractor.

1.7 SHOP DRAWING SUBMITTALS

A. General: Follow the procedures specified in Section 01 33 00 – Submittal Procedures. Submit for final and official approval through the General Contractor.

1.8 SEQUENCING AND SCHEDULING

A. Coordinate electrical equipment installation with other building components.

B. Arrange for chases, slots, and openings in building structure during progress of construction to allow for electrical installations.

C. Coordinate installing required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

D. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning prior to closing in the building.

E. Coordinate connecting electrical service to components furnished under other Sections.

F. Coordinate connecting electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Coordinate requirements for access panels and doors where electrical items requiring access are concealed by finished surfaces.

1.9 SUBSTANTIAL COMPLETION

A. At Substantial Completion of Project, be ready to demonstrate the following list of items below. If this is not possible, inform the General Contractor and Engineer no less than 1 week prior to Engineer's visitation of the site for Substantial Completion.

B. Demonstrate the operation and test of the emergency lighting system.

C. Demonstrate the main service ground, bonding to neutral and resistance readings obtained at time of installation. This will involve having some covers removed from the main panels at the time of the Engineer's visitation.

D. All electrical systems and items specified shall be installed and operational.

E. Demonstrate exterior lighting controls.

F. Demonstrate the operation of all emergency power systems including generators, uninterruptible power supplies and inverter systems.

G. Demonstrate compliance with IEEE 519 for harmonic distortion within "Pacific Power's" distortion limit requirement of "8%". Distortion limits apply to the entire plant load measured at the primary meter. This point in the system shall be defined as the point of common coupling (PCC). Meeting these requirements is a condition of service and a requirement of this project. Refer to Section 26 29 23 – Variable-Frequency Motor Controllers (VFCs/VFDs), Part 2.3.I.

1.10 RECORD DOCUMENTS

A. Prepare Record Documents in accordance with the requirements in Section 01 77 00 – Closeout Procedures. In addition to the requirements specified in Division 1, indicate the following installed conditions:

B. Actual location of all electrical service gear/feeders, panel/motor/special equipment feeders, all major underground or under slab conduits, all conduit stubs for future use, any change in branch circuitry from Drawings, key junction boxes and pull boxes not indicated on Drawings, any control locations or indicator lights not shown on Drawings.

C. Addendum items, Change Order items and all changes made to Drawings from Bidding phase through to Project completion.

D. Actual equipment and materials installed. Where manufacturer and catalog number are indicated on Drawings, generally or in fixture or equipment schedules, change to reflect actual products installed.

E. Change service panel and branch panel breaker locations and schedules to reflect actual installed conditions.

1.11 MAINTENANCE MANUALS

A. Prepare maintenance manuals in accordance with Section 01 77 00 – Closeout Procedures. In addition to the requirements specified in Division 1 assemble O & M Manuals as follows:

1. Compile Operating and Maintenance Manuals for the electrical systems and equipment. The manuals shall be provided to the Engineer for approval complete and at one time, prior to requesting final payment. Partial or separate data will be returned for completion.

2. Manuals shall be assembled in three-ring binders. Binders shall be 3 inch thick or less and have slip sleeve jacket on binder side and front. More than one binder shall be used for each set of data if required to prevent overfilling of one binder. All information shall be arranged in Sections and each Section shall have a blank buff colored, heavy paper divider with a protruding tab clearly labeled. Sections shall be arranged in the same order that the equipment is listed in the Specification and each Specification section shall have a separate tab. Shop Drawings which are larger than 8-1/2-inch by 11 inch shall be individually folded so they are 8-1/2-inch by 11 inch or less and inserted behind the appropriate tab.

3. Tabs shall be labeled and arranged as follows:

   a. Index: Furnish under the first tab an index of Sections listing name of Section and Specification numbers.

   b. Equipment Manufacturers: Furnish under the second tab a complete typed list of equipment suppliers and manufacturer's representative including type of equipment, name, address, and phone number. The company listed here should be the one which could furnish replacement parts and offer technical information about the equipment.

   c. Product Literature: Each tab, starting with the third shall contain the name of a Specification Section. Behind each tab shall be the previously submitted and approved Shop Drawing, factory published operation and maintenance instructions and parts lists. Also include description of function, normal operating characteristics and limitations, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions. Servicing instructions and lubrication charts and schedules.

4. Upon completion and approval of the booklets, one copy shall be given to the Architect, and two to the Owner. Using the booklet, the Electrical Contractor shall explain in detail and instruct the Owner's operating personnel in the correct operation and maintenance of the equipment.

PART 2 - PRODUCTS

2.1 SUPPORTING DEVICES

A. Channel and angle support systems, hangers, anchors, sleeves, brackets, fabricated items, and fasteners are designed to provide secure support from the building structure for electrical components.

1. Material: Steel, except as otherwise indicated, protected from corrosion with zinc coating or with treatment of equivalent corrosion resistance using approved alternative finish or inherent material characteristics.

2. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel, except as otherwise indicated.

B. Steel channel supports have 9/16-inch diameter holes at a maximum of 8 inches o.c., in at least 1 surface.

1. Fittings and accessories mate and match with channels and are from the same manufacturer.

C. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps or "click"- type hangers.

D. Sheet-Metal Sleeves: 0.0276-inch or heavier galvanized sheet steel, round tube, closed with welded longitudinal joint.

E. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.

F. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Plugs have number and size of conductor gripping holes as required to suit individual risers. Body constructed of malleable iron casting with hot-dip galvanized finish.

G. Expansion Anchors: Carbon-steel wedge or sleeve type.

H. Toggle Bolts: All-steel springhead type.

I. Powder-Driven Threaded Studs: Heat-treated steel.

2.2 CONCRETE EQUIPMENT BASES

A. Concrete: 3000 psi, 28-day compressive strength as specified

B. RACEWAY AND CABLE LABELS

C. Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

1. Color: Black letters on orange field.

2. Legend: Indicates voltage.

D. Adhesive Labels: Preprinted, flexible, self-adhesive vinyl with legend overlaminated with a clear, weather- and chemical-resistant coating.

E. Pretensioned, Wraparound Plastic Sleeves: Flexible, preprinted, color-coded, acrylic band sized to suit the diameter of the line it identifies and arranged to stay in place by pretensioned gripping action when placed in position.

F. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

G. Underground-Line Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape.

1. Not less than 6 inches wide by 4 mils thick.

2. Compounded for permanent direct-burial service.

3. Embedded continuous metallic strip or core.

4. Printed legend indicating type of underground line.

H. Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

2.3 NAMEPLATES

A. Engraved Plastic Nameplates: Engraving stock, melamine plastic laminate, minimum 1/16-inch thick for signs up to 20 sq. in. and 1/8-inch thick for larger sizes.

1. Engraved legend with white letters on black face.

2. Punched or drilled for mechanical fasteners.

2.4 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.

1. Minimum Width: 3/16-inch.

2. Tensile Strength: 50 lb minimum.

3. Temperature Range: Minus 40 to plus 185 deg F.

4. Color: According to color-coding.

B. Paint: Formulated for the type of surface and intended use.

1. Primer for Galvanized Metal: Single-component acrylic vehicle formulated for galvanized surfaces.

2. Primer for Concrete Masonry Units: Heavy-duty-resin block filler.

3. Primer for Concrete: Clear, alkali-resistant, binder-type sealer.

4. Enamel: Silicone-alkyd or alkyd urethane as recommended by primer manufacturer.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION REQUIREMENTS

A. Install components and equipment to provide the maximum possible headroom where mounting heights or other location criteria are not indicated.

B. Install items level, plumb, and parallel and perpendicular to other building systems and components, except where otherwise indicated.

C. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

D. Give right of way to raceways and piping systems installed at a required slope.

3.2 ELECTRICAL SUPPORTING METHODS

A. Damp Locations and Outdoors: Hot-dip galvanized materials, U-channel system components.

B. Dry Locations: Steel materials.

C. Support Clamps for PVC Raceways: Click-type clamp system.

D. Conform to manufacturer's recommendations for selecting supports.

E. Strength of Supports: Adequate to carry all present and future loads, times a safety factor of at least 4; 200 lb minimum design load.

3.3 GENERAL INSTALLATION OF MATERIALS

A. Install wires according to manufacturer's written instructions and NECA's "Standard of Installation."

B. Conductor Splices: Keep to the minimum and comply with the following:

1. Install splices and taps that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

2. Use splice and tap connectors that are compatible with conductor material.

C. Connect outlets and components to wiring systems and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening requirements specified in UL 486A.

D. Install devices to securely and permanently fasten and support electrical components.

E. Raceway Supports: Comply with NFPA 70 and the following requirements:

1. Conform to manufacturer's recommendations for selecting and installing supports.

2. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.

3. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.

4. Spare Capacity: Size supports for multiple conduits so capacity can be increased by a 25 percent minimum in the future.

5. Support individual horizontal raceways with separate, malleable iron pipe hangers or clamps.

6. Hanger Rods: 1/4-inch diameter or larger threaded steel, except as otherwise indicated.

7. Spring Steel Fasteners: Specifically designed for supporting single conduits or tubing. May be used in lieu of malleable iron hangers for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to channel and slotted angle supports in accordance with NEC.

8. In vertical runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports, with no weight load on raceway terminals.

F. Vertical Conductor Supports: Install simultaneously with conductors.

G. Miscellaneous Supports: Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices except where components are mounted directly to structural features of adequate strength.

H. Sleeves: Install for cable and raceway penetrations of concrete slabs and walls, except where core-drilled holes are used. Install for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.

I. Fastening: Unless otherwise indicated, securely fasten electrical items and their supporting hardware to the building structure. Perform fastening according to the following:

1. Fasten by means of wood screws or screw-type nails on wood; toggle bolts on hollow masonry units; concrete inserts or expansion bolts on concrete or solid masonry; and by machine screws, welded threaded studs, or spring-tension clamps on steel.

2. Threaded studs driven by a powder charge and provided with lock washers and nuts may be used instead of expansion bolts, machine screws, or wood screws.

3. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or any other items.

4. In partitions of light steel construction use sheet-metal screws.

5. Drill holes in concrete beams so holes more than 1-1/2 inches deep do not cut main reinforcing bars.

6. Drill holes in concrete so holes more than 3/4-inch deep do not cut main reinforcing bars.

7. Fill and seal holes drilled in concrete and not used.

8. Select fasteners so the load applied to any fastener does not exceed 25 percent of the proof-test load.

J. Install concrete pads and bases where indicated.

K. Install utility-metering equipment according to utility company's written requirements. Provide grounding and empty conduits as required by company.

3.4 LABEL INSTALLATION

A. Identification Materials and Devices: Install at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations in the Contract Documents or with those required by codes and standards. Use consistent designations throughout Project.

C. Sequence of Work: If identification is applied to surfaces that require finish, install identification after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before applying.

E. Install painted identification according to manufacturer's written instructions and as follows:

1. Clean surfaces of dust, loose material, and oily films before painting.

2. Prime surfaces using type of primer specified for surface.

3. Apply one intermediate and one finish coat of enamel.

F. Caution Labels for Indoor Boxes and Enclosures for Power and Lighting: Install pressure-sensitive, self-adhesive labels identifying system voltage with black letters on orange background. Install on exterior of door or cover.

G. Circuit Identification Labels on Boxes: Install labels externally.

1. Exposed Boxes: Permanent black marker indicating panel and circuit designation.

2. Concealed Boxes: Permanent black marker indicating panel and circuit designation.

H. Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communication lines, install continuous underground plastic line marker located directly above line at 6 to 8 inches below finished grade. Where width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches overall, use a single line marker. Install line marker for underground wiring, both direct-buried cables and cables in raceway.

I. Color-Coding of Secondary Phase Conductors: Use the following colors for service, feeder and branch-circuit phase conductors:

1. 208/120-V Conductors:

a. Phase A: Black.

b. Phase B: Red.

c. Phase C: Blue.

d. Neutral: White.

e. Ground: Green.

2. 480/277-V Conductors:

a. Phase A: Brown.

b. Phase B: Orange

c. Phase C: Yellow.

d. Neutral: Gray.

e. Ground: Green.

3. Factory apply color the entire length of conductors, except the following field-applied, color-coding methods may be used instead of factory-coded wire for sizes larger than No. 10 AWG:

a. Colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Use 1 inch wide tape in colors specified. Adjust tape bands to avoid obscuring cable identification markings.

J. Power-Circuit Identification: Metal tags or aluminum, wraparound marker bands for cables, feeders, and power circuits in vaults, pull and junction boxes, manholes, and switchboard rooms.

1. Legend: 1/4-inch steel letter and number stamping or embossing with legend corresponding to indicated circuit designations.

2. Tag Fasteners: Nylon cable ties.

3. Band Fasteners: Integral ears.

K. Apply identification to conductors as follows:

1. Conductors to Be Extended in the Future: Indicate source and circuit numbers.

2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color-coding to identify circuits' voltage and phase.

3. Multiple Control and Communication Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color-coding, or cable marking tape.

L. Apply warning, caution, and instruction signs as follows:

1. Warnings, Cautions, and Instructions: Install to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.

2. Emergency Operation: Install engraved laminated signs with white legend on red background with minimum 3/8-inch high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.

M. Equipment Identification Labels: Engraved plastic laminate. Install on each unit of equipment, including central or master unit of each system. This includes power, lighting, communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Unless otherwise indicated, provide a single line of text with 1/2-inch high lettering on 1-1/2 inch high label; where two lines of text are required, use labels 2 inches high. Use white lettering on black field. Apply labels for each unit of the following categories of equipment using mechanical fasteners:

1. Panelboards, electrical cabinets, and enclosures.

2. Access doors and panels for concealed electrical items.

3. Electrical switchgear and switchboards.

4. Emergency system boxes and enclosures.

5. Disconnect switches.

6. Enclosed circuit breakers.

7. Motor starters.

8. Push-button stations.

9. Power transfer equipment.

10. Contactors.

11. Remote-controlled switches.

12. Control devices.

13. Transformers.

14. Battery racks.

15. Power-generating units.

N. For panelboards, provide framed type circuit schedules with identification of items controlled by each breaker. Indicate room numbers of items controlled or room name where appropriate for Owners convenience. Final schedules shall be typed or printed for clarity. Hand written schedules are not acceptable. Schedules shall be posted inside each panel door mounted in transparent card holder upon project completion.

END OF SECTION 26 05 00

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. 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.

1. Comply with UL 467.

B. Comply with NFPA 70; for overhead-line construction and medium-voltage underground construction, comply with IEEE C2.

C. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.

1.2 SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2.2 GROUNDING CONDUCTORS

A. Material: Copper.

B. Equipment Grounding Conductors: Insulated with green-colored insulation.

C. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.

D. Grounding Electrode Conductors: Stranded cable.

E. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.

F. Bare Copper Conductors: Comply with the following:

1. Solid Conductors: ASTM B 3.

2. Assembly of Stranded Conductors: ASTM B 8.

G. Copper Bonding Conductors: As follows:

1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4-inch in diameter.

2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.

3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16-inch thick.

4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

H. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators.

2.3 CONNECTOR PRODUCTS

A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.

B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.

C. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

2.4 GROUNDING ELECTRODES

A. Ground Rods: Sectional type; copper-clad steel.

1. Size: 3/4 inch in diameter by 120 inches in length.

PART 3 - EXECUTION

3.1 APPLICATION

A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.

B. In raceways, use insulated equipment grounding conductors.

C. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells.

D. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.

E. Ground Rod Clamps at Test Wells: Use bolted pressure clamps with at least two bolts.

F. Underground Grounding Conductors: Use copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches below grade or bury 12 inches above duct bank when installed as part of the duct bank.

3.2 EQUIPMENT GROUNDING CONDUCTORS

A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

B. Install equipment grounding conductors in all feeders and circuits.

C. Install insulated equipment grounding conductor with circuit conductors for the following items, in addition to those required by NEC:

1. Feeders and branch circuits.

2. Lighting circuits.

3. Receptacle circuits.

4. Single-phase motor and appliance branch circuits.

5. Three-phase motor and appliance branch circuits.

6. Flexible raceway runs.

7. Armored and metal-clad cable runs.

D. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

E. Air-Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.

F. Water Heater: Bond conductor to heater units, piping, connected equipment, and components.

G. Signal and Communication Systems: Provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

H. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bus.

1. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

3.3 INSTALLATION

A. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NEC. If concrete foundation is less than 20 feet long, coil excess conductor within the base of the foundation. Bond grounding conductor by cadweld process to reinforce steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to a grounding electrode external to concrete.

B. Ground Rods: Install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes.

1. Drive ground rods until tops are 6 inches below finished floor or final grade, unless otherwise indicated.

2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.

C. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

D. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

E. Metal Water Service Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

F. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.

G. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.

H. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.

3.4 CONNECTIONS

A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.

2. Make connections with clean, bare metal at points of contact.

B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

D. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.

E. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

F. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

END OF SECTION 26 05 26

SECTION 26 05 33.16 – CABINETS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes cabinets, boxes, and fittings for electrical installations and certain types of electrical fittings not covered in other sections. Types of products specified in this Section include:

1. Cabinets.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers complying with the Quality Assurance requirements are acceptable.

1. Data communication cabinets

a. Hoffman EWMW482425 or comparable

b. Panduit

2.2 CABINETS, GENERAL

A. Electrical Cabinets: Of indicated types, sizes, and NEMA enclosure classes. Where not indicated, provide units of types, sizes, and classes appropriate for the use and location. Provide all items complete with covers and accessories required for the intended use. Provide gaskets for units in damp or wet locations.

2.3 MATERIALS AND FINISHES

A. Sheet Steel: Flat-rolled, code-gage, galvanized steel.

B. Fasteners for General Use: Corrosion resistant screws and hardware including cadmium and zinc plated items.

C. Fasteners for Damp or Wet Locations: Stainless steel screws and hardware.

D. Exterior Finish: Gray baked enamel for items exposed in finished locations except as otherwise indicated.

E. Painted Interior Finish: Where indicated, white baked enamel.

F. Fittings for Boxes, Cabinets, and Enclosures: Conform to UL 514B. Zinc plated steel for conduit hubs, bushings, box connectors and couplers. Set screw type. Use insulated throat connectors.

2.4 CABINETS

A. Comply with UL 50, "Electrical Cabinets and Boxes."

B. Construction: Sheet steel, NEMA 12 class except as otherwise indicated. Cabinet shall consist of a box and a front consisting of a one piece frame and a hinged door. Arrange door to close against a rabbet placed all around the inside edge of the frame, with a uniformly close fit between door and frame. Provide concealed fasteners, not over 24 inches apart, to hold fronts to cabinet boxes and provide for adjustment. Provide flush or concealed door hinges not over 24 inches apart and not over 6 inches from top and bottom of door. For flush cabinets, make the front approximately 3/4-inch larger than the box all around. For surface mounted cabinets make front same height and width as box.

C. Doors: Double doors for cabinets wider than 24 inches. Telephone cabinets wider than 48-inches may have sliding or removable doors.

D. Locks: Combination spring catch and key lock, with all locks for cabinets of the same system keyed alike. Locks may be omitted on signal, power, and lighting cabinets located within wire closets and mechanical/electrical rooms. Locks shall be of a type to permit doors to latch closed without locking.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locations: Install items where indicated and where required to suit code requirements and installation conditions.

B. Cap unused knockout holes where blanks have been removed and plug unused conduit hubs.

C. Sizes shall be adequate to meet NEC volume requirements, but in no case smaller than sizes indicated.

D. Remove sharp edges where they may come in contact with wiring or personnel.

3.2 INSTALLATION OF CABINETS AND HINGED DOOR ENCLOSURES

A. Mount with fronts straight and plumb.

B. Install with tops 78 inches above floor.

C. Set cabinets in finished spaces flush with walls.

3.3 GROUNDING

A. Electrically ground metallic cabinets, boxes, and enclosures. Where wiring to item includes a grounding conductor, provide a grounding terminal in the interior of the cabinet, box or enclosure.

3.4 CLEANING AND FINISH REPAIR

A. Upon completion of installation, inspect components. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, abrasions and weld marks.

B. Galvanized Finish: Repair damage using a zinc-rich paint recommended by the tray manufacturer.

C. Painted Finish: Repair damage using matching corrosion inhibiting touch-up coating.

END OF SECTION 26 05 33.16

SECTION 26 08 00 – FIELD ELECTRICAL ACCEPTANCE TESTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Responsibilities for testing the electrical installation.
2. Routine tests during installation.
3. Adjusting and calibration.
4. Acceptance tests.
5. Demonstration of electrical equipment.
6. Commissioning and plant start-up.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
    a. Section 01 33 00 – Submittal Procedures
    b. Section 26 05 00 – Electrical, General
    c. Section 26 05 26 – Grounding and Bonding for Electrical Systems

C. Copyright information:

1. Some portions of this Section are copyrighted by the InterNational Electrical Testing Association, Inc (NETA). See NETA publication ATS for details.

1.2 REFERENCES

A. As specified in Section 26 05 00 – Electrical, General.

B. American National Standards Institute (ANSI).

C. ASTM International (ASTM):

1. D 877 - Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes.

2. D 923 - Standard Practices for Sampling Electrical Insulating Liquids.

3. D 971 - Standard Test Method for Interfacial Tension of Oil Against Water by the Ring Method.

4. D 1298 - Standard Test Method for Density, Relative Density, or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method.

5. D 1500 - Standard Test Method for ASTM Color of Petroleum Products (ASTM Color Scale).

6. D 1524 - Standard Test Method for Visual Examination of Used Electrical Insulating Oils of Petroleum Origin in the Field.

7. D 1816 - Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using VDE Electrodes.

8. D 3612 - Standard Test Method for Analysis of Gases Dissolved in Electrical Insulating Oil by Gas Chromatography.

D. Institute of Electrical and Electronics Engineers (IEEE):

1. 43 - IEEE Recommended Practice for Testing Insulation Resistance of Rotating Machinery.

2. 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System.

3. 95 - IEEE Recommended Practice for Insulation Testing of AC Electric Machinery (2300 V and Above) With High Direct Voltage.

4. 450 - IEEE Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications.

5. C57.13 - IEEE Standard Requirements for Instrument Transformers.

6. C57.13.1 - IEEE Guide for Field Testing of Relaying Current Transformers.

7. C57.13.3 - IEEE Guide for Grounding of Instrument Transformer Secondary Circuits and Cases.

8. C57.104 - IEEE Guide for the Interpretation of Gases Generated in Oil-Immersed Transformers.

E. Insulated Cable Engineer's Association (ICEA).

F. InterNational Electrical Testing Association (NETA).

1. ATS-2009 Standard for Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems.

G. International Electrotechnical Commission (IEC).

H. Manufacturer's testing recommendations and instruction manuals.

I. National Fire Protection Association (NFPA):

1. 70 - National Electrical Code (NEC).

2. 110 - Standard for Emergency and Standby Power Systems.

J. National Institute of Standards and Technology (NIST).

K. Specification sections for the electrical equipment being tested.

L. Shop drawings.

1.3 DEFINITIONS

A. As specified in Section 26 05 00 – Electrical, General.

B. Specific definitions:

1. Testing laboratory: The organization performing acceptance tests.

1.4 SYSTEM DESCRIPTION

A. Testing of all electrical equipment installed under this Contract in accordance with the manufacturer's requirements and as specified in this Section.

B. Conduct all tests in the presence of the Engineer or the Engineer's representative:

1. The Engineer will witness all visual, mechanical and electrical tests and inspections.

C. The testing and inspections shall verify that the equipment is operational within the tolerances required and expected by the manufacturer, and these Specifications. The results of the tests shall determine the suitability for continued reliable operation.

D. Responsibilities:

1. Contractor responsibilities:

a. Ensure that all resources are made available for testing, and that all testing requirements are met.

2. Electrical subcontractor responsibilities:

a. Perform routine tests during installation.

b. Demonstrate operation of electrical equipment.

c. Commission the electrical installation.

d. Provide the necessary services during testing, and provide these services to the testing laboratory, Contractor, and other subcontractors, including but not limited to:

1) Providing electrical power as required.

2) Operating of electrical equipment in conjunction with testing of other equipment.

3) Activating and shutting down electrical circuits.

4) Making and recording electrical measurements.

5) Replacing blown fuses.

6) Installing temporary jumpers.

3. Testing laboratory responsibilities:

a. Perform all acceptance tests as defined in this Section.

b. Provide all required equipment, materials, labor, and technical support during acceptance tests.

E. Upon completion of testing or calibration, attach a label to all serviced devices:

1. The label shall indicate the date serviced and the company that performed the service.

1.5 SUBMITTALS

A. Furnish submittals as specified in Sections 01 33 00 – Submittal Procedures and 26 05 00 – Electrical, General.

B. LAN cable test form:

1. LAN cable test reports:

a. Submit 3 copies of test reports showing the results of all tests specified in this Section:

1) Test type.

2) Test location.

3) Test date.

4) Cable number.

5) Cable length.

6) Certification that the cable meets or exceeds the specified standard.

b. Furnish hard copy and electronic copy for all traces.

C. Test report:

1. Include the following:

a. Summary of Project.

b. Description of equipment tested.

c. Description of tests performed.

d. Test results.

e. Conclusions and recommendations.

f. Completed test forms.

g. List of test equipment used and calibration dates.

h. LAN cable test reports.

D. Testing laboratory qualifications:

1. Submit a complete resume and statement of qualifications from the proposed testing laboratory detailing their experiences in performing the tests specified:

a. This statement will be used to determine whether the laboratory is acceptable, and shall include:

1) Corporate history and references.

2) Resume of individual performing test.

3) Equipment list and test calibration data.

E. Division of responsibilities:

1. Submit a list identifying who is responsible for performing each portion of the testing.

F. Manufacturers' testing procedures:

1. Submit manufacturers' recommended testing procedures and acceptable test results for review by the Engineer.

1.6 QUALITY ASSURANCE

A. As specified in Section 26 05 00 – Electrical, General.

B. Testing laboratory qualifications:

1. The testing laboratory may be qualified testing personnel from the electrical subcontractor's staff or an independent testing company.

2. Selection of the testing laboratory and testing personnel is subject to approval by the Engineer based on testing experience and certifications of the individuals and testing capabilities of the organization.

1.7 DELIVERY, STORAGE, AND PROTECTION NOT USED

1.8 PROJECT OR SITE CONDITIONS

A. As specified in Section 26 05 00 – Electrical, General.

1.9 SEQUENCING

A. Perform testing in the following sequence:

1. Perform routine tests as the equipment is installed including:

a. Insulation resistance tests.

b. Continuity tests.

c. Rotational tests.

2. Adjusting and preliminary calibration.

3. Acceptance tests.

4. Demonstration.

5. Commissioning and plant start-up.

1.10 SCHEDULING NOT USED

1.11 WARRANTY

A. As specified in Section 26 05 00 – Electrical, General.

1.12 SYSTEM START-UP NOT USED

1.13 OWNER'S INSTRUCTIONS NOT USED

1.14 COMMISSIONING

A. Commissioning and plant start-up, as described in the Specifications, shall not begin until acceptance testing is complete, and operation has been demonstrated to the satisfaction of the Engineer.

B. Commissioning shall only be attempted as a function of normal plant operation in which plant process flows and levels are routine and equipment operates automatically in response to flow and level parameters or computer command, as applicable:

1. Simulation of process parameters will be considered only upon receipt of a written request by the Contractor.

C. Record all motor currents during normal operation.

D. Record the indications of all power meters every half-hour during commissioning.

1.15 MAINTENANCE NOT USED

PART 2 - PRODUCTS

2.1 MANUFACTURERS NOT USED

2.2 EXISTING PRODUCTS NOT USED

2.3 MATERIALS NOT USED

2.4 MANUFACTURED UNITS NOT USED

2.5 EQUIPMENT NOT USED

2.6 COMPONENTS NOT USED

2.7 ACCESSORIES NOT USED

2.8 MIXES NOT USED

2.9 FABRICATION NOT USED

2.10 FINISHES NOT USED

2.11 SOURCE QUALITY CONTROL

A. General:

1. Test instrument calibration:

a. Utilize a testing laboratory with a calibration program which maintains all applicable test instrumentation within rated accuracy.

b. The accuracy shall be traceable to the NIST in an unbroken chain.

c. Calibrate instruments in accordance with the following frequency schedule:

1) Field instruments: 6 months maximum.

2) Laboratory instruments: 12 months maximum.

3) Leased specialty equipment where the accuracy is guaranteed by the lessor (such as Doble): 12 months maximum.

d. Dated calibration labels shall be visible on all test equipment.

e. Maintain an up-to-date instrument calibration record for each test instrument:

1) The records shall show the date and results of each calibration or test.

f. Maintain an up-to-date instrument calibration instruction and procedure for each test instrument.

PART 3 - EXECUTION

3.1 EXAMINATION NOT USED

3.2 PREPARATION

A. Do not begin testing until the following conditions have been met:

1. All instruments required are available and in proper operating condition.

2. All required dispensable materials such as solvents, rags, and brushes are available.

3. All equipment handling devices such as cranes, vehicles, chain falls and other lifting equipment are available or scheduled.

4. All instruction books, calibration curves, or other printed material to cover the electrical devices are available.

5. Data sheets to record all test results are available.

3.3 INSTALLATION NOT USED

3.4 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION NOT USED

3.5 REPAIR/RESTORATION NOT USED

3.6 RE-INSTALLATION NOT USED

3.7 FIELD QUALITY CONTROL

A. Dry type transformers:

1. Visual and mechanical inspection:

a. Compare equipment nameplate data with that indicated on the Drawings and specified in the Specifications.

b. Inspect physical and mechanical condition.

c. Inspect anchorage, alignment, and grounding.

d. Verify that resilient mounts are free and that any shipping brackets have been removed.

e. Inspect equipment for cleanliness.

f. Inspect bolted electrical connections for high resistance using one of the following methods:

1) Use of low resistance ohmmeter.

2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:

Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.

3) Thermographic survey.

g. Verify that as-left tap connections are as specified.

2. Electrical tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.

b. Perform insulation-resistance tests winding-to-winding and each winding-to-ground:

1) Apply voltage in accordance with manufacturer's published data.

Refer to NETA ATS tables in the absence of manufacturer's published data.

c. Calculate dielectric absorption ration or polarization index.

d. Perform turns ratio tests at all tap positions.

e. Verify correct secondary voltage, phase-to-phase and phase-to-neutral after energization and before loading.

3. Test values:

a. Compare bolted connection resistance values to values of similar connections:

1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

b. Bolt-torque levels shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

c. Results of the thermographic survey shall be in accordance with NETA ATS requirements.

d. Tap connections are left as found unless otherwise specified.

e. Minimum insulation resistance values of transformer insulation shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

2) Investigate insulation values less than the allowable minimum.

f. The dielectric absorption ratio or polarization index shall not be less than 1.0.

g. Turns-ratio results should not deviate more than 1/2 percent from either the adjacent coils or calculated ratio.

h. Phase-to-phase and phase-to-neutral secondary voltages shall be in agreement with nameplate data.

B. Cables, 600 volts and less:

1. Visual and mechanical inspection:

a. Compare cable data with that indicated on the Drawings and specified in the Specifications.

b. Inspect exposed sections of cables for physical damage and correct connection as indicated on the Drawings.

c. Inspect bolted electrical connections for high resistance using one of the following methods:

1) Use of low resistance ohmmeter.

2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:

Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.

3) Thermographic survey.

d. Inspect compression-applied connectors for correct cable match and indentation.

e. Inspect for correct identification and arrangements.

f. Inspect jacket insulation and condition.

2. Electrical tests:

a. Perform resistance measurements through bolted connections with low-resistance ohmmeter.

b. Perform insulation-resistance tests on each conductor with respect to ground and adjacent conductors:

1) Applied voltage shall be:

500 VDC for 300-volt rated cable.

1,000 VDC for 600-volt rated cable.

2) Test duration shall be 1 minute.

c. Perform continuity tests to ensure correct cable connection.

d. Verify uniform resistance of parallel conductors.

3. Test values:

a. Compare bolted connection resistance values to values of similar connections:

1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

b. Bolt-torque levels shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

c. Results of the thermographic survey shall be in accordance with NETA ATS requirements.

d. Insulation resistance values shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

2) Investigate values of insulation resistance less than the allowable minimum.

e. Cables shall exhibit continuity.

f. Investigate deviations in resistance between parallel conductors.

C. Low voltage molded case and insulated case circuit breakers:

1. Visual and mechanical inspection:

a. Compare equipment nameplate data with that indicated on the Drawings and specified in the Specifications.

b. Inspect physical and mechanical condition.

c. Inspect anchorage and alignment.

d. Verify the unit is clean.

e. Operate circuit breaker to ensure smooth operation.

f. Inspect bolted electrical connections for high resistance by one of the following methods:

1) Use of low resistance ohmmeter.

2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:

Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.

3) Thermographic survey.

g. Inspect operating mechanism, contacts, and arc chutes in unsealed units.

h. Perform adjustments for final protective device settings in accordance with the coordination study.

2. Electrical tests:

a. Perform resistance measurements through bolted connections with a low resistance ohmmeter.

b. Perform insulation resistance tests for 1 minute on each pole, phase-to-phase and phase-to-ground with the circuit breaker closed and across each open pole:

1) Apply voltage in accordance with manufacturer's published data.

2) Refer to NETA ATS tables in the absence of manufacturer's published data.

c. Perform a contact/pole-resistance test.

d. Determine long-time pickup and delay by primary current injection.

e. Determine short-time pickup and delay by primary current injection.

f. Determine ground-fault pickup and delay by primary current injection.

g. Determine instantaneous pickup value by primary current injection.

h. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data.

i. Verify correct operation of any auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, anti pump function and trip unit battery condition:

1) Reset all trip logs and indicators.

j. Verify operation of charging mechanism.

3. Test values:

a. Compare bolted connection resistance values to values of similar connections:

1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

b. Bolt-torque levels shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

c. Results of the thermographic survey shall be in accordance with NETA ATS requirements.

d. Insulation resistance values shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

2) Investigate values of insulation resistance less than the allowable minimum.

e. Microhm or dc millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data:

1) If manufacturer's data is not available, investigate any values which deviate from adjacent poles or similar breakers by more than 50 percent of the lowest value.

f. Insulation resistance values of control wiring shall not be less than 2 megohms.

g. Long-time pickup values shall be as specified, and the trip characteristic shall not exceed manufacturer's published time-current characteristic tolerance band including adjustment factors:

1) If manufacturer's curves are not available, trip times shall not exceed the value shown in NETA ATS tables.

h. Short-time pickup values shall be as specified, and the trip characteristic shall not exceed manufacturer's published time-current tolerance band.

i. Ground fault pickup values shall be as specified, and the trip characteristic shall not exceed manufacturer's published time-current tolerance band.

j. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

k. Pickup values and trip characteristics shall be within manufacturer's published tolerances.

l. Minimum pickup voltage of the shunt trip and close coils shall conform to the manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

m. Breaker open, close, trip, trip-free, antipump, and auxiliary features shall function as designed.

n. The charging mechanism shall operate in accordance with manufacturer's published data.

D. Grounding systems:

1. Visual and mechanical inspection:

a. Inspect ground system for compliance with that indicated on the Drawings, specified in Specifications, and in the National Electrical Code.

b. Inspect physical and mechanical condition.

c. Inspect bolted electrical connections for high resistance using one of the following methods:

1) Use of low resistance ohmmeter.

2) Verify tightness of accessible bolted electrical connections by calibrated torque wrench method:

Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.

d. Inspect anchorage.

2. Electrical tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.

b. Perform fall of potential test or alternative test in accordance with IEEE 81 on the main grounding electrode or system.

c. Perform point-to-point tests to determine the resistance between the main grounding system and all major electrical equipment frames, the system neutral and any derived neutral points.

3. Test values:

a. Grounding system electrical and mechanical connections shall be free of corrosion.

b. Compare bolted connection resistance values to values of similar connections:

1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

c. Bolt torque levels shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

d. The resistance between the main grounding electrode and ground shall be as specified in Section 26 05 26 – Grounding and Bonding for Electrical Systems. Investigate point-to-point resistance values that exceed 0.5 ohm.

E. Rotating machinery:

1. Visual and mechanical inspection:

a. Compare equipment nameplate information with that indicated on the Drawings and specified in the Specifications.

b. Inspect physical and mechanical condition.

c. Inspect anchorage, alignment, and grounding.

d. Inspect air baffles, filter media, cooling fans, slip rings, brushes, and brush rigging.

e. Inspect bolted electrical connections for high resistance using one of the following methods:

1) Use of low resistance ohmmeter.

2) Verify tightness of accessible bolted electrical connections by calibrated torque wrench method:

Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.

Thermographic survey.

f. Perform special tests such as gap spacing and machine alignment if applicable.

g. Verify correct application of appropriate lubrication and lubrication systems.

h. Verify that resistance temperature detector (RTD) circuits conform to that indicated on the Drawings.

2. Electrical tests:

a. Perform resistance measurements through bolted connections with a low resistance ohmmeter.

b. Perform insulation resistance test in accordance with IEEE 43:

1) On motors 200 horsepower and smaller, test duration shall be 1 minute. Calculate dielectric absorption ratio.

2) On motors larger than 200 horsepower, test duration shall be 10 minutes. Calculate polarization index.

c. Perform dc dielectric withstand voltage tests on machines rated at 2,300 volts and greater in accordance with IEEE 95.

d. Perform phase-to-phase stator resistance test on machines rated at 2,300 volts and greater.

e. Perform insulation resistance test on insulated bearings in accordance with manufacturer's published data.

f. Test surge protection devices as specified in this Section.

g. Test motor starter as specified in this Section.

h. Perform resistance tests on resistance temperature detector (RTD) circuits.

i. Verify operation of motor space heater.

j. Perform a rotation test to ensure correct shaft rotation.

k. Measure running current and evaluate relative to load conditions and nameplate full-load amperes.

3. Test values:

a. Inspection:

1) Air baffles shall be clean and installed in accordance with the manufacturer's published data.

2) Filter media shall be clean and installed in accordance with the manufacturer's published data.

3) Cooling fans shall operate.

4) Slip ring alignment shall be within manufacturer's published tolerances.

5) Brush alignment shall be within manufacturer's published tolerances.

6) Brush rigging shall be within manufacturer's published tolerances.

b. Compare bolted connection resistance values to values of similar connections:

1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

c. Bolt-torque levels shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

d. Results of the thermographic survey shall be in accordance with NETA ATS requirements.

e. Air-gap spacing and machine alignment shall be in accordance with manufacturer's published data.

f. The dielectric absorption ratio or polarization index shall not be less than 1.0. The recommended minimum insulation ($IR_{1\ min}$) test results in megohms shall be corrected to 40 degrees Celsius and read as follows:

1) IR1 min equals 100 megohms for dc armature and ac windings with form-wound coils above 1 kilovolt.

2) IR1 min equals 5 megohms for machines and random-wound stator coils and form-wound coils rated below 1 kilovolt.

Dielectric withstand voltage and surge comparison tests shall not be performed on machines having lower values than those indicated above.

g. If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the dielectric withstand test, the test specimen is considered to have passed the test.

h. Investigate phase-to-phase stator resistance values that deviate by more than 10 percent.

i. Power factor or dissipation factor values shall be compared to manufacturer's published data:

1) In the absence of manufacturer's published data compare values of similar machines.

j. Tip-up values shall indicate no significant increase in power factor.

k. If no evidence of distress, insulation failure or waveform nesting is observed by the end of the total time of voltage application during the surge comparison test, the test specimen is considered to have passed the test.

l. Bearing insulation resistance measurements shall be within manufacturer's published tolerances:

1) In the absence of manufacturer's published data compare values of similar machines.

m. Test results of surge protection devices shall be as specified in this Section.

n. Test results of motor starter equipment shall be as specified in this Section.

o. RTD circuits shall conform to the design intent and machine protection device manufacturer's published data.

p. Heaters shall be operational.

q. Vibration amplitudes shall not exceed values in NETA ATS tables:

1) If values exceed those in the NETA ATS tables, perform a complete vibration analysis.

r. Machine rotation should match required rotation of connected load.

s. Running phase-to-phase voltages should be within 1.0 percent. Running currents shall be balanced and proportional to load condition and nameplate data.

F. Motor starters, low voltage:

1. Visual and mechanical inspection:

a. Compare equipment nameplate information with that indicated on the Drawings and specified in the Specifications.

b. Inspect physical and mechanical condition.

c. Inspect anchorage, alignment, and grounding.

d. Verify the unit is clean.

e. Inspect contactors:

1) Verify mechanical operation.

2) Verify contact gap, wipe, alignment, and pressure are in accordance with manufacturer's published data.

f. Motor-running protection:

1) Verify overload element rating is correct for its application.

2) If motor running protection is provided by fuses, verify correct fuse rating.

g. Inspect bolted electrical connections for high resistance using one of the following methods:

1) Use of low resistance ohmmeter.

2) Verify tightness of accessible bolted electrical connections by calibrated torque wrench method:

Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.

3) Thermographic survey.

h. Lubrication requirements:

1) Verify appropriate lubrication on moving current-carrying parts.

2) Verify appropriate lubrication on moving and sliding surfaces.

2. Electrical tests:

a. Perform resistance measurements through bolted connections with a low resistance ohmmeter.

b. Perform insulation resistance tests for 1 minute on each pole, phase-to-phase and phase to ground with the starter closed, and across each open pole for 1 minute:

1) Test voltage shall be in accordance with manufacturer's published data.

2) Refer to NETA ATS tables in the absence of manufacturer's published data.

c. Perform insulation-resistance tests on control wiring with respect to ground. Applied potential shall be 500 VDC for 300-volt rated cable and 1,000 VDC for 600-volt rated cable. Apply the test voltage for 1 minute:

1) For solid state devices that cannot tolerate the applied voltage, follow the manufacturer's recommendation.

d. Test motor protection devices in accordance with manufacturer's published data.

e. Test circuit breakers as specified in this Section.

f. Perform operational tests by initiating control devices.

3. Test values:

a. Compare bolted connection resistance values to values of similar connections:

1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

b. Bolt-torque levels shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

c. Results of the thermographic survey shall be in accordance with NETA ATS requirements.

d. Insulation resistance values shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

2) Investigate values of insulation resistance less than the allowable minimum.

e. Insulation resistance values of control wiring shall not be less than 2 megohms.

f. Motor protection parameters shall be in accordance with manufacturer's published data.

g. Circuit breaker test results shall as specified in this Section.

h. Control devices shall perform in accordance with system design requirements.

G. Motor control centers, low voltage:

1. Visual and mechanical inspection:

a. Compare equipment nameplate data with that indicated on the Drawings and specified in the Specifications.

b. Inspect physical and mechanical condition.

c. Inspect anchorage, alignment, grounding and required clearances.

d. Inspect equipment for cleanliness.

e. Verify that circuit breaker/fuse sizes and types correspond to the approved submittals and coordination study.

f. Verify that current and voltage transformer ratios correspond to that indicated on the Drawings.

g. Inspect bolted electrical connections for high resistance using one of the following methods:

1) Use of low resistance ohmmeter.

2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:

Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.

3) Thermographic survey.

h. Mechanical and electrical interlocks:

1) Attempt closure on locked-open devices.

2) Attempt to open locked-closed devices.

3) Make/attempt key-exchanges in all positions.

i. Lubrication requirements:

1) Verify appropriate lubrication on moving current-carrying parts.

2) Verify appropriate lubrication on moving and sliding surfaces.

j. Inspect insulators for evidence of physical damage or contaminated surfaces.

k. Verify correct barrier and shutter installation and operation.

l. Exercise all active components.

m. Inspect all indicating devices for correct operation.

n. Verify that filters are in place and/or vents are clear.

o. Perform visual and mechanical inspection of instrument transformers as specified in this Section.

p. Inspect control power transformers:

1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.

2) Verify that primary and secondary fuse/circuit breaker ratings match the submittal drawings.

q. Perform visual and mechanical inspection of circuit breakers as specified in this Section.

r. Perform visual and mechanical inspection of starters as specified in this Section.

s. Perform visual and mechanical inspection of dry-type transformers as specified in this Section.

t. Perform visual and mechanical inspection of variable frequency drives as specified in this Section.

2. Electrical tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter if applicable.

b. Perform insulation-resistance tests on each bus section, phase-to-phase and phase-to-ground for 1 minute:

1) Perform test in accordance with NETA ATS tables.

c. Perform an dielectric withstand test on each bus section, each phase to ground with phases not under test grounded, in accordance with manufacturer's published data or NETA ATS tables. Apply the test voltage for 1 minute.

d. Perform insulation-resistance tests on control wiring with respect to ground. Applied potential shall be 500 VDC for 300-volt rated cable and 1,000 VDC for 600-volt rated cable. Apply the test voltage for 1 minute:

1) For solid state devices that cannot tolerate the applied voltage, follow the manufacturer's recommendation.

e. Perform ground-resistance tests:

1) Perform point-to-point tests to determine the resistance between the main grounding system and all major electrical equipment frames, system neutral and derived neutral points.

f. Determine the accuracy of all meters.

g. Control power transformers:

1) Perform insulation resistance tests, winding-to-winding and winding-to-ground:

Test voltages shall be in accordance with NETA ATS tables or as specified by the manufacturer.

2) Perform secondary wiring integrity test:

Disconnect transformer at secondary terminals and connect secondary wiring to a rated secondary voltage source:

(1) Verify correct potential at all devices.

3) Verify correct secondary voltage by energizing primary winding with system voltage:

Measure secondary voltage with the secondary wiring disconnected.

h. Verify operation of space heaters.

i. Perform electrical tests of circuit breakers as specified in this Section.

j. Perform electrical tests of starters as specified in this Section.

k. Perform electrical tests of dry-type transformers as specified in this Section.

l. Perform electrical tests of variable frequency drives as specified in this Section.

3. Test values:

a. Compare bus connection resistances to values of similar connections:

1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

b. Bolt-torque levels shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

c. Results of the thermographic survey shall be in accordance with NETA ATS requirements.

d. Compare bus connection resistances to values of similar connections:

1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Insulation-resistance values for bus and control power transformers shall be in accordance with manufacturer's published data:

Refer to NETA ATS tables in the absence of manufacturer's published data.

Investigate insulation values less than the allowable minimum.

Do not proceed with dielectric withstand voltage tests until insulation-resistance values are above minimum values.

e. Bus insulation shall withstand the overpotential test voltage applied.

f. Insulation-resistance values for control wiring shall not be less than 2.0 megohms.

g. Instrument transformer test values shall be as specified in this Section.

h. Investigate grounding system resistance values that exceed 0.5 ohm.

i. Meter accuracy shall be in accordance with manufacturer's published data.

j. Control power transformers:

1) Insulation resistance values of control power transformers shall be in accordance with manufacturer's published data:

Refer to NETA ATS tables in the absence of manufacturer's published data.

Investigate insulation values less than the allowable minimum.

Do not proceed with dielectric withstand voltage tests until insulation-resistance values are above minimum values.

2) Secondary wiring shall be in accordance with that indicated on the Drawings and specified in the Specifications.

3) Secondary voltage shall be in accordance with that indicated on the Drawings.

k. Heaters shall be operational.

l. Test values for circuit breakers shall be as specified in this Section.

m. Test values for starters shall be as specified in this Section.

n. Test values for dry-type transformers shall as specified in this Section.

o. Test values for variable frequency drives shall be as specified in this Section.

H. Variable frequency drive systems:

1. Visual and mechanical inspection:

a. Compare equipment nameplate data with that indicated on the Drawings and specified in the Specifications.

b. Inspect physical and mechanical condition.

c. Inspect anchorage, alignment, and grounding.

d. Verify the unit is clean.

e. Ensure vent path openings are free from debris and that heat transfer surfaces are clean.

f. Verify correct connections of circuit boards, wiring, disconnects, and ribbon cables.

g. Motor running protection:

1) Verify drive overcurrent setpoints are correct for their application.

2) If drive is used to operate multiple motors, verify individual overload element ratings are correct for their application.

3) Apply minimum and maximum speed setpoints. Verify setpoints are within limitations of the load coupled to the motor.

h. Inspect bolted electrical connections for high resistance using one of the following methods:

1) Use of low resistance ohmmeter.

2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:

Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.

3) Thermographic survey.

i. Verify correct fuse sizing in accordance with manufacturer's published data.

j. Perform visual and mechanical inspection of input circuit breaker as specified in this Section.

2. Electrical tests:

a. Perform resistance measurements through bolted connections with low-resistance ohmmeter.

b. Test the motor overload relay elements by injecting primary current through the overload circuit and monitoring trip time of the overload element.

c. Perform insulation-resistance tests on control wiring with respect to ground. Applied potential shall be 500 VDC for 300-volt rated cable and 1,000 VDC for 600-volt rated cable. Apply the test voltage for 1 minute:

1) For solid state devices that cannot tolerate the applied voltage, follow the manufacturer's recommendation.

d. Test for the following parameters in accordance with relay calibration procedures specified in this Section or as recommended by the manufacturer:

1) Input phase loss protection.

2) Input overvoltage protection.

3) Output phase rotation.

4) Overtemperature protection.

5) Direct current overvoltage protection.

6) Over frequency protection.

7) Drive overload protection.

8) Fault alarm outputs.

e. Perform continuity tests on bonding conductors as specified in this Section.

f. Perform start-up of drive-in accordance with manufacturer's published data. Calibrate drive to the system's minimum and maximum speed control signals.

g. Perform operational tests by initiating control devices:

1) Slowly vary drive speed between minimum and maximum. Observe the motor and load for unusual noise or vibration.

2) Verify operation of drive from remote start/stop and speed control signals.

h. Perform electrical tests of input circuit breaker as specified in this Section.

3. Test values:

a. Compare bolted connection resistances to values of similar connections:

1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

b. Bolt-torque levels shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

c. Results of the thermographic survey shall be in accordance with NETA ATS requirements.

d. Overload test trip times at 300 percent of overload element rating shall be in accordance with manufacturer's published time-current curve.

e. Test values for input circuit breaker shall be as specified in this Section.

f. Insulation-resistance values for control wiring shall not be less than 2.0 megohms.

g. Relay calibration results shall be as specified in this Section.

h. Continuity of bonding conductors shall be as specified in this Section.

i. Control devices shall perform in accordance with system requirements.

j. Operational tests shall conform to system design requirements.

I. Surge arresters, low-voltage:

1. Visual and mechanical inspection:

a. Compare equipment nameplate data with that indicated on the Drawings and specified in the Specifications.

b. Inspect physical and mechanical condition.

c. Inspect anchorage, alignment, grounding, and clearances.

d. Verify the arresters are clean.

e. Inspect bolted electrical connections for high resistance using one of the following methods:

1) Use of low resistance ohmmeter.

2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:

Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.

f. Verify that the ground lead on each device is individually attached to a ground bus or ground electrode.

g. Verify that stroke counter is correctly mounted and electrically connected, if applicable.

h. Record stroke counter reading.

2. Electrical tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.

b. Perform an insulation-resistance test on each arrester, phase terminal-to-ground:

1) Apply voltage in accordance with manufacturers published data.

2) Refer to NETA ATS tables in the absence of manufacturer's published data.

c. Test grounding connection as specified in this Section.

3. Test values:

a. Compare bolted connection resistances to values of similar connections:

1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

b. Bolt-torque levels shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

c. Insulation resistance values shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

2) Investigate insulation values less than the allowable minimum.

d. Resistance between the arrester ground terminal and the ground system shall be less than 0.5 ohm.

J. Fiber-optic cables:

1. Visual and mechanical inspection:

a. Compare cable, connector, and splice data with that indicated on the Drawings and specified in the Specifications:

b. Inspect cable and connections for physical and mechanical damage.

c. Verify that all connectors and splices are correctly installed.

2. Electrical tests:

a. Perform cable length measurement, fiber fracture inspection, and construction defect inspection using an optical time domain reflectometer (OTDR):

1) OTDR test performed on fiber cables less than 100 meters shall be performed with the aid of a launch cable.

2) Adjust OTDR pulse width settings to a maximum setting of 1/1000th of the cable length or 10 nanoseconds.

b. Perform connector and splice integrity test using an optical time domain reflectometer.

c. Perform cable attenuation loss measurement with an optical power loss test set:

1) Perform attenuation tests with an Optical Loss Test Set capable and calibrated to show anomalies of 0.1 dB as a minimum.

2) Test multimode fibers at 850 nanometer and 1,300 nanometer.

3) Test single mode fibers at 1,310 nanometer and 1,550 nanometer.

d. Perform connector and splice attenuation loss measurement from both ends of the optical cable with an optical power loss test set:

1) At the conclusion of all outdoor splices at one location, and before they are enclosed and sealed, all splices shall be tested with OTDR at the optimal wavelengths (850 and 1,300 for multimode, 1,310 and 1,550 for single mode), in both directions. The splices shall be tested for integrity as well as attenuation.

e. Perform fiber links integrity and attenuation tests using each link shall be an OTDR and an Optical Loss Test Set:

1) OTDR traces shall be from both directions on each fiber at the 2 optimal wavelengths, 850 nanometer and 1,300 nanometer for multimode fibers.

2) Optical loss testing shall be done with handheld test sets in 1 direction at the 2 optimal wavelengths for the appropriate fiber type. Test equipment shall equal or exceed the accuracy and resolution of Agilent/HP 8147 high performance OTDR.

3. Test values:

a. Cable and connections shall not have been subjected to physical or mechanical damage.

b. Connectors and splices shall be installed in accordance with industry standards.

c. The optical time domain reflectometer signal should be analyzed for excessive connection, splice, or cable backscatter by viewing the reflected power/distance graph.

d. Attenuation loss measurement shall be expressed in dB/km. Losses shall be within the manufacturer's recommendations when no local site specifications are available.

e. Individual fusion splice losses shall not exceed 0.1 dB. Measurement results shall be recorded, validated by trace, and filed with the records of the respective cable runs.

K. LAN cable testing:

1. Visual and mechanical inspections:

a. Compare cable type and connections with that indicated on the Drawings and specified in the Specifications.

b. Inspect cable and connectors for physical and mechanical damage.

c. Verify that all connectors are correctly installed.

2. Pre-testing:

a. Test individual cables before installation:

1) Before physical placement of the cable, test each cable while on the spool with a LAN certification test device.

2) Before the cable is installed, verify that the cable conforms to the manufacturer's attenuation specification and that no damage has been done to the cable during shipping or handling.

3) The test shall be fully documented, and the results submitted to the Engineer, including a hard copy of all traces, before placement of the cable.

4) The Engineer shall be notified if a cable fails to meet specifications and the cable shall not be installed unless otherwise directed by the Engineer.

3. Electrical tests:

a. Perform cable end-to-end testing on all installed cables after installation of connectors from both ends of the cable.

b. Test shall include cable system performance tests and confirm the absence of wiring errors.

4. Test results:

a. Cables shall meet or exceed TIA standards for a Category 5e or Category 6 installation, as applicable.

5. Test equipment:

a. LAN certification equipment used for the testing shall be capable of testing Category 6 cable installation to TIA proposed Level III accuracy. Tests performed shall include:

1) Near end cross talk.

2) Attenuation.

3) Equal level far end cross talk.

4) Return loss.

5) Ambient noise.

6) Effective cable length.

7) Propagation delay.

8) Continuity/loop resistance.

b. LAN certification test equipment shall be able to store and produce plots of the test results.

c. Acceptable manufacturers: The following or equal:

1) Agilent Technologies, WireScope 350.

L. Capacitors and reactors, capacitors:

1. Visual and mechanical inspection:

a. Compare equipment nameplate data with that indicated on the Drawings and specified in the Specifications.

b. Inspect physical and mechanical condition.

c. Inspect anchorage, alignment, grounding, and clearances.

d. Verify the unit is clean.

e. Verify that capacitors are electrically connected in their specified configuration.

f. Inspect bolted electrical connections for high resistance using one of the following methods:

1) Use of low-resistance ohmmeter.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method:

Refer to manufacturer's instructions for proper foot-pound levels NETA ATS tables.

3) Perform thermographic survey.

2. Electrical tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter, if applicable.

b. Perform insulation-resistance tests from phase terminal(s) to case for one minute.

1) Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, refer to NETA ATS tables.

c. Measure the capacitance of all terminal combinations.

d. Measure resistance of the internal discharge resistors.

3. Test values:

a. Test values - visual and mechanical:

1) Compare bolted connection resistance values to values of similar connections.

Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Bolt-torque levels shall be in accordance with manufacturer's published data:

Refer to NETA ATS tables in the absence of manufacturer's data.

3) Results of the thermographic survey shall be in accordance with NETA ATS requirements.

b. Test values - electrical:

1) Compare bolted connection resistance values to values of similar connections:

Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Insulation-resistance values shall be in accordance with manufacturer's published data:

Refer to NETA ATS tables in the absence of manufacturer's published data.

Values of insulation resistance less than NETA ATS tables or manufacturer's recommendations should be investigated.

3) Investigate capacitance values differing from manufacturer's published data.

4) Investigate discharge resistor values differing from manufacturer's published data. In accordance with NFPA 70 NEC, Article 460, residual voltage of a capacitor shall be reduced to 50 volts in the following time intervals after being disconnected from the source of supply:

Rated Voltage	Discharge Time
Less than or equal to 600 volts	1 minute
Greater than 600 volts	5 minutes

3.8 ADJUSTING

A. Adjust limit switches and level switches to their operating points before testing.

B. Set pressure switches, flow switches, and timing relays to anticipated values before testing:

1. Final settings shall be as dictated by operating results during testing.

3.9 CLEANING

A. As specified in Section 26 05 00 –Electrical, General.

B. After the acceptance tests have been completed, dispose of all testing expendables, vacuum all cabinets, and sweep clean all surrounding areas.

3.10 DEMONSTRATION AND TRAINING

A. As specified in Section 26 05 00 – Electrical, General.

B. Subsystem demonstration:

1. Subsystem, as used in this Section, means individual and groups of pumps, conveyor systems, chemical feeders, air conditioning units, ventilation fans, air compressors, blowers, lighting control systems and other electrically operated or controlled equipment.

2. Before demonstrating any subsystem:

a. Demonstrate proper operation of all alarm and status contacts.

b. Adjust and calibrate all process and control devices as accurately as possible.

3. Operate each subsystem in its manual mode:

a. Demonstrate compliance with all Contract requirements.

4. After each subsystem has operated successfully in its manual mode, perform automatic and remote operation demonstrations:

a. Verify that all features are fully operational and meet all Contract requirements.

b. Demonstrate all operating modes and sequences, including proper start and stop sequence of pumps, proper operation of valves and proper speed control.

3.11 PROTECTION

A. As specified in Section 26 05 00 – Electrical, General.

3.12 SCHEDULES

A. At least 30 days before commencement of the acceptance tests, submit the manufacturer's complete field testing procedures to the Engineer and to the testing laboratory, complete with expected test results and tolerances for all equipment to be tested.

END OF SECTION 26 08 00

SECTION 26 29 00 - LOW VOLTAGE MOTOR CONTROL CENTERS

PART 1 - GENERAL

1.1 SUMMARY

A. The Contractor shall provide motor control centers (MCC's), complete and operable, in accordance with the Contract Documents. The Contractor shall be responsible for providing MCC's for all equipment relating to the contracted Scope of Supply.

B. In the event that motors sized and provided by the equipment vendor are delivered to the site with larger horsepower than motors indicated on approved shop drawings, raceways, conductors, starters, overload elements, and branch circuit protectors shall be revised as necessary to control and protect the increased motor horsepower according to applicable Sections of Division 26. This work shall be performed by the Contractor at no additional cost to Owner.

1.2 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00 – Submittal Procedures and include the following:

1. Enclosure NEMA rating and color
2. Horizontal and vertical bus amperages, voltage rating and interrupting capacity.
3. Ground bus size and material of construction
4. Conduit entrance provisions
5. Main incoming line entry provision (top or bottom)
6. Control unit nameplate schedule
7. All circuit breaker types, frames and settings
8. All starter NEMA sizes, auxiliary contact provisions, coil voltage
9. Relays, timers, pilot devices, control transformer VA and fuse sizes
10. Elementary schematic ladder diagrams for each compartment. Custom schematics shall be furnished and diagrams shall include all remote devices. Submittals with drawings not meeting this requirement will not be reviewed further and will be returned to the Contractor, stamped "REJECTED - RESUBMIT."
11. Short circuit rating of the complete assembly
12. Replacement parts lists and operation and maintenance procedures

13. Seismic design certification of the anchoring system in accordance with Section 26 05 00 – Electric, General.

14. Time-current curves for all protective devices

1.3 QUALITY ASSURANCE

A. Factory Tests: All motor control centers and their components shall be given manufacturer's standard electrical and mechanical production tests and inspections. The tests shall include electrical continuity check, dielectric tests for each circuit, and inspection for proper functioning of all components including controls, protective devices, metering, and alarm devices.

PART 2 - PRODUCTS

2.1 GENERAL

A. The manufacturer of the low voltage motor control center shall also be the manufacturer of at least the following:

1. Molded case circuit breakers up to and including 225 ampere frame size

2. Disconnect switches

3. Magnetic motor staters

4. Control and timing relays rated at 600 volts AC

5. Pushbuttons, lights and selector switches, including remote mounted control stations

6. Meters, including ammeter, voltmeter, and solid-state metering devices.

B. Devices of the same type shall be products of the same manufacturer. This requirement applies to all control devices, and insofar as practical, to equipment manufactured on a production basis. It also applies without exception to the equipment custom fabricated for this project.

C. Motor control centers shall conform to the standards for NEMA Class IIS, type B diagrams and wiring.

2.2 DESIGN, CONSTRUCTION, AND MATERIAL REQUIREMENTS

A. The motor control centers shall be 600-volt class suitable for operation on a three-phase, 60-Hz system. The system operating voltage and number wires shall be as indicated.

B. The motor control center shall receive power from a three phase switchgear. Power distribution from the MCC shall be 480 volt, three-phase, three-wire, however the MCC shall include provision for termination of an incoming neutral conductor in conformance to NEC requirements for service entrance.

C. Enclosure shall be NEMA Type 1, gasketed enclosure. Compartment doors shall be interlocked with compartment circuit breakers. The interlock shall be fitted with a maintenance override.

D. Size and Arrangement:

1. Motor control centers shall be of mechanical grouping of control center units, assembled into a lineup of control center sections. Each control section shall be nominally 90 inches tall by minimum 20 inches deep.

2. All switches and circuit breakers used as switches shall be located so that the center of the grip of the operating handle of the switch or circuit breaker, when in its highest position, will not be more than 6 feet 7 inches above the floor, including the height of the concrete pad.

E. Components:

1. Busses:

a. A continuous copper ground bus shall be provided with full width of the motor control center line-up.

b. The main horizontal bus shall be tin-plated copper located within an isolated compartment. The bus shall be rated 600 amperes minimum, but in no instance less than the main lug or main breaker frame size.

c. The vertical bus in each section shall consist of a single tin-plated copper conductor per phase with a current capacity of not less than 300 amps. The vertical bus shall be completely isolated and insulated and shall extend the full height of the section wherever possible.

d. All power buses shall be braced to withstand 65,000 amperes, minimum.

2. Wireways: A separate vertical wireway shall be provided adjacent to each vertical unit and shall be covered by a hinged door. Each individual unit compartment shall be provided with a side barrier to permit pulling wire in the vertical wireway without disturbing adjacent unit components.

F. Cabinet:

1. Structural members shall be fabricated of not less than 12-gauge steel and side and top panels and doors shall be not less than 14 gauge steel.

2. Spaces designated as “SPACE” or “BLANK” shall include blank hinged doors and vertical bus bars.

3. Control units inside compartments shall be clearly identified with tags or stencil markings.

4. Each control unit including spares, spaces and blanks, lights, and devices shall be identified by an engraved nameplate.

5. Each motor control center shall be fitted with the manufacturer's nameplate which shall include the NEMA Standard electric rating and other pertinent data, including manufacturer, sales order number, date of manufacturer, and place of manufacture.

6. Where "l" or "U" shaped MCC layouts are indicated, corner compartments shall have similar current and short circuit ratings as functional compartments.

7. Fans, heat exchangers, transformers, capacitors, junction boxes, or other devices may not be mounted on the outside of the motor control center enclosure.

8. Finish for motor control center shall be the manufacturers standard color. The panels shall be given two coats of primer inside and out and two coats of enamel finish.

2.3 MOTOR STARTERS

A. Motor starters shall be mounted in standard motor control center assemblies and shall meet requirements specified in applicable sections of Division 26.

B. Variable-Speed Drives (VFD's) shall be in conformance with Section 26 29 23 - Variable Frequency Motor Controllers.

2.4 MAIN AND FEEDER CIRCUIT BREAKERS (480V)

A. Circuit breakers having a frame size of 150 amperes or less shall be molded-case type with thermal magnetic non-interchangeable, trip-free, sealed trip units.

B. Circuit breakers with a frame size of 225 amperes to 1,200 amperes shall be molded case with interchangeable thermal, and adjustable magnetic trip elements.

C. The interrupting capacity of all main and feeder branch circuit breakers shall be a minimum of 65,000 RMS symmetrical amperes. Service disconnects rated 1000A or more shall provide ground fault protection of equipment.

D. Circuit breaker disconnect operators shall be capable of accommodating three padlocks for locking in the "open" position.

2.5 CONTROL DEVICES

A. All control devices shall conform to the requirements of Section 40 67 00 – Control Panels.

2.6 CURRENT TRANSMITTERS

A. The current transmitters shall measure motor current and output a 4-20 mA signal directly proportional to motor current. Accuracy shall be $\pm$ 0.5% of full scale. Repeatability shall be $\pm$ 0.1% of full scale. The current transmitter shall be mounted in the MCC as indicated. Current Transmitters shall be American Aerospace Model 1006x or equal.

2.7 SPARE PARTS

A. The Contractor shall furnish the following for each MCC:

1. One unit control transformer of each size furnished in magnetic starters installed

2. Three bezels of each color installed for pilot indicators

3. One dozen panel lamps

4. One dozen control fuses of each size installed.

2.8 MANUFACTURERS, OR EQUAL

A. Motor control centers shall be Cutler-Hammer “2100” series, General Electric “8000 Line” or Square D, Model 6.

PART 3 - EXECUTION

3.1 GENERAL

A. The Installing Contractor shall install motor control centers in accordance with manufacturer’s published instructions. Conduit installation shall be coordinated with the design engineer and vendor as-fabricated shop drawings so that all conduit stub-ups are with the area allotted for conduit. Conduit shall be stubbed up in the section that contains the devices to which conductors are terminated.

B. If stored at the Site, motor control centers shall be stored in a clean, dry space. Factory wrapping shall be maintained or an additional heavy plastic cover shall be provided to protect units from dirt, water, construction debris, and traffic. Storage space shall be heated or MCC space heaters shall be energized.

C. Motor control centers shall be handled carefully to avoid damage to motor control center components, enclosure, and finish. Damage shall be repaired before installation.

END OF SECTION 26 29 00

SECTION 26 29 13.13 - ACROSS-THE-LINE-MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes A.C. motor control devices rated 600 V and below that are not supplied as an integral part of a motor control center.

B. Related Sections include the following:

1. Section 26 05 00 – Electrical, General for general materials, installation methods, and labeling.

1.3 SUBMITTALS

A. Product data for products specified in this Section. Include dimensions, ratings, and data on features and components.

B. Maintenance Data: For products to include in the maintenance manuals specified in Division 1.

C. Load Current and Overload Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain similar motor-control devices through one source from a single manufacturer.

B. Comply with NFPA 70, UL, and NEMA.

C. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms “Listed and Labeled”: As defined in the National Electrical Code, Article 100.

1.5 COORDINATION

A. Coordinate features of controllers and control devices with pilot devices and control circuits provided under Divisions 23, 40 – 46 Sections covering control systems.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

1. Spare Fuses and Incandescent Indicating Lamps: Furnish 1 spare for every 5 installed units, but not less than 1 set of 3 of each kind.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Eaton

2. Allen-Bradley Co.; Industrial Control Group.

3. General Electric Co.; Electrical Distribution & Control Div.

4. Square D Co.

2.2 MANUAL MOTOR CONTROLLERS

A. Description: NEMA ICS 2, general purpose, Class A with toggle action and overload element.

2.3 MAGNETIC MOTOR CONTROLLERS

A. Description: NEMA ICS 2, Class A, full voltage, non reversing, across the line, unless otherwise indicated.

B. Control Circuit: 120 V. Provide control power transformer integral with controller where no other supply of 120 V control power to controller is indicated. Provide control power transformer with adequate capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity.

C. Combination Controller: Factory assembled with controller and arranged to disconnect switch with or without overcurrent protection as indicated.

1. Fusible Disconnecting Means: NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 947-4-1, as certified by a nationally recognized testing laboratory.

D. Electronic Overload Relay: Assembly designed to meet the following minimum requirements:

1. NEMA ICS 2, Class 10 tripping characteristics selected to protect motor against voltage unbalance and single phasing.

2. Control Module shall be provided with a minimum of four (4) Inputs and three (3) Relay Outputs.

3. Sensing Module shall be capable of voltage protection, power protection and voltage, power, and energy monitoring.

4. Communication Module providing Ethernet/IP with (2) RJ45 ports that can support a star, linear and ring topologies. Additional functionality shall include:

5. Two (2) concurrent Class 1 connections. (One (1) exclusive owner and one (1) listen only)

6. Six (6) simultaneous Class 3 connections. (Explicit messaging)

7. Embedded EDS file.

8. Studio 5000 Add-on Profile

9. Autotransformer Reduced-Voltage Controller: NEMA ICS 2, closed transition.

E. Overload Relay: NEMA ICS 2, Class 10 tripping characteristics selected to protect motor against voltage unbalance and single phasing.

2.4 ENCLOSURES

A. Description: Flush or surface mounted cabinets as indicated. NEMA 250, Type 12, unless otherwise indicated to comply with environmental conditions at installed location.

1. Outdoor Locations: NEMA 250, Type 3R.

2. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

3. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

2.5 ACCESSORIES

A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.

B. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.

C. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.

D. Control Relays: Auxiliary and adjustable time-delay relays.

E. Phase-Failure and Undervoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection. Provide adjustable undervoltage setting.

F. Current-Sensing, Phase-Failure Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection; arranged to operate on phase failure, phase reversal, current unbalance of from 30 to 40 percent, or loss of supply voltage; with adjustable response delay.

PART 3 - EXECUTION

3.1 APPLICATION

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, drive, and load; and configuration of pilot device and control circuit affecting controller functions.

B. Select horsepower rating of controllers to suit motor controlled.

C. Use fractional-horsepower manual controllers for single-phase motors, unless otherwise indicated.

D. Use manual controllers for 3-phase motors up to 5 hp not requiring automatic or remote control.

E. Pushbutton Stations: In covers of magnetic controllers for manually started motors where indicated, start contact connected in parallel with sealing auxiliary contact for low-voltage protection.

F. Hand-Off-Automatic Selector Switches: In covers of manual and magnetic controllers of motors started and stopped by automatic controls or interlocks with other equipment.

3.2 INSTALLATION

A. Install independently mounted motor-control devices according to manufacturer's written instructions.

B. Location: Locate controllers within sight of motors controlled, unless otherwise indicated.

C. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks .

D. Install freestanding equipment on concrete housekeeping bases conforming to Section 26 05 00 – Electrical, General.

E. Motor-Controller Fuses: Install indicated fuses in each fusible switch.

3.3 IDENTIFICATION

A. Identify motor control components and control wiring in accordance with Section 26 05 00 – Electrical, General.

3.4 CONTROL WIRING INSTALLATION

A. Install wiring between motor control devices in accordance to Division 26 Section "Wires and Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect hand-off-automatic switch and other automatic control devices where available.

1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.5, 7.6, and 7.16. Certify compliance with test parameters.

2. Remove and replace malfunctioning units with new units, and retest.

3.5 CONNECTIONS

A. Tighten connectors, terminals, bus joints, and mountings. Tighten field connected connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, comply with tightening torques specified in UL 486A and UL 486B.

3.6 FIELD QUALITY CONTROL

A. Testing: After installing motor controllers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Sections 7.5, 7.6, and 7.16. Certify compliance with test parameters.

2. Remove and replace malfunctioning units with new units, and retest.

3.7 CLEANING

A. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean devices internally using methods and materials as recommended by manufacturer.

END OF SECTION 26 29 13.13

SECTION 26 29 13.16 – REDUCED-VOLTAGE MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this Section.

1.2 SUMMARY

A. Utilize a 125 HP for blower motors. This soft starter shall be integral to the motor control center, unless otherwise indicated to comply with environmental conditions at installed location, see electrical drawings and division specifications.

B. Related Sections include the following:

1. Section 26 05 00 – Electrical, General for general materials, installation methods, and labeling.

1.3 SUBMITTALS

A. Manufacturer's technical data on features, performance, electrical ratings, characteristics, and finishes. In addition, provide the following:

B. Location of nearest factory authorized service center.

C. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.

D. Wiring diagrams: Power, signal, and control wiring.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and 24-hour emergency maintenance and repairs.

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. Source Limitations: Obtain similar soft start motor controllers through one source from a single manufacturer.

D. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms "Listed and Labeled": As defined in the National Electrical Code, Article 100.

1.5 COORDINATION

A. Coordinate features of controllers and control devices with pilot devices and control circuits provided under the Divisions and Sections covering control systems.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. ABB Power Distribution, Inc.; ABB Control, Inc. Subsidiary.

2. Allen-Bradley Co.; Industrial Control Group.

3. Eaton.

4. Square D Co.

2.2 GENERAL

A. Suitable For use with specified motors, (coordinate with Division 40), providing adjustable acceleration rate control using voltage or current ramp. Provide adjustable starting torque control with up to 450 percent current limitation for 10 seconds. Provide surge suppressor in solid-state power circuits to provide 3-phase protection against damage form supply voltage surges 10 percent or more above nominal line voltage. Provide snubbers to prevent malfunction due to system voltage transients. Provide overload protection for NEMA Class 10 or better. Provide LEDs to indicate motor and control status including control power available, controller on, overload trip, loss of phase, and shorted SCR. In addition, provide the following:

1. Provide automatic voltage reduction controls to reduce voltage when motor is running at light load.

2. Provide a motor running contactor to operate automatically when full voltage is applied to motor. Controller shall operate as a magnetic motor controller except during starting of motor.

3. H-O-A On-Off buttons, ETM and start counter.

4. Voltmeter and amp meter with switches.

5. 0-120 second soft start and soft stop time. Adjust acceleration and deceleration time per Engineer's direction.

6. Provide ancillary items required to meet the following control requirements:

   a. Accept start/stop signal from SCADA system that will be provided by others.

   b. Accept stop signal from pressure switch.

2.3 ENCLOSURES

A. Description: Flush or surface mounted cabinets as indicated. NEMA 250, Type 12, unless otherwise indicated to comply with environmental conditions at installed location.

2.4 ACCESSORIES

A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.

B. Control Relays: Auxiliary and adjustable time-delay relays.

PART 3 - EXECUTION

3.1 APPLICATION

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, drive, and load; and configuration of pilot device and control circuit affecting controller functions.

B. Select horsepower rating of controllers to suit motor controlled.

3.2 EXAMINATION

A. Examine areas, surfaces, and substrates to receive controller for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. All motor controllers to be installed in accordance with NEC, NEMA, UL listing and manufacturer's recommendations.

B. Make necessary control and power wiring connections.

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

D. Location: Locate controllers within sight of motors controlled, unless otherwise indicated.

E. Install freestanding equipment on concrete housekeeping bases conforming to Section 26 05 00 – Electrical, General.

3.4 IDENTIFICATION

A. Identify motor control components and control wiring in accordance with Section 26 05 00 – Electrical, General.

3.5 CONNECTIONS

A. Tighten connectors, terminals, bus joints, and mountings. Tighten field connected connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, comply with tightening torques specified in UL 486A and UL 486B.

3.6 FIELD QUALITY CONTROL

A. Testing: After installing motor controllers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Manufacturer’s Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including pre-testing and adjusting of controller.

2. Remove and replace malfunctioning units with new units, and retest.

3.7 CLEANING

A. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean devices internally using methods and materials as recommended by manufacturer.

3.8 START-UP SERVICE AND DEMONSTATION

A. Engage a factory-authorized service representative to perform startup service.

B. Verify that electrical wiring installation complies with manufacturer’s submittal and installation requirements in Division 26 sections.

C. Complete installation and startup checks according to manufacturer’s written instructions.

D. Set field-adjustable switches.

E. Engage a factory-authorized service representative to train Owner’s maintenance personnel to adjust, operate, and maintain controller.

END OF SECTION 26 29 13.16

SECTION 26 29 23 – VARIABLE-FREQUENCY MOTOR CONTROLLERS)

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes solid-state, PWM and VFD, VFCs for speed control of three-phase, induction motors. These VFCs are to be enclosed in freestanding NEMA 250, Type 12, unless otherwise indicated to comply with environmental conditions at installed location, see Electrical Drawings and Divisions 40-46 and 46 specifications.

B. VFC vendor to provide VFC that will operate at installed altitude. Vendor shall verify altitude.

1.2 SUBMITTALS

A. Product Data: For each type of VFC, provide dimensions; mounting arrangements; location for conduit entries; shipping and operating weights; and manufacturer's technical data on features, performance, electrical ratings, characteristics, and finishes.

B. The following shall be included in the bid package:

1. Description of equipment and tests included in bid to meet the indicated power quality requirements.

2. Nearest factory authorized service center meeting all points of 1.03A.

3. Qualification and name of engineering and technical persons responsible for support and warranty of this project.

C. The following shall be included in the submittal package and be approved by the engineer prior to any construction of the VFC system:

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Each installed unit's type and details.

b. Nameplate legends.

c. Short-circuit current ratings of integrated unit.

d. Features, characteristics, ratings, and factory settings of each motor-control center unit.

2. Wiring Diagrams: Power, signal, and control wiring for VFC. Provide schematic wiring diagram for each type of VFC.

3. Detailed description of the filter equipment and sample graphs and data to meet IEEE 519-1992.

4. Carrier frequency information.

D. Field Test Reports: Written reports specified in Part 3.04D below.

E. Manufacturer's field service report.

F. Operation and Maintenance Data: For VFCs, all installed devices, and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 26 05 00 – Electrical, General, include the following:

1. Routine maintenance requirements for VFCs and all installed components.

2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and 24 hour emergency maintenance and repairs.

B. Source Limitations: Obtain VFCs of a single type through one source from a single manufacturer.

C. The system shall be pre-integrated with the necessary harmonic mitigation equipment.

D. 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.

E. Comply with NFPA 70, IEEE 519-1992, ANSI C37, and ANSI C57.

1.4 COORDINATION

A. Match features of VFCs, installed units, and accessory devices with pilot devices and control circuits to which they connect.

B. Match features, accessories, and functions of each VFC and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load. See Division 40 sections for information on motor control sequence.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: To match existing parts and integration requirements, provide products by the following:

1. Allen Bradley; Rockwell Automation.

2. Eaton

3. Schnieder Electric

4. Siemens

5. Or equal

B. Contractor job site integration of reactors, harmonic filters, power components, etc. may be required. Start-up, harmonic testing and warranty support services must be supplied by the above or other qualified company approved by engineer. Allowable harmonic limits to be coordinated with Avista Utilities.

2.2 VARIABLE FREQUENCY CONTROLLERS

A. Description: NEMA ICS 2, IGBT, PWM, VFD, VFC; listed and labeled as a complete unit and arranged to provide variable speed of a NEMA MG 1, Design B, 3-phase, induction motor by adjusting output voltage and frequency. Refer to Divisions 40 – 43 and 46 for additional information on motors controlled by VFCs.

B. Design and Rating: Match load type such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

C. Output Rating: 3-phase; 6 to 120 Hz, with horsepower constant throughout speed range.

D. Unit Operating Requirements:

1. Input ac voltage tolerance of 480 V, plus or minus 10 percent.

2. Input frequency tolerance of 60 Hz, plus or minus 6 percent.

3. Output Rating: 3-phase; 6 to 66 Hz, with amperage equal or greater to motor nameplate amperage including altitude derating.

4. Minimum Inverter Efficiency: 96 percent at 60 Hz, full load.

5. Minimum Displacement Primary-Side Power Factor: 96 percent lagging.

6. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds.

7. Starting Torque: Default to be 50% with adjustment to 120%.

8. Speed Regulation: Plus or minus 1 percent.

9. Isolated control interface to allow controller to follow control signal over an 11:1 speed range.

E. 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: Adjustable from .01 to 3600 seconds.

4. Deceleration: Adjustable from .01 to 3600 seconds.

5. Current Limit: 50 to a minimum of 110 percent of maximum rating.

F. Self-Protection and Reliability Features:

1. Input transient protection by means of surge suppressors.

2. Snubber networks to protect against malfunction due to system voltage transients.

3. Under- and overvoltage trips; inverter overtemperature, overload, and overcurrent trips.

4. Filtering to prevent noise interference with other electronic equipment.

5. Motor Overload Relay: Adjustable.

6. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.

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.

G. Automatic Reset and Restart: To attempt three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bi-directional autospeed search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.

H. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped. VFC to automatically re-start motor after outage.

I. Carrier Frequency Adjustment: Provide ability to manually adjust drive carrier frequency. VFCs 100HP and less shall provide carrier frequency adjustment capability from 1 to 10kHz. VFCs over 100HP shall include carrier frequency adjustment information recommended by the manufacturer.

J. Torque Boost: Automatically vary starting and continuous torque to at least 1.5 times the minimum torque to insure high-starting torque and increased torque at slow speeds.

K. Motor Temperature Compensation at Slow Speeds: Adjustable current fallback based on output frequency for temperature protection of self-cooled fan-ventilated motors at slow speeds.

L. Provide line and load side filtering to minimize total harmonic distortion.

M. Status Lights: Door-mounted LED indicators shall indicate the following conditions:

1. Power on.
2. Run.
3. Overvoltage.
4. Line fault.
5. Overcurrent.
6. External fault.

N. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual speed control potentiometer and elapsed time meter.

O. Indicating Devices: Meters or digital readout devices and selector switch, mounted flush in controller door and connected to indicate the following controller parameters:

1. Output frequency (Hz).
2. Motor speed (rpm).
3. Motor status (running, stop, and fault).
4. Motor current (amperes).
5. Motor torque (percent).
6. Fault or alarming status (code).
7. PID feedback signal (percent).
8. DC-link voltage (VDC).
9. Set-point frequency (Hz).
10. Motor output voltage (V).

P. Control Signal Interface: Provide VFC with the following:

1. Electric Input Signal Interface: A minimum of 2 analog inputs (0 to 10 V or 0/4-20 mA) and 6 programmable digital inputs.

2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BMS or other control systems:

   a. 0 to 10-V dc.

   b. 0-20 or 4-20 mA.

   c. Potentiometer using up/down digital inputs.

   d. Fixed frequencies using digital inputs.

   e. RS485.

   f. Ethernet connectivity using Ethernet/IP or MODBUS protocol

   g. Keypad display for local hand operation.

   h. Remote start/stop input

3. Output Signal Interface:

   a. Provide two analog output signals (0/4-20 mA), which can be programmed for the following:

   b. Output frequency (Hz).

   c. Output current (load).

   d. DC-link voltage (VDC).

   e. Motor torque (percent).

   f. Motor speed (rpm).

   g. Set-point frequency (Hz).

4. Remote Indication Interface: Provide dry circuit relay outputs (120-V ac, 1 A) for remote indication of the following:

   a. Motor running.

   b. Set-point speed reached.

   c. Fault and warning indication (overtemperature or overcurrent).

   d. PID high or low speed limits reached.

   e. Drive system is in remote.

Q. Integral Disconnecting Means: Provide HACR rated breaker as indicated on drawings.

2.3 ACCESSORIES

A. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.

B. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.

C. Control Relays: Auxiliary and adjustable time-delay relays.

D. Standard Displays:

1. Output frequency (Hz).

2. Set-point frequency (Hz).

3. Motor current (amperes).

4. DC-link voltage (VDC).

5. Motor torque (percent).

6. Motor speed (rpm).

7. Motor output voltage (V).

E. Historical Logging Information and Displays:

1. Real-time clock with current time and date.

2. Running log of total power versus time.

3. Total run time.

4. Fault log, maintaining last four faults with time and date stamp for each.

F. Harmonic Mitigation: Complying with IEEE Standard 519-1992 shall be a requirement of this project. Harmonic filters, 18 pulse converter configurations, phase multiplication devices, or any other components required to mitigate harmonic voltage and current to IEEE Std. 519-1992 shall be an integral part of the VFC system. Designs which are not pre-integrated and factory wired as part of the UL label will not be acceptable.

1. Designs which cause voltage rise at the VFC terminals must document coordination with the total system variation to prevent nuisance tripping.

2. Designs which do not provide both true and displacement, measured at the VFC terminals, of at least 95% or better at full load are not acceptable. Designs that allow leading power factor at minimum loads are not acceptable.

G. Relevant data for VFC vendor calculations to meet IEEE Std. 519-1992 requirements are as follows:

1. The point of common coupling (PCC) shall be defined per 3.01.C below.

2. The calculated load current (I_L) shall be the total combined full load current of each ASD system supplied as part of this project or the total combined amperage of loads designated as "non-linear".

3. The VFC vendor is responsible for determining the short circuit current (I_{SC}) available at the PCC.

2.4 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFCs for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Select features of each VFC to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; and duty cycle of motor, drive, and load.

B. Select rating of controllers to suit motor controlled. The VFC vender shall certify that the supplied equipment is properly matched to the loads being fed.

C. The drive shall be capable of operating in compliance with IEEE 519-1992, with point of common coupling (PCC) defined as the point at which each individual device is connected to the electrical distribution system. Drive manufacturer shall provide harmonic calculations and on-site post installation harmonic testing with certified reports prior to final acceptance of installation. See 3.04D.

3.2 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

3. All tests necessary to prove compliance with IEEE Standard 519-1992.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including pretesting and adjusting VFCs.

C. Test Reports: Prepare a written report to record the following:

1. Test procedures used.

2. Test results that comply with requirements.

3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

3.3 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 26 sections.

C. Complete installation and startup checks according to manufacturer's written instructions.

3.4 ADJUSTING

A. Set field-adjustable switches.

3.5 CLEANING

A. Clean VFCs internally, on completion of installation, according to manufacturer's written instructions. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain VFCs.

END OF SECTION 26 29 23

SECTION 40 05 51 - VALVES, GENERAL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide valves, actuators, and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section shall apply to all valves and valve actuators pertaining to this Work as outlined in Contract Documents. Valves and actuators in particular locations may require a combination of units, sensors, and controls indicated in other sections of the Specifications.

C. Where a valve is to be supported by means other than the piping to which it is attached, the Contractor shall obtain from the valve manufacturer a design for support and foundation that satisfies the criteria in Section 43 05 01 – Equipment General Provisions. The design, including drawings and calculations sealed by an engineer, shall be submitted with the Shop Drawings. When the design is approved, the support shall be provided.

D. Unit Responsibility: A single manufacturer shall be made responsible for coordination of design, assembly, testing, and furnishing of each valve; however, the Contractor shall be responsible to the Owner for compliance with the requirements of each valve section. Unless indicated otherwise, the responsible manufacturer shall be the manufacturer of the valve.

E. Single Manufacturer: Where two or more valves of the same type and size are required, the valves shall be furnished by the same manufacturer.

1.2 REFERENCE STANDARDS

A.	ANSI B1.20.1	Pipe Threads, General Purpose
B.	ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings
C.	ANSI B16.5	Pipe Flanges and Flanged Fittings
D.	ANSI B16.18	Cast Copper Alloy Solder Joint Pressure Fittings Class 25, 125, 250 and 800
E.	AWWA C111	Rubber-Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings
F.	AWWA C207	Steel Pipe Flanges for Waterworks Service - Sizes 4 through 144 IN
G.	NEMA	Motors and Generators

1.3 SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Shop Drawings: Shop Drawings shall contain the following information:

1. Valve name, size, Cv factor, pressure rating, identification number (if any), and specification section number.

2. Complete information on valve actuator, including size, manufacturer, number, limit switches, and mounting.

3. Cavitation limits for control valves.

4. Assembly drawings showing part nomenclature, materials, dimensions, weights, and relationships of valve handles, handwheels, position indicators, limit switches, integral control systems, needle valves, and control systems.

5. Data in accordance with Section 40 05 93 – Motor Requirements for Process Equipment.

6. Complete wiring diagrams and control system schematics.

7. Valve Labeling: A schedule of valves to be furnished with stainless steel tags, indicating in each case the valve location and the proposed wording for the label.

8. Certification that products being used under meet requirements of standards referenced.

C. Operation and Maintenance Data: Provide in accordance with Section 01 78 23 – Operation Maintenance Data.

D. Spare Parts List: A Spare Parts List shall contain the required information for each valve assembly, where indicated.

E. Factory Test Data: Where indicated, signed, dated, and certified factory test data for each valve requiring certification shall be submitted before shipment of the valve. The data shall also include certification of quality and test results for factory-applied coatings.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Valve manufacturers shall have a successful record of not less than five (5) years in the manufacture of the valves indicated.

B. Valve Testing: As a minimum, unless otherwise indicated or recommended by the reference Standards, valves 3-inches in diameter and smaller shall be tested in accordance with manufacturer's standard, larger valves shall be factory tested as follows:

1. Hydrostatic Testing: Valve bodies shall be subjected to internal hydrostatic pressure equivalent to twice the water rated pressure of the valve. Metallic valves rating pressures shall be at 100 degrees F and plastic valves shall be at 73-degrees, higher temperature according to type of material. During the hydrostatic test, there shall be no leakage through the valve body, end joints, or shaft seals, nor shall any part of the valve be permanently deformed. The duration shall be sufficient time to allow visual examination for leakage. Test duration shall be at least 10 minutes.

2. Seat Testing: Valves shall be tested for leaks in the closed position with the pressure differential across the seat equal to the water rated pressure of the valve. The duration of test shall be sufficient time to allow visual examination for leakage. Test duration shall be at least 10 minutes. Leakage past the closed valve shall not exceed 1 fluid ounce per hour per inch diameter for metal seated valves and drop-tight for resilient seated valves.

3. Performance Testing: Valves shall be shop operated from fully closed to fully open position and reverse under no-flow conditions in order to demonstrate the valve assembly operates properly.

C. Certification: Prior to shipment, the Contractor shall submit for valves over 12- inches in size, certified, notarized copies of the hydrostatic factory tests, showing compliance with the applicable standards of AWWA, ANSI, or ASTM.

PART 2 - PRODUCTS

2.1 GENERAL

A. All valves used in potable water systems shall be NSF/ANSI 61 certified and compliant with 14 and 372.

2.2 PRODUCTS

A. Valves and gates shall be new and of current manufacture. Shut-off valves 6-inches and larger shall have actuators with position indicators. Gate valves 18-inches and larger or where chain wheel is required, shall be furnished with spur gear and hand wheel. Buried valves shall be provided with valve boxes and covers containing position indicators and valve extensions. Manual shut-off valves mounted higher than 7-feet above working level shall be provided with chain actuators.

B. Valve Actuators: Unless otherwise indicated, valve actuators shall be in accordance with Section 40 05 57 – Actuators for Process Valves and Gates.

C. Protective Coating: The exterior surfaces of all valves and the wet interior surfaces of ferrous valves of sizes 4-inches and larger shall be coated in accordance with manufacturer's written instructions. The valve manufacturer shall certify in writing that the required coating has been applied and tested in the manufacturing plant prior to shipment. Flange faces of valves shall not be epoxy coated.

D. Valve Labeling: Except when such requirement is waived by the Engineer in writing, a label shall be provided on shut-off valves and control valves except for hose bibbs. The label shall be of 1/16-inch plastic or stainless steel, minimum 2-inches by 4-inches in size and shall be permanently attached to the valve or on the wall adjacent to the valve as directed by the Engineer.

E. Valve Lining: Each valve shall be lined with the same material required for the pipeline in which the valve is installed.

2.3 MATERIALS

A. Materials shall be suitable for the intended application. Materials in contact with potable water shall be listed as compliant with NSF Standard 61. Materials not indicated shall be high-grade standard commercial quality, free from defects and imperfections that might affect the serviceability of the product for the purpose for which it is intended. Unless otherwise indicated, valve and actuator bodies shall conform to the following requirements:

1. Cast Iron: Close-grained gray cast iron, conforming to ASTM A 48 - Gray Iron Castings, Class 30, or to ASTM A 126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

2. Ductile Iron: ASTM A 536 - Ductile Iron Castings, or to ASTM A 395 - Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.

3. Steel: ASTM A 216 - Steel Castings, Carbon Suitable for Fusion Welding for High- Temperature Service, or to ASTM A 515 - Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service.

4. Bronze: ASTM B 62 - Composition Bronze or Ounce Metal Castings, and valve stems not subject to dezincification shall conform to ASTM B 584 - Copper Alloy Sand Castings for General Applications.

5. Stainless Steel: Stainless steel valve and operator bodies and trim shall conform to ASTM A 351 - Steel Castings, Austenitic, for High-Temperature Service, Grade CF8M, or shall be Type 316 stainless steel.

6. PVC: Poly Vinyl Chloride materials for valve body, flanges, and cover shall conform to Cell Classification 12454.

7. CPVC: Chlorinated Poly Vinyl Chloride materials for valve body, flanges, and cover shall conform to Cell Classification 23447.

2.4 VALVE CONSTRUCTION

A. Bodies: Valve bodies shall be cast, molded (in the case of plastic valves), forged, or welded of the materials indicated, with smooth interior passages. Wall thicknesses shall be uniform in agreement with the applicable standards for each type of valve, without casting defects, pinholes, or other defects that could weaken the body. Welds on welded bodies shall be done by certified welders and shall be ground smooth. Valve ends shall be as indicated, and be rated for the maximum temperature and pressure to which the valve will be subjected.

B. Valve End Connections: Unless otherwise indicated, valves 2-1/2 inches diameter and smaller may be provided with threaded end connections. Valves 3-inches and larger shall have flanged end connections.

C. Bonnets: Valve bonnets shall be clamped, screwed, or flanged to the body and shall be of the same material, temperature, and pressure rating as the body. The bonnets shall have provision for the stem seal with the necessary glands, packing nuts, or yokes.

D. Stems: Valve stems shall be of the materials indicated, or, if not indicated, of the best commercial material for the specific service, with adjustable stem packing, O-rings, Chevron V-type packing, or other suitable seal. Where subject to dezincification, bronze valve stems shall conform to ASTM B 62, containing not more than 5 percent of zinc or more than 2 percent of aluminum, with a minimum tensile strength of 30,000 psi, a minimum yield strength of 14,000 psi, and an elongation of at least 10 percent in 2 inches.

E. Stem Guides: Stem guides shall be provided per the manufacturer's recommendations. Submerged stem guides shall be 304 stainless steel.

F. Internal Parts: Internal parts and valve trim shall be as indicated for each individual valve. Where not indicated, valve trim shall be of Type 316 stainless steel or other best suited material.

G. Nuts and Bolts: Nuts and bolts on valve flanges and supports shall be in accordance with Section 43 05 50 – Equipment Mounting.

2.5 VALVE ACCESSORIES

A. Valves shall be furnished complete with the accessories required to provide a functional system.

2.6 SPARE PARTS

A. The Contractor shall furnish the required spare parts suitably packaged and labeled with the valve name, location, and identification number. The Contractor shall also furnish the name, address, and telephone number of the nearest distributor for the spare parts of each valve. Spare parts are intended for use by the Owner, after expiration of the correction of defects period.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to installation, inspect interconnecting piping and end connections to ensure compatibility.

B. Prior to installation, inspect and verify condition of valve and appurtenances. Installation constitutes installer's acceptance of product condition for satisfactory installation.

C. Ensure exposed piping is sufficiently supported to bear weight of valve when it is installed.

3.2 PREPARATION

A. Correct defects or conditions, which may interfere with or prevent a satisfactory installation.

3.3 VALVE INSTALLATION

A. Valves, actuating units, stem extensions, valve boxes, and accessories shall be installed in accordance with the manufacturer's written instructions and as indicated. Gates shall be adequately braced to prevent warpage and bending under the intended use. Valves shall be firmly supported to avoid undue stresses on the pipe.

B. Access: Valves shall be installed with easy access for actuation, removal, and maintenance and to avoid interference between valve actuators and structural members, handrails, or other equipment.

C. Valve Accessories: Where combinations of valves, sensors, switches, and controls are indicated, the Contractor shall properly assemble and install such items so that systems are compatible and operating properly. The relationship between interrelated items shall be clearly noted on Shop Drawing submittals.

END OF SECTION 40 05 51

SECTION 40 05 57 – ACTUATORS FOR PROCESS VALVES AND GATES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide all valve actuators and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section shall apply to all valves and gates, except where otherwise indicated in the Contract Documents. This Section includes manual operators and motorized valve operators, and mechanical, gear type limit switches.

C. Unit Responsibility: A single manufacturer shall be responsible for furnishing and coordinating design, assembly, testing, and installation of each type of valve and gate; however, the Contractor shall be responsible to the Owner for compliance with the requirements of each valve and gate section.

D. Single Manufacturer: Where two or more valve or gate actuators of the same type or size are required, the actuators shall all be produced by the same Manufacturer.

1.2 REFERENCE STANDARDS

A. Unless otherwise indicated and where applicable, all actuators shall be in accordance with ANSI/AWWA C540 - AWWA Standard for Power-Actuating Devices for Valves and Sluice Gates.

B. National Electrical Manufacturer's Association (NEMA).

1.3 SUBMITTALS

A. Submittals shall be furnished in accordance with Section 01 33 00 – Submittal Procedures and Section 40 05 51 - Valves, General.

B. Shop Drawings: Shop Drawings of all actuators shall be submitted together with the valve and gate submittals as a complete package.

C. Motorized valve submittals shall include the following:

1. Installation list of similar municipal applications with contacts and phone numbers to verify experience.

2. Shop drawings and product data.

3. Motor, gear type and design information.

4. Design Data shall include:

a. Operating calculations for max break and max dynamic torques and minimum safety factor at which degree of valve opening and at break.

b. Submit data and calculations to substantiate operating time.

c. Submit proposed operator configuration and dimensions for each valve.

5. Wiring Schematics.

6. Manufacturer's published installation instructions.

7. Submit Operation and Maintenance Manuals in accordance with Section 01 78 23 – Operation and Maintenance Data.

8. Warranty.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. The motorized operators offered for this project shall have a minimum of 5 years of commercial use in municipal wastewater installations of a similar scope and use. New and prototype hardware/software will not be accepted.

2. Submit evidence of satisfactory operation of the proposed product in at least five separate facilities in accordance with the following requirements. Include contact names and phone numbers.

PART 2 - PRODUCTS

2.1 GENERAL

A. All valve and gate actuators shall comply with the requirements of Section 40 05 51 – Valves, General.

B. Unless otherwise indicated, all shut-off and throttling valves, and externally actuated valves and gates, shall be provided with manual or power actuators. The Contractor shall furnish all actuators complete and operable with mounting hardware, motors, gears, controls, wiring, solenoids, handwheels, levers, chains, and extensions, as applicable. All actuators shall be capable of holding the valve in any intermediate position between fully-open and fully-closed without creeping or fluttering. All wires of motor-driven actuators shall be identified by unique numbers.

C. Where indicated, certain valves and gates may be provided with actuators manufactured by the valve or gate Manufacturer. Where actuators are furnished by different manufacturers, the Contractor shall coordinate selection to have the fewest number of manufacturers possible.

D. Materials: All actuators shall be current models of the best commercial quality materials and liberally-sized for the maximum expected torque. All materials shall be suitable for the environment in which the valve or gate is to be installed.

E. Mounting: All actuators shall be securely mounted by means of brackets or hardware specially designed and sized for this purpose and of ample strength. The word "open" shall be cast on each valve or actuator with an arrow indicating the direction to open in the counter-clockwise direction. All gear and power actuators shall be equipped with position indicators. Where possible, manual actuators shall be located between 48 and 60 inches above the floor or the permanent working platform.

F. Functionality: Electric and pneumatic actuators shall be coordinated with power and instrumentation equipment indicated elsewhere in the Contract Documents.

2.2 MANUAL ACTUATORS

A. Unless otherwise indicated, all valves and gates shall be furnished with manual actuators as specified below:

1. Valves up to and including 4 inches in diameter shall have direct acting lever or handwheel actuators of the manufacturer's best standard design.

2. Larger valves and gates shall have gear-assisted manual actuators, with a maximum operating pull of 60 pounds on the rim of the handwheel.

a. Above ground valves 6-inches to 24-inches in diameter may have traveling nut actuators, worm-gear actuators, spur- or bevel-gear actuators, as appropriate for each valve.

b. Above ground valves 30-inches in diameter and greater and valves for pressures higher than 250 psi shall have totally enclosed worm-gear actuators.

~~c.~~ Buried and submerged valves, gates, and other valves as indicated shall have totally enclosed worm-gear actuators, hermetically-sealed water-tight and grease-packed.

B. Buried Valves: Unless otherwise indicated, buried valves shall have extension stems to grade, with square nuts or floor stands, position indicators, and cast-iron or steel pipe extensions with valve boxes, covers, and operating keys. Where so indicated, buried valves shall be in cast-iron, concrete, or similar valve boxes with covers of ample size to allow operation of the valve actuators. Covers of valve boxes shall be permanently labeled as required by the local Utility Company or the Engineer. Wrench-nuts shall comply with AWWA C500 – Metal-Seated Gate Valves for Water Supply Service.

C. Chain Actuator: Manually-activated valves with the stem located more than 7-feet above the floor or operating level shall be furnished with chain drives consisting of sprocket-rim chain wheels, chain guides, and operating chains, and be provided by the valve Manufacturer. The wheel and guide shall be of ductile-iron, cast-iron, or steel, and furnish heavy-duty, Type 304 stainless steel operating chain looped to extend within 3-feet of the operating floor level. The valve stem of chain-actuated valves shall be extra strong to allow for the extra weight and chain pull. Hooks shall be provided for chain storage where chains interfere with pedestrian traffic.

D. Floor Boxes: Hot-dip galvanized cast-iron or steel floor boxes and covers to fit the slab thickness shall be provided for all operating nuts in or below concrete slabs. For operating nuts in the concrete slab, the cover shall be bronze-bushed.

E. Manual Worm-Gear Actuator: The actuator shall consist of a single or double reduction gear unit contained in a weather-proof cast-iron or steel body with cover and minimum 12-inch diameter handwheel. The actuator shall be capable of 90-degree rotation and shall be equipped with travel stops capable of limiting the valve opening and closing. The actuator shall consist of spur or helical gears and worm-gearing. The spur or helical gears shall be of hardened alloy steel and the worm-gear shall be alloy bronze. The worm-gear shaft and the handwheel shaft shall be of stainless steel. All gearing shall be accurately cut with hobbing machines. Ball or roller bearings shall be used throughout. Actuator output gear changes shall be mechanically possible by simply changing the exposed or helical gear set ratio without further disassembly of the actuator. All gearing shall be designed for a 100 percent overload.

2.3 ELECTRIC MOTOR ACTUATORS

A. Where electric motor actuators are indicated, an electric motor-actuated valve control unit shall be attached to the actuating mechanism housing by means of a flanged motor adaptor piece.

B. Design:

1. The actuators shall be suitable for use on a nominal 480 volt, 3 phase, 60Hz power supply and are to incorporate motor, integral reversing starter, local control facilities and terminals for remote control and indication connections housed within a self-contained, sealed enclosure.

2. Meet applicable AWWA requirements and meet the requirements set out in EN15714-2 and ISA SP96.02.

3. The actuator shall be sized to guarantee valve closure. The safety margin of motor power available for seating and unseating the valve shall be sufficient to ensure torque switch trip at maximum valve torque with the supply voltage 10% below nominal. For linear operating valves, the operating speed shall be such as to give valve closing and opening at approximately 10-12 inches per minute unless otherwise stated in the data sheet. For quarter turn valve types, the operating time will be a maximum of 60 seconds.

4. Handwheels for Manual Operation:

a. Metallic with arrows to indicate "open" rotation; incapable of rotation during motor operation; unaffected by fused motor, being mechanically independent of the motor drive; maximum 80 pound pull on rim for manual operation. Actuators shall be fitted with 2-inch AWWA nut for portable operator. When in the manual operating mode, actuator to remain in this mode until motor is energized, at which time the actuator shall automatically return to electric operation.

5. Declutch Lever: Padlockable, capable of mechanically disengaging motor and related gearing positively when motor is de-energized and freeing handwheel for manual operation.

   a. Do not share any gearing between motor operation and handwheel operation.

   b. Design so that simultaneous manual and motor operation is impossible.

6. Motorized operators shall be provided with an integrally mounted communication module within the actuators, to allow non-intrusive set up, double sealed electrical housing and shall not require access after factory fitting. In order to maintain the integrity of the enclosure, setting of the torque levels, position limits and configuration of the indication contacts etc. shall be carried out without the removal of any actuator covers and without mains power over an Infra-red or *Bluetooth*® wireless interface. Sufficient commissioning tools shall be provided with the actuators and must meet the enclosure protection and certification levels of the actuators. Commissioning tools shall not form an integral part of the actuator and must be removable for secure storage. In addition, provision shall be made for the protection of configured actuator settings by a means independent of access to the commissioning tool. Provision shall be made to disable *Bluetooth*® communications or only allow a *Bluetooth*® connection initiated by an Infra-Red command for maximum security.

   a. Each operator shall have independent HAND-OFF-AUTO selector switch and OPEN-CLOSE control devices that are wired to the motor starter circuit and completely isolated and independent of the valve actuator remote control network.

   b. The actuator shall include a device to ensure that the motor runs with the correct rotation for the required direction of valve travel irrespective of the connection sequence of the power supply.

7. The complete motorized operator enclosure shall be:

   a. NEMA 4 and NEMA 6 submersible to IP68 (20 feet of head for 72 hours). Actuators shall be suitable for indoor and outdoor use. The actuator shall be capable of functioning in an ambient temperature ranging from -6°C (22°F) to 70°C (158°F), up to 100% relative humidity.

   b. Actuators for hazardous area applications shall meet the area classification, gas group and surface temperature requirements specified in data sheet.

   c. Equipped with a separately sealed (double “O” ring) terminal area, such that with the terminal cover removed the actuator’s internal components are protected from environmental moisture and dust during storage and “no-power” conditions, start-up and working life. Enclosure must allow for temporary site storage without the need for electrical supply connection.

   d. All external fasteners shall be stainless steel.

C. Actuator Gearing:

1. Meet applicable AWWA requirements.

2. Single reduction type with hardened alloy steel worm gear, and aluminum bronze worm gear set; self-locking to maintain gate position.

3. Power Gearing: Accurately cut to assure minimum backlash; anti-friction bearing with caged balls or rollers throughout.

4. Stem Nuts: High tensile aluminum bronze; accurately machined and mounted in heavy ball or roller bearings.

5. Actuator Gear Housing: Aluminum housing with a separate cast iron thrust base.

6. Lubrication: Rotating power train components immersed in oil with provisions for inspection and re-lubrication without disassembly.

   a. Lubricants: Suitable for ambient conditions of -20 degrees F to +150 degrees F.

   b. Provide seals on shafting. All seals, feed throughs, and bearings shall provide sealing such that the actuator can be mounted in any position with no leakage of oil. Secondary gearboxes shall be externally attached to the actuator to accommodate variations in output speeds, torques or operating times and for use with quarter-turn valves. These multi-turn and quarter-turn gearboxes are to use accurately cut gears suitable for motor drive.

D. Motors:

1. The motor shall an integral part of the actuator, designed specifically for valve actuator applications. It shall be a low inertia high torque design, class F insulated with a class B temperature rise giving a time rating of 15 minutes at 40°C (104°F) at an average load of at least 33% of maximum valve torque. Where the total cycle time (two complete strokes) is longer than 15 minutes then NEMA Class H motor for 30 minute duty rating is to be used, with a maximum continuous temperature rating of 125 degrees C rise over ambient Temperature shall be limited by 2 thermostats embedded in the motor end windings and integrated into its control. Type: Specifically designed for gate actuator service with high starting torque, low inertia, totally enclosed, non-ventilated construction.

2. Protection shall be provided for the motor as follows:

   a. Stall - the motor shall be de-energized within 8 seconds in the event of a stall when attempting to unseat a jammed valve.

   b. Over temperature - thermostat will cause tripping of the motor. Auto-reset on cooling.

   c. Single phasing - lost phase protection

   d. Direction – phase rotation correction

3. Motor Windings: Epoxy treated.

4. Size: Sufficient to provide the maximum torque required for valve opening/closing operation, with a safety factor of 1.5. Torque shall be based on the valve manufacture's calculated torque required for opening/closing at full differential and maximum valve dynamic torque.

5. Voltage Tolerance: Capable of operating at within 10 percent of specified voltage.

6. Motor Starters:

   a. For Open-Close Service: Self-contained electromechanical reversing starter suitable for 60 starts/hr.

   b. For Modulating Service: Self-contained solid-state reversing starter suitable for 1,200 starts per hour. The hammer action will be replaced by a direct drive.

7. Accessories: Internal thermal contacts embedded in the motor windings for detecting motor overload and a ground lug.

8. Power Supply: As scheduled or as indicated on the Drawings.

9. Enclosures for Motors, Switches, and Other Electrical Compartments shall be:

   a. In Class 1, Division 1 or Division 2, classified areas or where indicated in the Motorized Operator Schedule: NEMA 7 and NEMA 6 submersible to IP68.

   b. In other locations: NEMA 4 and NEMA 6 submersible to IP68.

   c. Terminal compartment shall have three threaded cable entries as a minimum. Provide additional threaded entries if required or indicated on the Drawings.

E. Controls:

1. Voltage Transformer:

   a. As required to step down power supply to control voltage.

   b. Size voltage transformer to provide 24VDC or 120 VAC control power, for customer signals, indication and interlock relays as needed with 25 percent spare capacity or 15 VA, whichever is greater, for the multi-turn actuator.

2. Control Station:

   a. Integral with operator. Enclosures shall be:

      1) In Class 1, Division 1 or Division 2 classified areas: NEMA 7 and NEMA 6 submersible to IP68.

      2) In other locations: NEMA 4 and NEMA 6 submersible to IP68.

   b. Provided with Following Devices:

      1) HAND-OFF-AUTO selector switch, lockable in the OFF position.

      2) OPEN and CLOSE pushbuttons.

      3) OPEN and CLOSE indicating lights.

3. Torque Sensing:

   a. Torque and thrust loads in both closing and opening directions shall be limited by a torque sensing device.

   b. Torque setting: 40 percent to 100 percent rated torque, adjustable in 1% increments and indicated locally.

4. Electric Circuit Diagrams:

   a. Identical regardless of whether gates are to open or close on torque or position limit.

   b. Non-intrusive calibration-adjustment and interrogation of the actuator shall be accomplished without the removal of any of the actuator's covers. Non-intrusive calibration, adjustment & interrogation will be by means of a setting tool to provide speedy interrogation capabilities as well as security. The setting tool shall be in a non-intrusive intrinsically safe watertight casing. In addition it shall be possible to use a PDA or laptop.

5. Valve Position/Actuator Status Indication:

   a. The actuator shall provide a local display of the position of the valve, even when the power supply is not present.

   b. In the event of a (main) power (supply) loss or failure, the position contacts shall continue to be able to supply remote position feedback and maintain interlock capabilities.

   c. Absolute position measurement should be incorporated within the actuator. The technology must be capable of reliably measuring position even in the case of a single fault. The design must be simple with the minimum amount of moving parts (no more than 5). Technologies such as LEDs or potentiometers for position measurement are considered unreliable and therefore not preferred. The position of the actuator and valve shall be updated contemporaneously, even when the power supply is not present.

d. Four contacts shall be provided which can be selected to indicate any position of the valve; Provision shall be made for the selection of a normally closed or open contact form. Contacts shall maintain and update position indication during handwheel operation when all external power to the actuator is isolated. The contacts shall be rated at 5 Amps, 250 VAC, 30 VDC. Provision shall be made in the design for an additional eight contacts having the same functionality. A configurable monitor relay shall be provided as standard, which can be used to indicate either Availability or Fault. The relay should be a spring return type with a Normally Open / Normally Closed contact pre-wired to the terminal bung.

e. As an alternative to providing valve position, any of the above contacts shall be selectable to signal one of the following:

1) Valve Opening or Closing.

2) Motor Tripped on Torque in Mid Travel.

3) Motor Stalled.

4) Actuator Being Operated by Handwheel.

f. For actuators in modulating service, provide a controller that will accept a 4-20 mA analog signal. Additionally, a 4-20 mA position transmitter shall be included to provide a valve position feedback. The controller shall compare the input signal with the feedback signal to produce an error signal. The controller shall cause the motor to move the valve or gate in a direction so as to reduce the magnitude of the error signal. The controller positioning accuracy shall be plus or minus 1.0 percent of travel or better. It shall be possible to adjust Dead Band (0 to 9.9 percent of travel) and a Motion Inhibit Timer (2 to 99 seconds), and select action upon loss of signal, open/close/stay put.

6. Integral Starter and Transformer

a. The reversing starter, control transformer and local controls shall be integral with the valve actuator, suitably housed to prevent breathing and condensation. The starter shall be suitable for 60 starts per hour and of rating appropriate to motor size. The controls supply transformer shall be fed from two of the incoming three phases and incorporate overload protection. It shall have the necessary tapping and be adequately rated to provide power for the following functions:

1) Energizing of the contactor Coils

2) 24VDC or 110V AC output for remote controls (maximum 5W/VA)

3) Supply for all internal electrical circuits

7. Local Position Indication:

   a. The actuator display shall include a dedicated numeric/symbol digital position indicator displaying valve position from fully open to fully close in 0.1% increments. Valve closed and open positions shall be indicated by symbols showing valve position in relation to the pipework to ensure that valve status is clearly interpreted. With mains power connected, the display shall be backlit to enhance contrast at all ambient light levels and shall be legible from a distance of at least 5m (16ft).

   b. Red, green, and yellow LEDs corresponding to open, closed and intermediate valve positions shall be included on the actuator display when power is switched on. The yellow LED should also be fully programmable for on/off, blinker and fault indication. The digital display shall be maintained and updated during handwheel operation when mains power to the actuator is isolated.

   c. The actuator display shall include a fully configurable dot-matrix display element with a minimum pixel resolution of 168 x 132 to display operational, alarm, configuration and graphical datalogger information. The text display shall be selectable between English and other languages such as: Spanish, German, French, and Italian. Provision shall be made to upload a different language without removal of any covers or using specialized tools not provided as standard with the actuator Local Display: Large enough to be readable from a distance of six feet when the actuator is powered up. It shall be possible to rotate the display in 90 degree increments to compensate for the actuators installed position.

   d. Each actuator shall include a Data Logger to provide diagnostic information for maintenance & preventative maintenance purposes, including torque curves for both open & close strokes. This information is to be accessed by means of a) the setting tool, b) PDA or c) laptop, and in a format that can be saved electronically or on paper and then viewed at a later date. The software to achieve this and any updates to the software are to be supplied at no extra cost to the end user. Datalogger graphical displays should as a minimum be able to display log and trend graphs on the local LCD for the following:

      1) Torque versus Position

      2) Number of Starts versus Position

      3) Number of starts per hour

      4) Dwell Time

      5) Average temperature.

   e. The main display shall be capable of indicating 4 different home-screens of the following configuration:

      1) Isolation and status

2) Position and torque (analogue)

3) Position and torque (digital)

4) Position and demand (positioning).

F. Operation:

1. Controller System: Rated as follows:

a. Open-Close Service - 60 starts per hour (minimum).

b. Modulating Service - 1,200 starts per hour (minimum).

G. Manufacturers:

1. Intelligent electric actuators with torque output requirements of 750 ft-lbs and less for butterfly valves and eccentric plug valves shall be quarter turn type. Acceptable manufactures include:

a. Rotork “IQT Series”

b. Limitorque “QX”

c. EIM “HQ Series”

2. Intelligent electric actuators for open-close service shall be multi-turn type. Acceptable manufacturers include:

a. Rotork “IQ Series”

b. Limitorque “MX”

c. EIM “TEC 2000”

3. Intelligent electric actuators for modulating service shall be as follows:

a. Rotork “IQ Series”

b. Limitorque “MX”

c. EIM “TEC 2000”

4. Intelligent actuators for explosion proof service shall be as follows:

a. Rotork “IQ Series”

b. Limitorque “MX”

c. EIM “TEC 2000”

PART 3 - EXECUTION

3.1 GENERAL

A. Field representatives of manufacturers of valves or gates with electric actuators shall adjust actuator controls and limit switches in the field for the required function.

B. All valve and gate actuators and accessories shall be installed in accordance with Section 40 05 51 - Valves, General. Actuators shall be located to be readily accessible for operation and maintenance, without obstructing walkways. Actuators shall not be mounted where shock or vibrations will impair their operation, nor shall the support systems be attached to handrails, process piping, or mechanical equipment.

3.2 SOURCE QUALITY CONTROL

A. Factory test each motorized operator assembly in accordance with AWWA C540, except as modified herein.

B. Demonstrate that the stroke time is within the specified range.

C. Verify limit switch and torque switch functions in both directions.

D. Provide individual factory test certificates for each motorized actuator at no additional cost. Record the following parameters as a minimum.

1. No load current.
2. Current at maximum torque setting.
3. Stall current.
4. Torque at maximum torque setting.
5. Stall torque.
6. Test voltage and frequency.
7. Flash test voltage.
8. Actuator output speed.

E. Record details of specification, such as gear ratios for both manual and automatic drive, closing direction, wiring diagram, and serial number on the test certificates.

F. Require the motorized actuator manufacturer to submit certified statements that proof-of-design tests were carried out per the “Valve Actuator” section of AWWA C540 and that all requirements were successfully met.

3.3 INSTALLATION

A. Install operators in accordance with manufacturer's instructions.

3.4 MANUFACTURER'S FIELD SERVICES

A. Coordinate field service work with Owner and Engineer prior to initiating such work.

B. Contractor shall furnish a qualified Manufacturer's Representative to provide manufacturer's field services for inspection, testing, equipment startup, and operator training.

C. Require manufacturer's representative to perform the following services as described below and as specified in Section 01 75 00 - Equipment Testing and Startup Procedures.

1. Installation Assistance:

a. Advise/observe the Contractor on the installation of motorized operators.

b. Check and verify that installation of the motorized operators is in accordance with the Drawings and manufacturer's installation instructions.

c. Provide additional assistance as required.

2. Provide a 2-year warranty from date of substantial completion for the project.

3. Training: Provide a minimum of four (4) hours of training for the Owner's staff on the operation and maintenance of electric operated gates and valves.

3.5 COMMISSIONING KIT

A. Each actuator shall be supplied with a start-up kit comprising installation instruction manual, electrical wiring diagram and cover seals to make good any site losses during the commissioning period. In addition, sufficient actuator commissioning tools shall be supplied to enable actuator set up and adjustment during valve/actuator testing and site installation commissioning.

END OF SECTION 40 05 57

SECTION 40 05 62 - PLUG VALVES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide plug valves and appurtenances, complete and operable, in accordance with the Contract Documents.

1.2 REFERENCE STANDARDS

A. ASTM A 126 Gray Iron Castings for Valves

B. ASTM A 536 Ductile Iron Castings

1.3 SUBMITTALS

A. The Contractor shall furnish submittals in accordance with Section 40 05 51 – Valves, General.

B. Contractor shall indicate actuator position for each valve in submittal. Valves installed in horizontal piping shall have the plug swing upward when opening, no exceptions.

PART 2 - PRODUCTS

2.1 ECCENTRIC PLUG VALVES (1/2 INCH TO 72-INCH)

A. Construction: Eccentric plug valves shall be of the non-lubricated, eccentric plug design with cast iron bodies conforming to ASTM A 126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings, with ANSI 125 lb. flanged ends for valves 3-inch and larger, and screwed or flanged ends for smaller sizes.

1. The plugs and shafts shall be of cast iron or ductile iron conforming to ASTM A 536 - Ductile Iron Castings, and the plugs shall be lined with a resilient coating, best suited for the specific service.

2. The body shall be lined with a suitable elastomer, where required for a special service, or it shall be epoxy-lined in accordance with manufacturer's standard coating system.

3. The seats shall be of nickel or stainless steel welded to the body.

4. All top and bottom shaft bearings shall be of permanently lubricated stainless steel or Teflon coated stainless steel.

5. Grit seals of Teflon, Nylatron, or similar suitable material shall be at the top and bottom plug journals.

6. Valves shall have an unobstructed port area of 100 percent of full pipe area.

7. All eccentric plug valves shall have a pressure rating of not less than 150 psi WOG, for bubble-tight shut-off in the standard flow direction, and 25 psi WOG in the reverse flow direction.

8. When equipped with worm gear actuator, the pressure rating shall be 150 psi WOG in both directions.

9. The stem seal shall consist of field adjustable packing, replaceable without removal of the actuator, or of self-adjusting U-cup packing.

2.2 ACTUATORS

A. Unless otherwise indicated, eccentric plug valves 3-inch and smaller shall have operating levers; larger valves shall have worm-gear actuators. Valve actuators shall be in accordance with Section 40 05 57 – Actuators for Process Valves and Gates.

B. Contractor shall coordinate actuator position for ease of operation by Owner and to ensure plug shall swing upward when installed in horizontal piping.

2.3 MANUFACTURERS, OR EQUAL

A. DeZurik Corporation

B. Clow Valve Company

C. Pratt Valve

D. Val-Matic

PART 3 - EXECUTION

3.1 INSTALLATION

A. Plug valves shall be installed in strict accordance with the manufacturer's published recommendations and the applicable provisions of Section 40 05 51 – Valves, General.

B. Unless otherwise directed, the following rules shall be observed for the installation of eccentric plug valves on sewage, sludge, or other liquid systems containing solids, silt, or fine sand:

1. The valves shall be positioned with the stem in the horizontal direction.

2. In horizontal pipelines, the plug shall swing upwards when opening, to permit flushing out of solids. Coordinate location of valve actuator so plug swings upward prior to ordering valves.

3. The orientation of the valve shall prevent the valve body from filling up with solids when closed; however, where the pressure differential through the valve exceeds 25 psi, the higher pressure for valves without worm gear, electric, or air operators shall be through the valve to force the plug against the seat.

4. Valves which may be closed for extended periods (stand-by, bypass, or drain lines) and valves with reversed flow (higher pressure on downstream side, forcing the plug away from its seat), shall be equipped with worm gear operators for all sizes.

5. For special applications or when in doubt, consult with the manufacturer prior to installation.

END OF SECTION 40 05 62

SECTION 40 05 64 - BUTTERFLY VALVES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish all labor, materials, and equipment as required to furnish and install butterfly valves with manual, electric or pneumatic actuators as indicated on the Plans and in accordance with these specifications.

1.2 REFERENCE STANDARDS

A. Commercial Standards:

1.	ANSI/AWWA C504	Rubber-Seated Butterfly Valves.
2.	ANSI/AWWA C540	Power Actuating Devices for Valves and Sluice Gates
3.	ANSI/AWWA C550	Protective Epoxy Interior Coatings for Valves and Hydrants
4.	ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800
5.	ANSI B16.5	Pipe Flanges and Flanged Fittings
6.	ASTM A48	Specifications for Gray Iron Castings
7.	ASTM A126	Gray Iron Castings for Valves, Flanges and Pipe Fittings
8.	STM A276	Specifications for Stainless and Heat-Resisting Steel Bars and Shapes
9.	ASTM A436	Austenitic, Gray Iron Castings
10.	ASTM A536	Ductile Iron Castings
11.	MSS SP67	Butterfly Valves

1.3 SUBMITTALS

A. Provide shop drawings per Section 01 33 00 – Submittal Procedures and Section 40 05 51 – Valves, General including:

1. Complete Shop Drawings of butterfly valves and actuators.

2. Drawings showing valve port diameter complete with dimensions, part numbers and materials of construction

3. Certification of proof-of-design test form the valve manufacturer.

4. If automatically actuated, provide actuator information in accordance with Section 40 05 57 – Actuators for Process Valves and Gates.

5. For above grade installations, provide literature regarding valve position indicators and installation information to indicate if valves must be installed in the upright position. If valve must be installed in upright position, provide modified valve position indicator that can be seen from the floor when opening or closing the valve.

1.4 QUALITY ASSURANCE

A. Valves shall be subjected to performance, leakage, and hydrostatic test in accordance with procedures and acceptance criteria established by AWWA C504.

PART 2 - PRODUCTS

2.1 GENERAL

A. Butterfly valves shall comply with the requirements of Section 40 05 51 – Valves, General.

2.2 BUTTERFLY VALVES FOR GENERAL PURPOSE SERVICE

A. Valves shall be certified to NSF Standard 61.

B. Butterfly valves shall be rubber seated butterfly valves that conform to AWWA C504, rated for water working pressures up to 150 psig, subject to the following requirements. Butterfly valves for general purpose service shall be rubber seated butterfly valves that conform to AWWA C504, rated for water working pressures up to 150 psig, subject to the following requirements. Valves shall be of the size and class indicated, suitable for bubble tight shut-off service as well as throttling service at rated pressure at ambient temperatures of 33 to 125 degrees F. Lug or wafer style valves shall have ANSI 125 lb flange bolt hole patterns.

C. Body: The valve body shall be of cast iron conforming to ASTM A126 - Specifications for Gray Iron Castings for Valves, Flanges and Pipe Fittings, Class B, with either wafer, lug, or flanged design as indicated in drawings, drilled to ANSI B 16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 125. The entire body shall be factory coated with an epoxy coating system in accordance with AWWA C550.

D. Disc: The disc shall be a ductile iron conforming to ASTM A536, with factory applied epoxy coating in accordance with AWWA C550. The disc shall have no holes drilled into it for securing the disc to the stem with pins, screws, or any other such hardware. If the disc design is such that securing hardware is required then the disc and securing hardware shall both be type 316 stainless steel.

E. Seat: The valve seat shall be Ethylene-Propylene-Diene Monomer (EPDM) or Buna N and shall be bonded or vulcanized to the valve body.

F. Stem: The valve stem shall be a Type 316 stainless steel ASTM A276, with keyed slots on the stem to make with receiving slots on the inner part of the disc requiring no disc screws or pins for connection of the tem to the disc. If connecting pins or screws are required for a particular manufacturer's design, then the disc as well as the connecting hardware shall be type 316 stainless steel.

G. Stem Bushing: The stem bushing shall be a non-corrosive, heavy duty acetal bushing.

H. Stem Seal: The stem shall be a double "U" cup seal or O-ring designed which is self adjusting and provides positive sealing in both directions, and is suitable for the service condition.

I. Flange / Style: Unless otherwise specified or noted on the drawings, the style of each butterfly valve shall be lug style. The Contractor shall not use any type of raised face type PVC flange on either side of any butterfly valve. Contractor shall be responsible to ensure that the selected butterfly valve will fully open and close without any physical interference at all.

J. Testing: Valves shall be factory leak tested in accordance with AWWA C504.

K. Manufacturers or equal:

1. DeZurik Water Controls

2. Henry Pratt Company

3. Bray

4. Val-matic

2.3 BUTTERFLY VALVES FOR AIR SERVICE

A. General: Butterfly valves for air service shall be specifically designed for this service and meet or exceed the design, strength, performance, and testing standards of AWWA C504. They shall be suitable for pressures from vacuum to 125 psi and temperatures from minus 40 degrees F to 300 degrees F.

B. Body: The valve body shall be of cast iron conforming to ASTM A126, Class B, with lug or flanged design as indicated, drilled to ANSI B16.1, Class 25, 125, 250, and 800, Class 125.

C. Disc: The disc shall be cast iron conforming to ASTM A126 with a nylon coating, bronze, or Type 316 stainless steel. The disc shall be designed with the air- profile or other suitable shape. Sprayed or plated disc edges are not acceptable.

D. Seat: The elastomer seat shall be in the body. It shall be field-replaceable without special tools. The seat material shall be EPDM to provide a tight shut-off at the temperatures above.

E. Shaft: The valve shaft shall be of Type 316 or 304 stainless steel, with sufficient strength to allow for the increased torque for air service.

F. Bearings: Shaft bearings shall be of the self-lubricating corrosion resistant sleeve type.

G. Packing: The packing shall be of the adjustable or self adjustable (a-ring) type, suitable for the temperature and service conditions.

H. Manufacturers, or Equal:

1. DeZurik water Controls

2. Henry Pratt Company

3. Bray

2.4 VALVE SCHEDULE

A. In addition to providing all necessary valves 3-inch diameter and smaller, the Contractor shall provide the butterfly valves as shown on the valve schedule in the Contract Drawings.

2.5 ACTUATORS

A. Manual Actuators: Actuators shall conform to Section 40 05 57 – Actuators for Process Valves and Gates and to ANSI / AWWA C540 - Power Actuating Devices for Valves and Sluice Gates, subject to the following requirements. Unless otherwise indicated, all manually-actuated butterfly valves of 6 inch diameter and larger shall be equipped with a handwheel and 2-inch square actuating nut and position indicator. Manual lever type actuators shall allow for positive throttling and have at minimum 10 stop positions from open to close for positive locking of the valve. The manual lever type actuators as well as handwheel actuators shall have an epoxy coating per manufacturer's standard coating.

B. Electric Actuators: Where indicated on Plans, provide electric actuators that meet the requirements of AWWA C 540 and are in accordance with Section 40 05 57 – Actuators for Process Valves and Gates. The maximum torque for the valve shall be input into the actuator program to be the maximum torque applied by the actuator.

2.6 PAINTING AND COATINGS

A. All valves inside of hydraulic structures shall be provided with a high build epoxy coating system, per manufacturers standard coating.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to installation, inspect interconnecting piping and end connections to ensure compatibility.

B. Prior to installation, inspect and verify condition of valve and appurtenances.

C. Ensure exposed piping is sufficiently supported to bear weight of valve when it is installed.

3.2 PRODUCT HANDLING

A. Protect valves and components against dirt and damage during shipment and storage.

B. Handle valves to prevent damage or contamination.

3.3 INSTALLATION

A. Install all valves in accordance with manufacturer's recommendations and with Section 40 05 51 – Valves, General.

END OF SECTION 40 05 64

SECTION 40 05 64.36 – HIGH-PERFORMANCE AIR CONTROL VALVES

PART 1 - GENERAL

WORK INCLUDED

A. Furnish all labor, materials, and equipment as required to furnish and install high-performance air control valves with, electric actuators as indicated on the Plans and in accordance with these specifications.

REFERENCE STANDARDS

B. Commercial Standards:

1.	ANSI/AWWA C550	Protective Epoxy Interior Coatings for Valves and Hydrants
2.	ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800
3.	ANSI B16.5	Pipe Flanges and Flanged Fittings
4.	ASTM A536	Ductile Iron Castings

SUBMITTALS

C. Provide shop drawings per Section 01 33 00 – Submittal Procedures and Section 40 05 51 – Valves, General including:

1. Complete Shop Drawings of High-Performance Air Control Valves and actuators.
2. Drawings showing valve port diameter complete with dimensions, part numbers and materials of construction
3. Certification of proof-of-design test form the valve manufacturer.
4. Provide actuator information in accordance with Section 40 05 57 – Actuators for Process Valves and Gates.
5. Provide literature regarding valve position indicators and installation information to indicate if valves must be installed in the upright position. If valve must be installed in upright position, provide modified valve position indicator that can be seen from the floor when opening or closing the valve.
6. Valve Cv
7. Valve pressure drop and position for each valve for maximum and minimum flow rates indicated
8. Recommended upstream straight length for each valve

QUALITY ASSURANCE

D. Valves shall be subjected to performance, leakage, and hydrostatic test in accordance with procedures and acceptance criteria established by AWWA C504.

PART 2 - PRODUCTS

GENERAL

A. High-Performance Air Control Valves shall comply with the requirements of Section 40 05 51 – Valves, General.

HIGH-PERFORMANCE AIR CONTROL VALVES

B. Valve Type:

1. Multi-segment valve designed to maintain the valve port geometry with central axial flow from open to close.
2. Minimum of six (6) segments
3. Hysteresis free
4. Provide valve with gear for operation with rotary motion
5. Provide position indicator
6. Automatic spindle lubrication
7. Valves optimized in accordance with DIN EN 60534

C. Valve Working Pressure: 87 psi

D. Valve Temperature Rating: 284 deg F

E. Body Type: Flanged, ANSI B16.1 Class 150

F. Provide valves optimized in accordance with DIN EN 60534

G. Materials:

1. Valve Body:
   a. Type 316 stainless steel ASTM A351 CF8M.
2. Valve Disc Segments:
   a. Material: Stainless steel, AISI Type 316L
   b. Provide segments with rounded edges and self-cleaning characteristic.

3. Elastomers:

   a. EPDM

4. Hardware: Type 316 stainless steel

H. Performance:

1. Minimum Control Range Turndown: 10:1

2. Maximum Required Pressure Drop for Control: 0.15 psi

3. Hysteresis-free performance

4. Aeration Control Valve Schedule: As indicated

5. Gain ($\Delta Q/\Delta H$) with Q = flow and H = relative stroke: The gain must be $0.5 < \Delta Q/\Delta H < 2$ for the complete regulation range

ACTUATORS

I. Electric Actuators: Where indicated on Plans, provide electric actuators that meet the requirements of AWWA C 540 and are in accordance with Section 40 05 57 – Actuators for Process Valves and Gates. The maximum torque for the valve shall be input into the actuator program to be the maximum torque applied by the actuator.

PAINTING AND COATINGS

J. All valves inside of hydraulic structures shall be provided with a high build epoxy coating system, per specifications Section 09 90 00 – Painting and Coating.

MANUFACTURER

K. Manufacturer or approved equal

1. Egger, IRIS

2. Equal must be approved during bidding process.

PART 3 - EXECUTION

EXAMINATION

A. Prior to installation, inspect interconnecting piping and end connections to assure compatibility.

B. Prior to installation, inspect and verify condition of valve and appurtenances.

C. Assure exposed piping is sufficiently supported to bear weight of valve when it is installed.

PRODUCT HANDLING

D. Protect valves and components against dirt and damage during shipment and storage.

E. Handle valves to prevent damage or contamination.

INSTALLATION

F. Install all valves in accordance with manufacturer's recommendations and with Section 40 05 51 – Valves, General.

END OF SECTION 40 05 64.36

SECTION 40 05 65.23 – SWING CHECK VALVES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide swing check valves and appurtenances, complete and operable, in accordance with the Contract Documents where required.

1.2 REFERENCE STANDARDS

A.	ANSI/AWWA C 508	Swing-Check Valves for Waterworks Service, 2 in. through 24 in.
B.	ASTM A 126	Gray Iron Casting for Valves, Flanges, and Pipe Fittings;
C.	ANSI/ASME B 16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 300;
D.	ASTM B 584	Copper Alloy Sand Castings for General Applications
E.	ASTM B 584 or B 148	Aluminum-Bronze Castings, or of Buna-N;
F.	ASTM B 763	Copper Alloy Sand Castings for Valve Application, or
G.	ANSI/ASME B1.20.1	Pipe Threads, General Purpose (inch);
H.	ASTM B 16	Free-Cutting Brass Rod, Bar, and Shapes for Use in Screw Machines.

1.3 SUBMITTALS

A. The Contractor shall furnish submittals in accordance with Section 40 05 51 – Valves, General.

PART 2 - PRODUCTS

2.1 SWING CHECK VALVES (3-INCH AND LARGER)

A. Valves shall be certified to NSF Standard 61.

B. General: If not specified otherwise, swing check valves for water, sewage, sludge, and general service shall be of the outside lever and spring or weight type, in accordance with ANSI/AWWA C 508 - Swing-Check Valves for Waterworks Service, 2 in. through 24 in. NPS. Valves shall have full-opening passages, designed for a water-working pressure of 150 psi. They shall have a flanged cover piece to provide access to the disc.

C. Body: The valve body and cover shall be of ductile iron conforming to ASTM A 536 – Ductile Iron Castings for Valves, Flanges, and Pipe Fittings, with flanged ends conforming to ANSI/ASME B 16.1 - Ductile Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800, or mechanical joint ends, as indicated.

D. Disc: The valve disc shall be of ductile iron, or bronze conforming to ASTM B 584 - Copper Alloy Sand Castings for General Applications.

E. Seat and Rings: The valve seat and rings shall be of stainless steel T304 or T316 Type.

F. Lining & Coating: The valve shall be lined and coated with NSF 61 Fusion Bonded Epoxy.

G. Hinge Pin: The hinge pin shall be of bronze or stainless steel.

H. Manufacturers, or equal

1. Val-Matic, 7800LW Series

2. American Flow Control (Darling)

3. APCO (Valve and Primer Corp.)

4. Kennedy Valve

5. Mueller Company

6. Crane Valves and Fittings

2.2 SWING CHECK VALVES (2-1/2-INCH AND SMALLER)

A. Swing check valves for steam, water, oil, or gas in sizes 2-1/2 inch and smaller shall be suitable for a steam pressure of 150 psi and a cold-water pressure of 300 psi. They shall have screwed ends unless otherwise indicated, and screwed caps.

B. Body: The valve body and cap shall be of bronze conforming to ASTM B 763 - Copper Alloy Sand Castings for Valve Application, or ASTM B 584 with threaded ends conforming to ANSI/ASME B1.20.1 - Pipe Threads, General Purpose (inch).

C. Disc: Valves for steam service shall have bronze or brass discs conforming to ASTM B 16 - Free-Cutting Brass Rod, Bar, and Shapes for Use in Screw Machines, and for cold water, oil, and gas service replaceable composition discs.

D. Hinge Pin: The hinge pins shall be of bronze or stainless steel.

E. Manufacturers, or equal

1. Crane Company

2. Milwaukee Valve Company

3. Stockham Valves and Fittings

4. Wm. Powell Company

2.3 SWING FLEX CHECK VALVES

A. Swing Flex Check Valves with Mechanical Disc position indicator are also acceptable as or equals in place of standard swing check valves.

B. Manufacturers:

1. Val-Matic Swing-Flex

2. Or Engineer approved equal

PART 3 - EXECUTION

3.1 GENERAL

A. Valves shall be installed in accordance with provisions of Section 40 05 51 – Valves, General.

END OF SECTION 40 05 65.23

SECTION 40 05 71.33 - TELESCOPING VALVES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide telescoping valves and appurtenances, complete and operable, in accordance with the Contract Documents.

1.2 REFERENCE STANDARDS

A. Except as modified or supplemental herein, all telescoping valves shall conform to the applicable requirements of AWWA C501, Latest edition.

1.3 SUBMITTALS

A. The Contractor shall furnish submittals in accordance with Section 01 33 00 – Submittals Procedures and Section 40 05 51 – Valves, General.

B. The Contractor shall submit shop drawings showing the principal dimensions, general construction and materials used in the valve and lift mechanism.

C. Provide operation and maintenance data in accordance with Section 01 78 23 – Operation and Maintenance Data.

PART 2 - PRODUCTS

2.1 GENERAL

A. Telescoping valves shall comply with the requirements of Section 40 05 51 – Valves, General.

2.2 VALVE ASSEMBLY

A. Telescoping sludge valves shall be furnished where shown on the plans. Each valve shall comprise a complete assembly including a valve stand, adjusting mechanism with non-rising stem, slip pipe and companion flange.

B. The valve body shall be constructed of structural member or formed plate welded to form a rigid one-piece body. The body shall be of a design suitable for mounting on a wall thimble.

2.3 MATERIALS OF CONSTRUCTION

A. Provide telescoping valves meeting the following material requirements:

Item	Material
Body, tube, stem guides and reinforcing members	Stainless steel, Type 304 or 316
Threaded Stem	Stainless steel, Type 304 or 316
Stem Extension	Stainless steel, Type 304 or 316
Fasteners	Bolts – ASTM F593 GR2 Type 304 Nuts ASTM F594 GR2 Type 304
Guide Seal Gasket	Ultra-high molecular weight polyethylene (UHMWPE) or Buna N
Gasket Retainer (Companion Flange)	UHMWPE or Stainless Steel, Type 304 or 316
Lift Nut	Manganese bronze ASTM B-584
Pedestal Handwheel	Cast Iron

B. The valve stand shall be stainless steel complete with base flange drilled to receive anchorage. A bronze adjusting nut which travels on a ¾-inch diameter threaded bronze adjusting rod shall operate the valve by rotation of a cast iron hand wheel. The nut and adjusting rod shall have special ACME threads for trouble-free valve operation.

C. Wear pads (guides) shall be installed at the lower end of the tube to guide it inside the body and to prevent metal to metal contact.

D. The slip pipe of each telescoping valve shall be fabricated from Type 316 stainless steel tubing. Bail and guide pipe shall also be fabricated from stainless steel.

E. Each telescoping valve shall be furnished with a stainless steel companion flange bored with sufficient clearance to allow the slip tube to slide but no liquid to escape. Each companion flange shall be furnished with sealing gaskets having an inner diameter slightly smaller than the outer diameter of the slip tube. The Contractor shall furnish the companion flange mounting bolts.

F. Provide stainless steel wall support for valve stand as shown on the drawings. The handwheel operator shall extend 3 feet above grade for ease of operation.

2.4 LIFTING MECHANISM

A. Provide manual handwheel operators supplied by the valve manufacturer. All bearings and gears shall be totally enclosed in a watertight housing. The pinion shaft of crank-operated mechanisms shall be constructed of stainless steel and supported by roller bearings or needle bearings.

B. Each manual operator shall be designed to operate the valve under the maximum load conditions by not more than a 40 lb effort on the handwheel and shall be able to withstand, without damage, an effort of 80 lbs. The maximum handwheel diameter shall be 24 inches.

2.5 SPARE PARTS

A. Spare parts shall be provided for field modification of valve to allow future operation at specified maximum water surface.

2.6 MANUFACTURERS, OR EQUAL

A. Troy Valve

B. H. Fontaine, ltd

PART 3 - EXECUTION

3.1 INSTALLATION

A. Telescoping valves shall be installed in strict accordance with the manufacturer's published recommendations and the applicable provisions of Section 40 05 51 – Valves, General.

END OF SECTION 40 05 71.33

SECTION 40 05 82 – SOLENOID VALVES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide miscellaneous valves, and appurtenances, complete and operable in accordance with the Contract Documents.

1.2 REFERENCE STANDARDS

A. Commercial Standards:

1.	AWWA C511	Reduced-Pressure Principle Backflow Prevention Assembly
2.	ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings
3.	C-510-97	Double Check Valve Backflow Prevention Assembly
4.	C-511-97	Reduced Pressure Principle Backflow Prevention Assembly
5.	NPFA 820	Standard for Fire Protection in Wastewater Treatment and Collection Facilities

1.3 SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures and Section 40 05 51 – Valves, General.

B. Technical Manual: Furnish operation and maintenance information in accordance with Section 01 78 23 – Operation and Maintenance Data.

1.4 QUALITY ASSURANCE

A. Comply with quality assurance requirements listed in Section 40 05 51 – Valves, General.

PART 2 - PRODUCTS

2.1 GENERAL

A. All valves specified in this Section shall meet the applicable requirements of Section 40 05 51 – Valves, General.

B. All components that are in contact with potable water shall be certified to NSF Standard 61.

2.2 SOLENOID VALVES

A. All coil ratings shall be for continuous duty. For electrical characteristics see electrical drawings or specifications.

B. Explosion-proof valves shall be provided in Class 1, Division 1 areas as required under NPFA 820 guidelines. This applies to any solenoid valves located in the Headworks Building.

C. Solenoid valves shall be of the size, type, and class indicated and shall be designed for not less than 150 psi water-working pressure. Valves for water, air, or gas service shall have brass or bronze body with screwed ends, stainless steel trim and spring, Teflon or other resilient seals with material best suited for the temperature and fluid handled. Unless otherwise indicated, for chemicals and all corrosive fluids, solenoid valves with PVC, CPVC, polypropylene (PP), polyvinylidene fluoride (PVDF), or Teflon materials of construction, suitable for the specific application shall be provided. Enclosures shall be NEMA rated in accordance with the area designations.

D. Solenoid valves shall be pilot controlled and shall be water hammer free.

E. Solenoid valves shall fail in the closed position unless otherwise indicated on the project drawings.

F. Where solenoid valves are apart of a packaged equipment system, those solenoids valves shall be specified and provided by the equipment manufacturer.

G. Manufacturers, or Equal:

1. For general duty
    a. Automatic Switch Co. (ASCO), Model "RED HAT"
    b. Skinner Valve (Parker Hannifin Corporation)
    c. Magnatrol Valve Corporation
    d. J. D. Gould Co.
2. Metallic valves for corrosive fluids
    a. Valcor Engineering Corporation
3. Plastic valves for corrosive fluids
    a. GF Plastic Systems, Inc.
    b. Spears Mfg. Co.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Valves shall be installed in accordance with the manufacturer's printed recommendations, and with provisions of Section 40 05 51 – Valves, General.

B. After installation is complete, the solenoid valve shall be tested for proper operation.

END OF SECTION 40 05 82

SECTION 40 05 93 – COMMON MOTOR REQUIREMENTS FOR PROCESS EQUIPMENT

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall provide electrical motors, accessories, and appurtenances complete and operable, in conformance with the individual driven equipment specifications and the Contract Documents.

B. The provision in this Section apply to all low voltage AC squirrel cage induction motors except as indicated otherwise.

C. All motors shown on the Drawings or specified in other divisions of the specifications shall in general, be furnished with the driven equipment and connected under Division 26 of the Specification.

D. If motors are specified in other divisions of the Specification, then in the event of conflicts, the more restrictive specification shall apply.

E. The Contractor shall assign to the equipment supplier the responsibility to select suitable electric motors for the equipment. The choice of motor manufacturer shall be subject to review by the Engineer. Such review will consider future availability of replacement parts and compatibility with driven equipment.

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Motors shall be designed, built, and tested in accordance with the latest revision of the following standard documents. In the case of conflict between the requirements of this Section and those of the standard documents, the requirements of this Section shall prevail.

1.	NEMA MG 1	Motors and Generators
2.	ANSI/IEEE 112	Test Procedures for Polyphase Induction Motors and Generators
3.	UL l004	Motors, Electric

1.3 CONTRACTOR SUBMITTALS

A. Refer to Section 01 33 00 – Submittal Procedures and individual equipment specification requirements.

B. Submit the motor manufacturer's certification of bearing life on motors where application conditions suggest significant belt drive or thrust loads.

C. A Motor Data form (sample Form follows section) shall be submitted for each and every motor furnished under this Contract.

D. Motor outline, dimensions, and weight.

E. Manufacturer's descriptive information relative to specified features.

F. Motor Performance Characteristics:

1. Guaranteed minimum efficiency at rated load at rated voltage.

2. Guaranteed minimum power factor at rated load at rated voltage.

3. Expected efficiency at 1/2, 3/4, and full load at rated voltage.

4. Expected power factor at 1/2, 3/4, and full load at rated voltage.

5. Motor no-load current at rated voltage.

6. Full load current at rated voltage.

7. Full load current at 110 percent voltage.

8. Starting current at rated voltage.

9. Full load speed.

10. Certified copy of test report for identical motor tested in accordance with NEMA MG 1-12.53a and IEEE Standard 112, Test Method B, showing full load efficiency and power factor not less than specified value. Motors not as specified will be rejected.

G. Vertical Motor Data:

1. Thrust bearing life

2. Type of thrust bearing lubrication.

3. Type of guide bearing lubrication.

H. Operation and Maintenance Manuals (provided before or during training of treatment plant staff), including:

1. Complete information for storage and installation.

2. Complete operating and maintenance instructions.

3. Bill of Materials.

1.4 EQUIPMENT GUARANTEE

A. Guarantees shall cover:

1. Faulty or inadequate design.

2. Improper assembly or erection.

3. Breakage, or other failure.

4. Defective workmanship or materials

1.5 FACTORY TESTS

A. Provide factory test and test reports as listed below for all polyphase motors. For motors 7 1/2 hp and above, provide test reports for the actual motor being supplied. For motors under 7 1/2 hp, test reports of an identical motor may be provided. Perform all tests in accordance with the Procedures for Polyphase Induction Motors and Generators No. 112A and NEMA MG 1.

B. Measurements of no-load current and speed at nominal voltage and frequency

1. Measurement of locked rotor current at rated frequency.

2. Results of high-potential test.

3. Determination of efficiency and power factor at 1/2 load, 3/4 load, full-load, and service factor load.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide squirrel-cage induction motors unless otherwise noted.

B. Electric motors driving identical machines shall be identical.

C. Coordination: Provide motors especially suitable both electrically and mechanically to drive the loads specified. The speed, horsepower, torque base, bearing, shaft, insulation and enclosure shall be closely coordinated with this specification so as to provide a satisfactory, efficient drive without overloading, overheating, abnormal noise or vibration. The BHP required of the driven equipment under the most severe operating conditions for the equipment served shall not exceed the rated nameplate horsepower of the motor when operating at its rated service factor, nor shall it exceed the rated nameplate horsepower of the motor when operated at specified conditions at a service factor of 1.0. The "most severe operating conditions" shall include the full possible range of normal operating conditions but shall not include unusual conditions such as equipment failure.

D. Standards: All motors shall be in accordance with NEMA-MG 1 "T" Line, IEEE and ANSI latest revision insofar as they are applicable.

E. Service Conditions: Provide motors designed and built for long, trouble-free life in industrial service capable of operating successfully under the following application conditions:

1. 40°C maximum ambient temperature to -20 degrees Celsius minimum ambient temperature.

2. Altitude at the facility site shall be verified.

3. Voltage variations to + 10 percent of nameplate rating.

4. Frequency variations to + 5 percent of nameplate rating.

5. Multiple speed motors suitable for use with multiple speed starter furnished.

6. Inverter duty motors suitable for use with variable frequency drives, if furnished.

F. Operating Characteristics: All motors shall be rated for full-voltage starting, NEMA Design B, normal torque, normal starting current, unless otherwise required by the driven equipment or specified.

G. Installation Environment: Provide motors suitable for the environment in which they are to be installed. Where the installation environment is specified, provide motors suitable for the environment indicated and in conformance with the specification.

H. Exempt Motors: Motors for valve operators, submersible pumps, or motors which are integral part of standard manufactured equipment, i.e., non-NEMA mounting, common shaft with driven element, or part of domestic or commercial uses apparatus may be exempted from these specifications to the extent that such variation reflects a necessary condition of motor service or a requirement of the driven equipment.

2.2 ENCLOSURES

A. Horizontal: Dripproof NEMA Standard MG 1, unless otherwise specified. Provide screen over all air openings.

B. Vertical: Motors shall be weather protected Type 1 (WP-l) NEMA Standard MG 1, with inlet and outlet openings screened unless otherwise specified.

C. TEFC and TENV: Totally enclosed fan cooled (TEFC) where specified. Provide horizontal TEFC motors with condensate drain holes. Totally enclosed non- ventilated (TENV) may be substituted for TEFC at Contractor's option.

D. Cast iron or extruded aluminum or die cast aluminum stator frames and end shields, rigid construction.

E. Heavy fabricated steel, cast iron or aluminum frames for single phase motors.

2.3 ACCESSORY REQUIREMENTS

A. Motor Assembly: Provide NEMA conduit entrance box. Provide conduit entrance box size and drilling to conform to the conduit or wiring requirements indicated on the electrical drawings. Include motor leads and all accessory leads in a common conduit entrance box.

B. Motor Leads: Provide motor leads compatible with motor insulation systems, permanently identified.

C. Eyebolts: Provide drilling and tapping for eyebolts on all motors weighing more than 83 pounds.

D. Nameplates: Provide one or more engraved stainless steel stamped metal nameplates with the information required by NEMA-MGI-IO.38 and the following additional information:

1. Maximum ambient temperature for which motor is rated.

2. Class of insulation.

3. Service factor.

4. Bearing number.

5. Motor connection diagram if more than three leads.

6. Power rating in KW if driven equipment ratings are given in metric units.

E. Oil Lubricated Polyphase Motors: Provide lubricating oil reservoirs and sight gauges.

F. Painting: As specified in Section 43 05 01 – Equipment General Provisions.

G. Provide motor grounding lug suitable to terminate ground wire, sized as indicated.

2.4 INSULATION CLASS

A. Provide NEMA Class B insulation for all polyphase squirrel-cage induction motors, unless otherwise specified.

1. Provide additional anti-abrasion protection for non-enclosed motors, per NEMA MGl-l.27.

2. Provide additional moisture protection for enclosed motors, per NEMA MGl-20.48a.

B. Class F insulation with additional nonhygroscopic moisture protection as specified in paragraph 2.03A above may be utilized at the Contractor's option, however, the temperature rise as measured by resistance when operating at rated service factor and load shall conform to the limiting observable temperatures in NEMA-MGl, for class of insulation used.

C. Class A insulating materials shall not be utilized except in single-phase fractional horsepower motors or used in dry locations, with a standard reduction in rated temperature rise.

D. Encapsulation: Where specified. Provide insulating resin encapsulation by a molded or equivalent process in which the resin completely surrounds the conductors in the slots and end turns, leaving no voids between the conductors or adjacent stator steel. Allowable temperature rise shall not exceed the limits of NEMA-MGl.

E. Motors to be operated from adjustable frequency drives shall be provided with insulation systems to withstand 1600 volt spikes, with dV/dt as defined in NEMA MG 1-31 and shall be labeled as “Inverter Duty”.

2.5 SERVICE FACTOR

A. Provide the service factor indicated, or NEMA standard for the specified insulation and enclosure, whichever is greater. Minimum service factor shall be 1.15.

2.6 NEMA TYPE

A. Provide motors in accordance with standard NEMA type classifications as specified. The use of industry standard subclassifications such as "mill and Chemical" motors and similar" standard" heavy-duty designs are encouraged where they meet or exceed the specified minimum requirements.

2.7 POWER RATINGS

A. Motor horsepower or kw ratings, if indicated in the detailed equipment specifications, are minimum size acceptable.

B. Ratings indicated on the electrical drawings are for guidance only and do not limit the equipment size.

C. Frame/hp relationships shall conform to the latest NEMA standards for "T" or "U" frames and all dimensions shall meet NEMA standards.

2.8 STANDARD RATED VOLTAGE PHASE AND FREQUENCY

A. Provide motors nameplate-rated for 60 Hertz power supply as follows unless otherwise specified or shown on the drawings:

1. Motor less than 1/6 hp, single-phase, 115 volts.

2. Motors 1/6 hp through 1 hp, single phase, 115/230 volts.

3. Motors 1 hp and greater, three phase, 460 volts.

4. Multi-speed motors may have single voltage rating if manufacturer's standard.

B. Conform to the specified service conditions and the equipment specifications without reduction in the service factor.

2.9 BEARINGS AND SHAFTS

A. Motors greater than 2 HP shall have bearings designed for 17,500 hours (belted) or 100,000 hours (coupled) L-10 life.

B. Fractional Horsepower: Motors with fractional horsepower through 2 HP shall be provided with Lubricated-for-Life ball bearings.

C. Horizontal Motors Over 2 HP: Motors larger than 2 HP shall be provided with relubricatable ball bearings. Lubrication shall be per manufacturer's recommendation for smooth operation and long life of the bearings.

D. Vertical Motors Over 2 HP: Vertical motors larger than 2 HP shall be provided with relubricatable ball, spherical, roller, or plate type thrust bearings. Lubrication shall be per manufacturer's recommendation for smooth operation and long life of the bearings.

E. Shafts: Shafts shall be in accordance with NEMA "T" or "TS" dimensions. Long shafts shall be suitable for belt, chain or gear drive within limits established by good industrial practice and documented by NEMA. Short shafts shall be used for direct connection. Vertical motors shall be the solid-shaft type except where application requires a hollow-shaft design.

F. Inverter Duty Motors: Motors to be used in VFD applications must have bearing protection from shaft currents. Provide AEGIS shaft grounding ring, ceramic bearings or equivalent means to prevent premature bearing failure due to shaft current discharge.

2.10 DUTY CYCLE

A. Provide motors rated for continuous duty unless otherwise specified. Short time rated motors may be provided where the application is well documented by NEMA, is usual industrial practice and the driven equipment and motor is a tested combination under the specified performance conditions.

2.11 LUBRICATION

A. Horizontal polyphase motors shall be grease lubricated. The bearing housing shall be large enough to hold sufficient lubricant to minimize the need for frequent relubrication, but facilities shall be provided for adding new grease and draining out old grease without major motor disassembly. Motors 180T frame and smaller may utilize grease release fitting in lieu of grease drain plug. The bearing housing shall have long, tight, running fits or rotating seals to protect against the entrance of foreign matter into the bearings or leakage of grease out of the bearing cavity.

B. Vertical polyphase motor lubrication shall conform to the motor manufacturer's recommendations. Except as otherwise recommended, guide bearings shall be ball bearings, grease lubricated; thrust bearings shall be grease lubricated through frame 28OT, oil lubricated in larger frame sizes.

2.12 MOTOR THERMAL PROTECTION

A. Provide one heat-sensing detector per phase, embedded in the windings to provide even temperature protection on motors 75 hp or larger. Coordinate over-temperature protection system with motor starter overload relays.

B. Single Phase Motor: Single phase 120, 208, or 230 volt motor shall have integral thermal overload protection or shall be inherently current limited.

C. Thermostats: Winding thermostats shall be snap action, bi-metallic, temperature-actuated switch, and shall be factory mounted integral to the motors. Thermostats shall be provided with one normally closed contact. The thermostat switch point shall be precalibrated by the manufacturer.

2.13 HIGH EFFICIENCY MOTORS

A. All motors provided shall be high efficiency as specified below.

B. High efficiency motors shall have minimum and nominal efficiencies which meet or exceed the efficiencies specified below when tested in accordance with the latest version of IEEE Test Procedure 112A. Method B. using accuracy improvement by segregated loss determination including stray load loss improvement as specified in NEMA Standard MGl-12.S3A. latest revision. Minimum efficiencies shall be guaranteed in writing.

C. Single speed induction high efficiency motors, three-phase, NEMA Design B, 460V, continuous duty, 40°C ambient shall meet or exceed the efficiencies specified in the following table.

Energy Efficiency Horizontal					
		Percent Guaranteed Minimum Rated Load Efficiencies		Percent Guaranteed Minimum Rated Load Power Factor	
HP	Nominal Speed RPM	DP	TEFC	DP	TEFC
1	1,800	80.0	81.5	85.0	85.0
	1,200	78.5	79.3	74.0	74.0
1.5	3,600	79.3	81.5	86.0	86.0
	1,800	79.3	82.0	88.0	88.0
	1,200	82.5	84.0	69.5	69.5
2	3,600	82.0	84.0	88.0	88.0
	1,800	81.5	83.7	84.0	84.0
	1,200	85.5	85.5	69.0	69.0
	900	82.9	82.5	54.0	54.0
3	3,600	82.0	84.0	91.0	88.0
	1,800	84.8	86.5	79.0	79.5
	1,200	87.5	88.1	71.0	71.5
	900	84.1	82.9	62.0	62.5
5	3,600	84.8	86.5	87.0	91.5
	1,800	86.5	86.5	81.0	81.0
	1,200	87.5	88.1	75.5	75.5
	900	87.5	86.5	70.0	70.5
7.5	3,600	86.5	88.1	90.0	90.0
	1,800	89.3	89.5	86.5	86.5
	1,200	88.5	88.5	80.0	80.0
	900	87.5	86.5	72.0	72.0
10	3,600	89.3	89.5	90.0	90.0
	1,800	89.3	89.5	86.0	86.0
	1,200	89.5	89.5	80.5	81.0
	900	89.3	88.5	77.5	78.0

2.14 ACCEPTABLE MANUFACTURER

A. U.S. Motors

B. General Electric

C. Equal

PART 3 - EXECUTION

3.1 ERECTION

A. Motors shall be factory installed on common bases, stands, etc., with the driven equipment. Provide suitable couplings and guards between motor and driven equipment.

B. Align and connect to driven equipment.

C. Connect motors to power supply and controllers and verify correct rotation of equipment.

3.2 INSTALLATION CHECK

A. Provide services of an experienced, competent, and authorized representative of the manufacturer to visit site of work and inspect, check, adjust if necessary, and approve equipment installation for motors 25 hp and larger.

B. Assure that equipment manufacturer's representative is present when equipment is placed in operation.

C. Verify that equipment representative revisits jobsite as often as necessary until all trouble is corrected and equipment installation and operation are satisfactory, in the opinion of the Owner.

D. The Installing Contractor shall perform the following field checks:

1. Inspect each motor installation for any deviation from rated voltage, phase, or frequency and improper installation.

2. Visually check for proper phase and ground connections. Verify that multi-voltage motors are connected for proper voltage.

3. Check winding and bearing temperature detectors and space heaters for functional operation.

4. Test for proper rotation prior to connection to the driven equipment.

5. Test insulation (megger test) of all new and re-used motors in accordance with NEMA MG-1. Test voltage shall be 1000 VAC plus twice the rated voltage of the motor.

END OF SECTION 40 05 93

MOTOR DATA FORM

Equipment Name: _____ Equipment Number(s):_____

Site Location: _____

Nameplate Markings

Mfr: _____ Mfr Model: _____ Frame: _____ HP: _____

Volts: _____ Phase: RPM: _____ Service Factor: _____

FLA: _____ LRA: _____ Freq: _____ Ambient Temp Rating: _____°C

Time Rating:_____ (NEMA MG-10.35) Design Letter _____ (NEMA MG-1.16)

KVA Code Letter: _____ Insulation Class: _____

The following information is required for high efficiency motors only:

A. Guaranteed minimum efficiency at full load at NEMA efficiency index:

_____
(NEMA MG1-12.53B)

B. Nameplate or nominal efficiency: _____

Data Not Necessarily Marked on Name Plate

Type of enclosure: _____ Enclosure Material: _____

Temp rise: _____ °C (NEMA MG1-12.41, 42)

Space heater included: _____ Yes _____ No;

If yes, _____ Watts _____ Volts

Type of Rotor winding over-temperature protection, if specified:

Use the space below to provide additional information on other motor modifications, if specified:

_____

_____

SECTION 40 67 00 - CONTROL PANELS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide control panels, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section apply to local panels provided in equipment systems specified in other sections unless indicated otherwise in those sections.

1.2 REFERENCE STANDARDS

A. ASTM A 283 Low and Intermediate Tensile Strength Carbon Steel Plates

B. UL 508A Industrial Control Panels

1.3 SUBMITTALS

A. Submittals shall be furnished in accordance with Sections 01 33 00 – Submittal Procedures.

B. Shop Drawings: The Contractor shall submit shop drawings for each panel and enclosure provided under Division 40. The shop drawings shall completely define and document the construction, finish, layout, power circuits, signal and safety grounding circuits, fuses, circuit breakers, signal circuits, internally mounted instrumentation, face plate mounted instrumentation components, internal panel arrangements, and external panel arrangements. The submittal shall include the following:

1. A complete index shall appear in the front of each bound volume. Drawings and data sheets associated with a panel shall be grouped together with the panels being indexed by systems or process areas. Panel tagging and nameplate nomenclature shall be consistent with the requirements of the Contract Documents.

2. Scaled physical arrangement drawings drawn to scale that define and quantify the physical groupings comprising control panel sections, auxiliary panels, subpanels, and racks. Cutout locations with nameplate identifications shall be shown.

3. Front of panel layouts for all control panels.

4. Schematic/elementary diagrams shall depict all control devices and circuits and their functions.

5. Interconnection diagrams shall locate and identify all external connections between the control panel/control panel devices and associated equipment. These diagrams shall show interconnecting wiring by lines, designate terminal assignments, and show the physical location of all panel ingress and egress points.

6. A bill of material that enumerates all devices associated with the control panel.

PART 2 - PRODUCTS

2.1 GENERAL

A. Environmental Suitability: Indoor and outdoor control panels and instrument enclosures shall be suitable for operation in the ambient conditions associated with the locations designated in the Contract Documents. Heating, cooling, and dehumidifying devices shall be provided, as indicated, in order to maintain all instrumentation devices within 20 percent of the minimums and maximums of their rated environmental operating ranges. The Contractor shall provide all power wiring for these devices. Instrumentation in hazardous areas shall be suitable for use in the particular hazardous or classified location in which it is to be installed.

B. The control panel shall be the source of power for any 120 VAC solenoid valves interconnected with the control panel. Equipment associated with the control panel shall be ready for service after connection of conductors to equipment, controls, and control panel.

C. Instrument power circuits shall be fed from the associated PLC panel.

D. Control panels that do not contain motor controllers, shall not contain any voltages greater than 120VAC.

E. Unless indicated otherwise, control panels shall be housed in NEMA rated enclosures in accordance with Section 26 05 33 16 – Cabinets and Boxes For Electrical Systems. Panels shall be either freestanding, pedestal-mounted or equipment skid-mounted, as indicated. Internal control components shall be mounted on an internal back-panel or side-panel as required.

F. Each source of foreign voltage shall be isolated by providing disconnecting or pull-apart terminal blocks. Each control panel shall be provided with identified terminal strips for the connection of all external conductors. The Contractor shall provide sufficient terminal blocks to connect 25 percent additional conductors for future use.

G. Motor starters, where required, shall be in accordance with Section 26 29 13 13 – Across-the-Line Motor Controllers, 26 29 13 16 – Reduced-Voltage Motor Controllers, and Section 26 29 23 – Variable-Frequency Motor Controllers. Each motor starter shall be provided with contact closures for motor overload, local indication, and remote alarm. Discrete outputs from the control panel shall be provided by electrically isolated interposing relay contacts. Analog inputs and outputs leaving the envelope of the building shall be isolated 4-20 mA, 2-wire signals with power supply. All analog inputs and outputs shall be individually fused.

H. Control panel mounted devices shall be mounted a minimum of 3 feet above finished floor elevation.

2.2 CONTROL PANELS

A. Each PLC and remote I/O system and corresponding housing, including I/O modules, power supply modules, communication interface devices, and peripheral equipment shall be mounted inside a NEMA enclosure in accordance with Section 26 05 00 – Electrical, General. I/O wiring from the field to the remote I/O system shall be terminated on terminal blocks in the lower portion of the enclosure.

B. Materials: Panels shall be made of Grade 304 stainless steel. Panel section faces shall be No. 12 gauge minimum thickness for free standing panels and No. 14 gauge minimum thickness for wall mounted or pedestal mounted panels. Materials shall be selected for levelness and smoothness.

1. Relay rack high density type panels shall utilize standard relay racks with No. 14 gauge steel frame and supports.

2. Structural shapes and strap steel shall comply with ASTM A 283 - Low and Intermediate Tensile Strength Carbon Steel Plates, Grade C.

3. Bolting Material: Commercial quality carbon steel bolts, nuts, and washers shall be 1/2-inch diameter with UNC threads. Carriage bolts shall be used for attaching end plates. All other bolts shall be hex end machine bolts. Nuts shall be hot pressed hex, American Standard, heavy. Standard wrought washers shall be used for foundation bolts and attachments to building structures. Other bolted joints shall have SAE standard lock washers.

C. Construction: Dimensions shall be in accordance with vendor's requirements. Control panels greater than 84 inches in width shall be built in sections not to exceed 84 inches. Elevations and horizontal spacing shall be subject to Engineer's approval.

D. Fabrication: End plates, top plates, and top closure panels (to hung ceiling) shall be provided when required by the material requisition. End plates, top plates, and top closure panels shall be removable with countersunk bolts to match panels. Top closure panels shall be furnished in lengths which match the widths of standard panels, except that one top closure panel may extend across two 4-foot 6-inch wide or five 2-foot wide standard panels. The vertical joints of these panels shall align with the vertical joints of the standard panels.

1. End closure or rear closure doors shall be provided where required. Such doors shall be flush fitting, gasketed, and be of the hinged lift-off type with lockable door handles. A common key shall be provided for all doors on one panel assembly. Removable access panels shall be provided with dished handle fasteners. Screw driver 1/4 turn or Dzus type fasteners are not acceptable.

2. The flanged edges of all panels shall be straight and smooth. Corners shall be welded and ground smooth.

3. The face of the panel shall be true and level after angling.

4. All panel cutouts and holes may be cut or drilled by any standard method that does not cause deformation. Burrs shall be ground smooth.

5. Adjacent panels shall assemble with races flush. Gaps or cracks shall not be visible from the front of the assembled instrument board.

6. Stiffeners shall be welded to the back of panels, as required to prevent panel deformation due to the weight of face mounted instruments.

E. Preparation of Panel Surface: The following requirements apply to the front and rear face of the panel, both sides and the edges of all flanges, and the periphery of all holes or cutouts.

1. High spots, burrs, and rough spots shall be ground smooth.

2. The surfaces shall be sanded or sandblasted to a smooth, clean, bright finish.

3. All traces of oil shall be removed with a solvent.

4. The first coat of primer shall be applied immediately.

F. Instrument Finishing: The final coats applied to painted surface of instrument cases, doors, or bezels which are visible from the front of panels shall be manufacturer's standard unless otherwise indicated. Black Japan or "crinkle" finishes on instrument cases are not acceptable.

G. Mounting of Instruments: The panel vendor shall provide cutouts, and shall mount all instrument items indicated to be panel mounted, including any instruments indicated to be furnished by other vendors but installed in the panel.

1. The panel vendor shall also mount behind the panels other instrument accessory items as required for functionality as indicated.

2. Equipment mounted at the rear of panel shall be installed to allow for commissioning adjustments, servicing requirements, and cover removal.

3. Spare space shall be kept clear of wiring, etc., to give maximum space for future additions.

H. Panel Components:

1. Terminal Blocks.

a. Terminal blocks for power distribution and digital signals shall comply with the following requirements

1) Terminal blocks shall be UL rated for 600V, 30A minimum.

2) Terminal blocks shall have a compression-style screw clamp connection.

3) Terminal blocks shall be capable of accepting #12 AWG wire.

4) Terminal blocks directly associated with digital I/O signals shall be two-tier with pre-manufactured jumper bars for distribution of common signals.

b. Terminal blocks for analog signals shall comply with the following requirements:

1) Terminal blocks shall be UL rated for 300V, 20A minimum.

2) Terminal blocks shall have a compression-style screw clamp connection.

3) Terminal blocks shall be capable of accepting #16 AWG wire.

4) Terminal blocks shall be three-tier sensor blocks for termination of signal positive, negative, and shield with pre-manufactured jumper bars for distribution of common signals.

c. Fuse blocks shall comply with the following requirements:

1) Fuse blocks shall be UL rated for 600V, 10A minimum.

2) Fuse blocks shall incorporate a hinged lever that accepts 5x20 mm fuses.

3) Fuse blocks shall have a compression-style screw clamp connection.

4) Fuse blocks shall be capable of accepting #12 AWG wire.

5) Fuse blocks shall contain blown-fuse indication through the use of a neon lamp or an LED.

d. All terminal blocks and fuse blocks shall be designed for DIN rail mounting. Extra deep 15 mm DIN rail shall be used.

e. Contractor shall provide terminal block end sections and end stops as necessary for a complete installation.

f. Terminal blocks and fuse blocks shall be provided with pre-printed snap-on label strips. Stick-on labeling is not acceptable. Labeling shall be consistent with Contractor's control panel drawings. Contractor shall clearly label all terminal blocks in every control panel; unlabeled terminal blocks are not acceptable.

g. Terminal blocks and fuse blocks shall be ABB, Allen-Bradley, or approved equal.

2. Instrument Power: All instruments requiring power that are wired to a PLC shall also have power supplied from the same PLC control panel. All instrument power sources shall be individually fused.

3. Signal surge suppressors. Signal surge suppressors shall be provided for all analog signals leaving the envelope of the building.

a. Signal surge suppressors shall be Phoenix Contact TT-2-PE-24DC or equal.

4. Control Relays. Control relays shall comply with the following requirements:

a. Relays shall be plug-in style with a DIN-rail mountable base.

b. Relays shall have on/off indication.

c. General purpose control relays shall have 24VDC or 120VAC coil as required for application. Relay contacts shall be rated 10 Amp at 120VAC or 125VDC. Contractor shall be responsible for quantity of contacts as required for application. New general purpose control relays shall be Allen Bradley 700-HA series or equal.

d. Digital output interposing relays shall be terminal block style. Allen Bradley 700-HL series or equal.

5. Intrinsically Safe Barriers. Relays shall be solid-state electronic type in which the energy level of the sensing or actuation circuit is low enough to allow safe use in hazardous areas. Relays shall be located in non-hazardous areas. Relays shall be manufactured by GEMS, MTL, R.Stahl, Inc., or Turck.

6. Circuit Breakers. Circuit breakers for use in control panels shall be rated for 600V service.

a. Control panel circuit breakers shall be DIN-rail mounted.

b. Control panel circuit breakers shall be Allen-Bradley, Square D, or approved equal.

7. Surge Suppression. PLC control panels shall incorporate a transient-voltage surge suppressor on the incoming line. Surge suppressors shall be properly sized by the Contractor based upon the maximum current draw of the control panel.

a. Surge suppressors shall be Innovative Technology, Leviton, or equal.

8. DC Power Supplies. PLC control panels shall be provided with a redundant DC power supply system containing two identical 24VDC power supplies and a redundancy module to regulate loading.

a. DC Power Supplies shall be redundant. A redundancy module shall be used to regulate loading.

b. Size DC power supplies based upon the actual 24V load. Power supplies shall not be loaded more than 50% of rated capacity.

c. DC power supply systems shall be Sola HD SDN Series, ABB CP Series, or equal.

9. Digital Panel Indicators. Digital indicators shall be designed for semi-flush mounting in a panel. The indicator shall be a 3 1/2 digit LED, LCD, or gas discharge type display, with digits at least 0.5 inch high. The indicator shall be easily read at a distance of 10 feet in varying control room lighting environments. Operating temperature range shall be 32°F to 140°F. Accuracy shall be ±0.1 percent. The indicator shall be scaled in engineering units, with the units engraved on the display face or on the associated nameplate. The indicator shall have a selectable decimal point and shall provide over-range indication. Digital indicators shall be manufactured by Invensys/Eurotherm/Action Instruments, Newport Electronics, Precision Digital Corporation, or Red Lion Controls.

10. Selector Switches. Selector switches shall be 30.5-mm, heavy-duty, oil-tight type with gloved-hand or wing lever operators. Position legends shall be engraved on the switch faceplate. Switches for electric circuits shall have silver butting or sliding contacts, rated 10 amperes continuous at 120 V ac. Contact configuration shall be as indicated on the Drawings or for the application. Switches used in electronic signal circuits shall have contacts suitable for that duty. Switches shall be Eaton/Cutler-Hammer "10250T", General Electric "CR104P", or Allen Bradley “800T”.

11. Indicating Lights. Indicating lights shall be 30.5-mm, heavy-duty, oil-tight type, with full voltage LED lamps. Legends shall be engraved on the lens or on a legend faceplate. Lights shall be push-to-test type. Indicating lights shall be Eaton/Cutler Hammer "10250T", General Electric "CR104P", or Allen Bradley “800T”.

12. Pushbuttons. Push buttons shall be 30.5-mm, heavy-duty, oil-tight type. Legends shall be engraved on the push-button faceplate. Contacts shall be rated 10 amperes continuous at 120 V ac. Push buttons shall be Eaton/Cutler-Hammer "10250T", General Electric "CR104P", or Allen Bradley “800T”.

13. Alarm Horns. Horns shall be high-decibel, panel-mount, vibrating type designed for heavy-duty use. Horn volume shall be field-adjustable from 78 to 103 dB at 10 feet. Horns shall operate at 120 volts ac. Horns shall be weatherproof NEMA Type 4X. Horns shall be panel front mounted and shall be supplied with gasket. Horns shall be Edwards Signals “870P Series.”Horns shall be supplied with a field mounted enclosure. Horns shall be Edwards Signals “876 series.”

I. Electrical Requirements:

1. All conduit, wireways, switches, wire, and electrical fittings for 120 volt circuits to instruments and other electrical devices as required for a complete and operable installation.

2. Conduit, wireways, junction boxes and fittings shall be provided for signal wire, thermocouple, or resistance thermometer lead wire. Conduit or wireway runs shall include those required between temperature sensors and temperature transmitters and between the thermocouple wireway or junction box and instruments.

3. Each terminal connection shall have a plastic plate with a terminal and instrument tag number. Wiring shall be identified with stamped tubular wire end markers.

4. PLC control panels shall be provided with a 15 amp, 120 volt, service outlet circuit within the back-of-panel area.

5. PLC control panels shall be provided with fluorescent light and door activated switch.

6. Wall mounted or pedestal mounted panels shall be so sized as to adequately - dissipate heat generated by equipment mounted in or on the panel.

7. Control panels mounted outside shall be provided with thermostatically controlled heaters that maintain inside temperature above 40 degrees F.

8. Wiring Methods: Wiring methods and materials for all panels shall be in accordance with the NEC requirements for General Purpose (no open wiring) unless otherwise indicated. Control Panels shall be UL508A listed Control Panels.

9. Signal and Control Circuit Wiring: Wire type and sizes: Conductor shall be flexible stranded copper machine tool wire, UL listed Type MTW, and shall be rated 600 volts. Wires, including shielded cables, shall be No. 16 AWG minimum.

   a. Wire Insulation Colors: Ungrounded control circuit conductors operating at the supply voltage shall have a black insulation. Grounded circuit conductors shall have white insulation. Insulation for ungrounded AC control circuit conductors operating at less than the supply voltage shall be red. Wires energized by a voltage source external to the control panel shall have yellow insulation. Insulation for ungrounded DC conductors shall be blue. Insulation for grounded DC conductors shall be white with blue stripe. Twisted pair wiring shall be positive(+) black and negative(-) white/clear.

   b. Wire Marking: Wire numbers shall be marked using white numbered wire markers made from plastic-coated cloth, Brady Type B 500 or equal, or shall be heat shrink plastic.

   c. Flexible conduit is not acceptable except when specifically approved by the Engineer in writing. Conduit fittings shall be Crouse Hinds cast fittings or equal.

   d. Splicing of wires will only be allowed in junction boxes. Splices shall be either soldered or pressure crimped type.

   e. For case grounding, panels shall be provided with a 1/4-inch by 1-inch copper ground bus complete with soderless connector for one No.4 AWG bare stranded copper cable. The copper cable shall be provided by the Contractor and be connected to a system ground loop.

10. Power Supply: Unless otherwise indicated control panel primary power supplies shall be 120 volt, 60 Hz circuits. 24VDC subsystems shall be provided for PLC control panels and as indicated on the drawings.

J. Labor and Workmanship: Panels shall be fabricated, piped, and wired by fully qualified workmen who are properly trained, experienced, and supervised.

K. At a minimum, control panels shall be constructed in a UL shop and contain UL labels prior to shipment.

2.3 UNINTERRUPTIBLE POWER SUPPLY (UPS)

A. Provide and install UPS(s) to power all PLC hardware furnished under this Specification.

B. The UPS shall receive a 120 VAC, 60 HZ power input, and generate a 120 VAC, 60 HZ output signal which is protected from incoming spikes, sags, noise, brownouts, and power outages.

1. The UPS shall incorporate a transformer, a battery pack, a battery charger, an inverter, and a microprocessor based controller to provide continuous, on-line, computer grade uninterruptible power. Lighting and surge protection shall meet ANSI/IEEE c62.41 categories A and B. The UPS shall be U.L. listed. Spike attenuation shall be 2000 to 1. The output neutral shall be bonded to ground. Noise isolation shall be 120 Db common-mode, 60 Db normal mode. Output voltage regulation shall be + 3% with less than 5% total harmonic distortion. UPS efficiency shall be at least 85%. The UPS shall be rated for ambient temperatures from 32 degrees F to 104 degrees F and relative humidity from 0 to 95%

2. Each UPS shall maintain power to all of its connected loads, including non-constant loads such as alarms and printers, for a minimum of 15 minutes with a 50% growth factor over the connected load. The equipment submittal shall include sizing calculations which support the model and size selected. The UPS shall be supplied with a low output voltage cutoff to prevent damage to loads when the battery power is exhausted.

C. The equipment shall include sizing calculation which support the unit selected being able to power all its connected loads for the indicated time period with a 50% growth factor.

D. The uninterruptible power supply shall be Eaton Ferrups UPS series, Liebert, IPM or equal.

PART 3 - EXECUTION

3.1 LISTING AND INSTALLATION

A. Control Panels shall be fabricated in accordance with UL 508A, and shall be UL Listed Industrial Control Panels.

3.2 EQUIPMENT DELIVERY

A. Panels shall be crated for shipment using a heavy framework and skids. Panel sections shall be cushioned to protect the finish of the instruments and panel during shipment. Instruments which are shipped with the panel shall further have suitable shipping stops and cushioning material installed to protect parts which could be damaged due to mechanical shock. Each separate panel unit shall be provided with removable lifting lugs to facilitate handling.

B. Shipments by air ride van unless otherwise indicated. Control panel testing and inspection, if required, shall be performed prior to shipping.

3.3 CONTROL PANEL SIGNAL AND CONTROL CIRCUIT WIRING

A. Wiring Installation: Wires shall be run in plastic wireways except (1) field wiring, (2) wiring between mating blocks in adjacent sections, (3) wiring from components on a swing out panel to components on a part of the fixed structure, and (4) wiring to panel mounted components. Wiring run from components on a swing out panel to other components on a fixed panel shall be made up in tied bundles. These bundles shall be tied with nylon wire ties and shall be secured to panels at both sides of the "hinge loop" so that conductors are not strained at the terminals.

B. Wiring run to control devices on the front panels shall be tied together at short intervals with nylon wire ties and be secured to the inside face of the panel using adhesive mounts.

C. Wiring to rear terminals on panel-mount instruments shall be in plastic wireways secured to horizontal brackets above or below the instruments in about the same plane as the rear of the instruments.

D. Shop Drawings shall show conformance to the above wiring installation requirements.

E. Wire Marking: Each signal, control, alarm, and indicating circuit conductor connected to a given electrical point shall be designated by a single unique number which shall be shown on Shop Drawings. These numbers shall be marked on conductors at every terminal.

3.4 CALIBRATION, TESTING, AND INSTRUCTION

A. Calibration, testing, and instruction shall be performed in accordance with Section 40 79 23 – Testing, Calibration, and Commissioning.

B. Inspection and Approval: Panel fabricator shall conduct the following tests before shipment.

1. Alarm circuits rung out to determine their operability.

2. Electrical circuits checked for continuity and where applicable, operability.

3. Any other test required to place the panel in an operating condition.

C. It shall be the responsibility of the Contractor to furnish all necessary testing devices and sufficient manpower to perform the tests required by the Engineer.

D. Factory Acceptance Testing: PLC control panels shall be factory tested as required by Division 40 specifications.

E. Field Testing: Each control panel shall be tested again for functional operation in the field after the connection of external conductors and prior to equipment startup.

END OF SECTION 40 67 00

SECTION 40 72 00 - LEVEL MEASURING SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide level sensing equipment, complete and operable, in accordance with the Contract Documents.

1.2 SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 Submittals.

1.3 QUALITY ASSURANCE

A. Calibration: All level sensing equipment shall be shipped to the project site factory calibrated and accompanied with certificate of such.

B. Warranty: All sensors shall be provided with manufacturer's standard one-year product warranty.

PART 2 - PRODUCTS

2.1 SUBMERSIBLE PRESSURE SENSOR

A. Submersible pressure sensors shall consist of a transducer, transmitter/receiver, and control relays. The pressure sensing unit shall consist of a top half of a 316 stainless steel seal with a welded 316 stainless steel diaphragm. The liquid level shall be obtained by converting pressure sensed across a diaphragm-protected transducer element. A microprocessor shall amplify and convert the signal into a digital representation from pressure to a liquid level surface reading. An output is produced when manually determined trip values are exceeded. The microprocessor-based electronics shall enable user selection of range, span, setpoints, time delay, units of distance, and selectable failsafe mode. Relay setpoints shall be adjustable over the entire span without the use of reference targets. Automatic temperature compensation circuitry shall be incorporated.

1. Diaphragm: The diaphragm shall be glycerin-filled and be welded 316 stainless steel with a 0.13 cubic inch displacement.

2. Material: All wetted parts, including standoff ring, spacers, nuts and bolts shall be of 316 Stainless steel. The body shall be made of 300 stainless steel and shall be explosion-proof design. Cable shall be polyurethane-jacketed, and 40-ft shall be provided as standard.

3. Signal Output: A 4-20 MADC using 2-wire twisted pair grounded shield cable. FM and CSA explosion-proof and intrinsically safe with a response time less than 5 ms.

4. Accuracy: the pressure sensing transducer shall have a static accuracy of 0.25% FSO BFSL and a 1-year stability accuracy of 0.20% FSO.

5. Remote mounted units shall be provided with connecting cable provided by the manufacturer of the switches. Input power shall be 120 VAC.

6. Switches shall be SPBT with a minimum rating of 10 Amps at 120 V AC.

7. Repeatability shall be 0.1-inch or less with a response time of less than one second and an accuracy of plus or minus 0.25 percent of full scale.

B. Manufacturers, or equal

1. Blue Ribbon, Model BR313S

2. WIKA, LS-10 LevelGuard

3. Hach FL1500 Flow Sensor and Controller

4. Equal must be approved during bidding process.

2.2 NON-INTRUSIVE ULTRASONIC LEVEL SENSORS

A. Non-intrusive ultrasonic level sensors shall consist of a transducer, transmitter/receiver, and control relays. The sonic level switch transmitter shall generate pulses that are directed to the liquid level. The returning echo/signal shall be detected by the receiver. A microprocessor shall amplify and convert the signal into a digital representation of the distance from the reflecting surface. An output is produced when manually determined trip values are exceeded. The microprocessor-based electronics shall enable user selection of range, span, setpoints, time delay, units of distance, and selectable failsafe mode. Relay setpoints shall be adjustable over the entire span without the use of reference targets. Automatic temperature compensation circuitry shall be incorporated.

1. The transducer housing shall be PVC with corrosion resistant sensor element.

2. Remote mounted units shall be provided with connecting cable provided by the manufacturer of the switches. Input power shall be 120 V AC.

3. Switches shall be SPBT with a minimum rating of 10 Amps at 120 V AC.

4. Repeatability shall be 0.1-inch or less with a response time of less than one second and an accuracy of plus or minus 0.25 percent of full scale.

B. Manufacturer, or equal

1. SIEMENS HydroRanger 200

2. Equal must be approved during bidding process.

2.3 FLOAT SWITCHES

A. Float switch shall be a non-floating (tilting switch action only) SPDT submersible switch. The switch shall be intrinsically safe with a zener barrier between the switch contacts and the power source. The switch shall be sealed in a polypropylene housing with a submersible cable sealed in the float switch body. The switch shall be supplied with a cable with adequate length to reach the barrier location without splicing the cable.

PART 3 - EXECUTION

3.1 GENERAL

A. Mounting: All level sensing devices shall be mounted inside a PVC tube as shown on drawings with sufficient horizontal and/or vertical separation from other similar devices such that interference of signals is not possible. The Contractor shall verify installation requirements prior to mounting of similar level sensing devices.

END OF SECTION 40 72 00

SECTION 40 74 00 - TEMPERATURE MEASURING SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. General: The Contractor shall provide temperature-measuring systems, complete and operable, in accordance with the Contract Documents.

1.2 SUBMITTALS

A. The Contractor shall submit manufacturer's information for Engineer review in accordance with Section 01 33 00 – Submittal Procedures.

1.3 QUALITY ASSURANCE

A. Warranty: All temperature measuring systems shall be provided with manufacturer's standard one-year product warranty.

PART 2 - PRODUCTS

2.1 TEMPERATURE MEASURING SYSTEMS

A. Insertion type resistance temperature detectors (RTDs) shall be 100 ohms nominal at 0 degree C, tip-sensitive, 3 wire platinum in 1/4-inch Type 316 stainless steel sheath with watertight potting. Time constant in agitated water shall not exceed 6.0 seconds. RTD shall comply with International Practical Temperature Scale (IPTS) 68 standards. Accuracy shall be plus or minus 0.1 degree C. Temperature transmitters shall be 2 wire devices with continuously adjustable span and zero adjustments, integral direct reading indicator, solid state circuitry, and a 4 - 20 mA DC output linearly proportional to the indicated temperature span. Where indicated with thermowells, RTDs shall be provided with 316 stainless steel thermowell, spring-loading device, extensions, union coupler, and explosion-proof aluminum connection head. Union shall extend out beyond the pipe lagging. Surface type RTDs shall be a 100 ohm nominal at 0 degree C, 3 wire platinum element in a flexible watertight case for strapping to a pipe surface.

B. Temperature transmitters shall be 2 wire devices with continuously adjustable span and zero adjustments, integral direct reading indicator, solid state circuitry, and a 4 - 20 mA DC output linearly proportional to the indicated temperature span.

C. Where indicated with thermowells, RTDs shall be provided with 316 stainless steel thermowell, spring-loading device, extensions, union coupler, and explosion-proof aluminum connection head. Union shall extend out beyond the pipe lagging.

D. Surface type RTDs shall be a 100 ohm nominal at 0 degree C, 3 wire platinum element in a flexible watertight case for strapping to a pipe surface.

E. Resistance temperature detector assemblies shall be Rosemount Series 78, Moore Industries Ready to Install, or equal. Transmitter shall be Rosemount Model 3144/644, Moore Industries Ready to Install RTI2, or equal.

F. Resistance temperature for room detection shall be Versis Industries TE Series wall temperature sensor or equal.

2.2 BIMETALLIC TEMPERATURE DETECTION SWITCHES

A. Temperature switches shall be bimetallic type with 3/4-inch NPT thermowell process connection per applicable piping code. Switches shall have SPOT -contacts and be provided with an adjustable setpoint.

B. Bimetallic temperature detection switches shall be Mercoid Series FM-437 (water and oil service), Honeywell, or equal.

END OF SECTION – 40 74 00

SECTION 40 75 13 – PH/ORP ANALYZERS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide pH measuring equipment, complete and operable, in accordance with the Contract Documents.

1.2 SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures.

1.3 QUALITY ASSURANCE

A. Calibration: All pH measuring equipment shall be shipped to the project site factory calibrated and accompanied with certificate of such.

B. Warranty: A written Contractor's warranty shall be provided for the equipment specified in this Section. The warranty shall be for a minimum period of one (1) year from the date of Substantial Completion equipment. The Contractor shall repair or replace all defects of materials or workmanship in the equipment.

PART 2 - PRODUCTS

2.1 PH MEASURING SYSTEM

A. pH sensor housing shall be stainless steel body with 1 in. MNPT threads suitable for submerged or flow through installation. The sensor shall come standard with automatic temperature compensation.

B. Performance Requirements:

1. Measurement range: 0 to 14 pH
2. Sensitivity: 0.01 pH
3. Stability: 0.03 pH per 24 hours, non-cumulative
4. Maximum sample flow rate: 10 feet per second
5. The minimum temperature range is 0 to 50°C
6. The minimum temperature accuracy is ± 0.2°C

C. pH transmitter housing shall be NEMA 4X, weatherproof, corrosion resistant enclosure or epoxy-painted aluminum and shall include a front panel membrane keyboard for configuration. The unit shall include (2) independent 4-20 mA signals and (2) process alarm outputs. Unit shall operate in ambient temperature of 0-50 Degrees C.

D. Calibration Equipment: One set of standard buffers shall be supplied per manufacturer's recommendations to permit onsite calibration.

E. Manufacturer:

1. Hach

2. Rosemount

3. Or preapproved equal.

PART 3 - EXECUTION

3.1 SERVICE REPRESENTATIVE

A. Erection and Startup Assistance: During erection and startup, the Contractor shall obtain all necessary assistance from an experienced factory service representative to ensure a correct and first-class installation, in accordance with the manufacturer's instructions.

B. Instruction of Owner's Personnel: After completion of the installation and during startup of the plant, the Installation Contractor shall instruct the Owner's personnel in the proper operation, maintenance and repair of all equipment.

END OF SECTION 40 75 13

SECTION 40 75 43 – DISSOLVED OXYGEN MEASURING SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall provide dissolved oxygen (D.O.) measuring equipment, complete and operable, in accordance with the Contract Documents.

1.2 SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures.

1.3 QUALITY ASSURANCE

A. Calibration: All D.O. measuring equipment shall be shipped to the project site factory calibrated and accompanied with certificate of such.

B. Warranty: A written Contractor's warranty shall be provided for the equipment specified in this Section. The warranty shall be for a minimum period of one (1) year from the date of Substantial Completion equipment. The Contractor shall repair or replace all defects of materials or workmanship in the equipment.

PART 2 - PRODUCTS

2.1 DISSOLVED OXYGEN MEASURING SYSTEM

1. The dissolved oxygen (D.O.) monitoring system shall consist of a sensor, analyzer, and auxiliary equipment to facilitate mounting the D.O. monitoring system.

2. The system shall output a signal proportional to the dissolved oxygen level and the measured temperature. The analyzer shall meet NEMA 4X/IP66 requirements and shall be supplied with sufficient cable to connect the probes to the transmitter/indicators (22.9 feet minimum). The system shall be able to display the following parameters at a minimum:

   a. Dissolved Oxygen Concentration

   b. Temperature

   c. Relay Status

   d. Selected Salinity at Calibration

   e. Selected Value for Alarm Relays (High and Low Dissolved Oxygen)

   f. Error Pending and Error Log

   g. The system shall be able to perform automatic calibration of the dissolved oxygen monitoring system. The Power supply shall be 115 VAC, +10%, -15%.

3. The wetted probe shall sense the dissolved oxygen concentration via a luminescent sensor. The signal from the sensor shall be tied to the interface unit that will send all pertinent data to the PLC via ethernet cable. The dissolved oxygen transmitter shall be utilized for monitoring the dissolved oxygen concentration in the tank.

4. The measuring principle shall be based on luminescent material that is sensitive to oxygen.

5. Sensor replacement shall not require factory service personnel to be present. Calibration shall be accomplished in free air and will not require special chemical baths.

6. The interface unit shall be housed in a NEMA 4X/IP66 metal enclosure with a corrosion-resistant finish. The panel must be complete with terminal strips and wire ducts (if needed).

7. The interface unit shall be capable of managing a minimum of six (6) inputs.

8. Operation Characteristics:

   a. The dissolved oxygen probe shall be a continuous-reading probe that utilizes luminescent sensor technology.

   b. The probe will not require calibration more frequently than once every six months.

   c. The probe material shall be formed either Noryl® and 316 Stainless Steel or 316Ti, POM, and PVC. All parts of the probe shall be corrosion resistant and fully immersible.

   d. The sensor material shall be either poly butyl mehoacrolate or PMMA, PVC and silicone.

   e. The measurement range shall be 0.00 to 20.00 mg/L dissolved oxygen with an accuracy of ±0.2 ppm.

   f. The operation of the analyzers shall not be affected by H_2S, pH, K^{+1}, Na^{+1}, Mg^{+2}, Ca^{+2}, NH_4^{+1}, Al^{+3}, Pb^{+2}, Cd^{+2}, Zn^{+2}, $Cr_{(total)}$, Fe^{+2}, Fe^{+3}, Mn^{+2}, Cu^{+2}, Ni^{+2}, Co^{+2}, CN^{-1}, NO_3^{-1}, SO_4^{-2}, S^{-2}, $PO_4^{+}3$, Cl^{-1}, anion-active tensides, crude oils, or Cl_2.

   g. The sensor shall be supplied with a microprocessor-based analyzer. The analyzer shall contain a digital display with menu-driven software, two analog 4-20 mA outputs and 3 unpowered SPDT form ‘C’ alarm contacts. The controller shall be enclosed in a corrosion resistant IP66 enclosure.

   h. The probe shall provide electrolyte-free operation without the requirements of sample conditioning.

   i. The probe shall be furnished with a mounting kit.

   j. The temperature range is 0 to 50°C.

   k. The temperature accuracy is ± 0.2°C.

9. The dissolved oxygen sensor shall be suitable for submerged or flow through installation.

10. Spare Parts

    a. Supplier shall provide a minimum of one (1) spare DO probe for shelf stock.

    b. Supplier shall provide a minimum of one (1) spare interface unit (transmitter) for shelf stock.

11. Manufacturer of D.O. sensors and analyzers, or equal

    a. Hach LDO2 transmitter (Part No. 9020000) with Hach SC1000 controller (Part No. LXV402.99.12002) and Hach Sunroof and Mounting Hardware for SC1000 Controller (Part No. LZX957).

    b. YSI Optical DO with System 2020 3G – 20 Channel Terminal/Controller, IQ Sun Shield, and Rail Mounting Kit.

    c. Equal must be approved during bidding process

PART 3 - EXECUTION

3.1 SERVICE REPRESENTATIVE

A. Erection and Startup Assistance: During erection and startup, the Contractor shall obtain all necessary assistance from an experienced factory service representative to ensure a correct and first-class installation, in accordance with the manufacturer's instructions.

B. Instruction of Owner's Personnel: After completion of the installation and during startup of the plant, the Installation Contractor shall instruct the Owner's personnel in the proper operation, maintenance and repair of all equipment.

END OF SECTION 40 75 43

SECTION 40 79 23 – TESTING, CALIBRATION, AND COMMISSIONING

PART 1 - GENERAL

1.1 GENERAL PROCEDURES FOR INSPECTION, TEST, AND INSTRUMENT CALIBRATION

A. Each instrument shall be checked against the latest version of the design documents for tagging, manufacturer, model number, range, action, etc., before functional testing or calibration.

B. Any air system, permanent or temporary, used for energizing instrumentation shall be dry and clean at all times, and be blown down thoroughly before use. Any connection between the air supply system shall be via proper filter and regulator.

C. Plastic sealing plugs shall be used for all pneumatic connections and tubing except during test and immediately before final connection in the field.

D. Care shall be observed when connecting electric power supplies to the instrumentation. Insure correct voltage and frequency on AC power supplies. Insure correct voltage, polarity, and superimposed ripple on DC power supplies. Insure correct polarity of the supply and proper grounding before connecting instruments.

E. The Instrumentation and Control Systems Contractor shall satisfy the requirement that the installation, calibration, and checkout of the instruments meet the requirements of the project specifications.

F. The Calibration procedures for verifying instrument precision should conform to accepted practices as outlined in ASTM, ASHRAE, ISA, etc. specifications.

G. The Instrumentation and Control Systems Contractor shall provide copies of manufacturer's installation and calibration instructions to the calibration technicians prior to the commencement of calibration.

1.2 INSTRUMENT QUALITY LEVELS AND METEROLOGY

A. Instrumentation supplied for the calibrating sensing instruments for facility control system shall include documentation concerning the calibration method and traceability to the National Institute for Standards and Testing (NIST).

B. Process instrumentation shall be field checked for accuracy before installation even if the instruments have been calibrated by the manufacturer's metrology facilities.

PART 2 - PRODUCTS

2.1 CALIBRATION AND TEST EQUIPMENT

A. All calibration and test equipment shall be in proper working order and calibrated using traceable standards and equipment set by the NIST. Certificates of traceability shall be kept on file in the field calibration office or field project office. Copies of the traceability documents shall be included with the submittal of the calibration forms.

B. All calibration and test equipment shall carry a documented current calibration sticker reflecting the date of the last calibration and the name or initials of the technician who performed the calibration. A current calibration will be performed before the equipment is shipped to the site. The calibration equipment shall be shipped directly from the calibrating authority to the site, in packaging provided by the calibrating authority. A current calibration will be performed for all calibration or test equipment every 180 days or within the normal calibration interval, whichever is less.

C. Any field instruments calibrated with test equipment whose calibration has expired will be rejected and will be required to be recalibrated.

D. All Calibration and test equipment shall be of a higher accuracy than the instrument being calibrated. The manufacturer's recommendations for calibration accuracy will prevail in all instances.

E. The Control Systems Contractor shall supply calibration and test equipment of sufficient quantity, quality, and type to calibrate the instruments and sensors used in the installation.

2.2 BENCH TEST AND CALIBRATION FORMS AND METHODOLOGY

A. Calibration forms and calibration procedures for each instrument type shall be generated by the Instrumentation and Control Systems Contractor and approved by the Owner or his representative before proceeding with any calibrations. The manufacturer's procedures or the Owner's existing procedures shall form the basis for the calibration procedure.

B. The following format shall be used for instrument calibration form:

1. A separate calibration form shall be generated for similar types of instruments that have different accuracy and tolerance requirements.

2. The form shall contain as found and as calibrated data areas. The form shall contain areas for the calibrating and test instruments manufacture, serial number, and date of calibration.

3. The forms shall be filled out and signed in black ink.

4. Those instruments that can shall be calibrated on the bench under controlled conditions. Care shall be taken with those instruments that must be calibrated in the field to approximate the conditions of the bench test.

PART 3 - EXECUTION

3.1 GENERAL

A. The Control Systems Contractor shall calibrate all instrumentation in an environment suitable to quality testing procedures. High accuracy comparative instruments or mechanisms shall be the standard against which instrument calibration is tested.

B. Verify that all process and test instruments have been calibrated and traceable to the NIST or other appropriate reference standards. Verify that a calibration sticker has been affixed to the instrument and that each instrument is within its calibration period at the time that the calibration is performed.

C. Each instrument shall be calibrated as per Owner approved calibration procedures and forms.

D. Each instrument shall have a calibration sheet completely filled out with all pertinent data related to the calibration and system. These calibration sheets shall be organized in a binder by system and turned over to the Owner at the completion of the project.

E. Instruments shall have a calibration sticker placed on the instrument. The sticker shall not be placed until the instrument has successfully completed the calibration procedure and the associated calibration form has been filled out and signed. The sticker shall bear the date of calibration and expiration and initials of the technician certifying calibration.

END OF SECTION 40 79 23

SECTION 43 05 01 - EQUIPMENT GENERAL PROVISIONS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The provisions of this Section apply to all sections of Divisions 41 to 46 unless specifically revised therein.

B. Furnish each piece of equipment complete with its base, drives, shafting, couplings, controls, guards, and other appurtenances which are specified or are required for proper and safe operation.

C. Furnish any special tools or equipment required for proper operation maintenance, testing, or adjusting.

1.2 REFERENCE STANDARDS

A. Codes: All codes, as referenced herein, are specified in Section 01 42 19 – Reference Standards.

B. Equipment shall be in accordance with the following standards, as applicable and as indicated in each equipment specification:

1.	AFBMA	Anti-Friction Bearing Manufacturers Association, Inc.
2.	ASTM	American Society for Testing and Materials
3.	ANSI	American National Standards Institute
4.	ASME	American Society of Mechanical Engineers
5.	AWWA	American Water Works Association
6.	ASHREA	American Society of Heating, Refrigerating, and Air Conditioning Engineers
7.	AWS	American Welding Society
8.	NFPA	National Fire Protection Association
9.	NEMA	National Electrical Manufacturers Association
10.	OSHA	General Industry Safety Orders

C. The following standards are referenced in this and other Divisions 41 to 43 and Division 46:

1.	ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800

2.	ANSI B16.5	Pipe Flanges and Flanged Fittings, Steel, Nickel Alloy and other Special Alloys
3.	ANSI B46.1	Surface Texture
4.	ANSI S12.6	Method for the Measurement of the Real-Ear Attenuation of Hearing Protectors
5.	ASME B1.20.1	General Purpose Pipe Threads (Inch)
6.	ASME B31.1	Power Piping
7.	AWWA C206	Field Welding of Steel Water Pipe
8.	AWWA C207	Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144-inches (100 mm through 3,600 mm)
9.	AWWA D100	Welded Steel Tanks for Water Storage
10.	ASTM A48	Gray Iron Castings
11.	ASTM A108	Steel Bars, Carbon, Cold-Finished, Standard Quality
12.	ASME B17.1	Keys and Keyseats
13.	ASME B106.1M	Design of Transmission Shafting

1.3 SUBMITTALS

A. Submittals shall be made in accordance with Section 01 33 00 – Submittal Procedures and the specific equipment specifications sections.

B. Shop Drawings: Furnish complete drawings and technical information for equipment, piping, valves, electrical and controls. Where indicated or required by the Engineer, Shop Drawings shall include clear, concise calculations showing equipment anchorage forces and the capacities of the anchorage elements proposed by the Contractor.

C. Spare Parts List: The Contractor shall obtain from the manufacturer and submit at the same time as Shop Drawings a list of suggested spare parts for each piece of equipment. Contractor shall also furnish the name, address, and telephone number of the nearest distributor for each piece of equipment.

D. Operation and Maintenance Manual: Provide technical operation and maintenance manuals in accordance with Section 01 78 23 – Operation and Maintenance Data.

1.4 ADAPTATION OF EQUIPMENT

A. The Contractor shall furnish equipment readily adaptable for installation and operation. Equipment furnished shall be compatible with all other equipment furnished under the Contract.

B. The Contractor shall assume full responsibility for all modifications of mechanical and electrical controls, equipment, wiring, piping, as required to accomplish function intended by the Contract Documents.

1.5 QUALITY ASSURANCE

A. Guarantees: Unless otherwise accepted herein, guarantee all equipment and its install required. Guarantees shall cover the following: (1) Faulty or inadequate design; (2) Improper assembly or erection; (3) Leakage, breakage, or other failure; and (4) Defective workmanship or materials.

B. Inspection, Start-up and Field Adjustment: The Contractor shall demonstrate that all equipment meets the specified performance requirements. Contractor shall provide the services of an experienced, competent, and authorized service representative of the manufacturer of each item of major equipment who shall visit the site of Work to perform the following tasks:

1. Assist the Contractor in the installation of the equipment.

2. To inspect, check, adjust if necessary and approve the equipment installation.

3. To start-up and field-test the equipment for proper operation, efficiency, and capacity.

4. To perform necessary field adjustments during the test period until the equipment installation and operation are satisfactory to the Engineer.

5. To instruct the Owner's personnel in the operation and maintenance of the equipment. Instruction shall include step-by-step trouble shooting procedures with all necessary test equipment.

C. Quality and Tolerances: Tolerances and clearances shall be as shown on the Shop Drawings and shall be closely adhered to.

D. Machine Finish: The type of finish shall be the most suitable for the application and shall be shown in micro-inches in accordance with ANSI B46.1

E. Manufacturer's Experience: Equipment manufacturer shall have a record of at least 5 years of successful, trouble free operation in similar applications and size equal or larger than the equipment in this contract.

PART 2 - PRODUCTS

2.1 GENERAL

A. Protection of Equipment: Equipment shall be boxed, crated, or otherwise protected from damages and moisture during shipment, handling, and storage. Equipment shall be protected from exposure to corrosive fumes and shall be kept thoroughly dry at all times. Pumps, motors, drives, electrical equipment, and other equipment having anti-friction or sleeve bearings shall be stored in weather tight storage facilities prior to installation. For

extended storage period, plastic equipment wrappers shall be avoided to prevent accumulation of condensate in gears and bearings. In addition, motor space heaters shall be energized, and shafts shall be rotated. Equipment delivered to the Site with rust or corroded parts shall be rejected. If equipment develops defects during storage, it shall be disassembled, cleaned and recoated to restore it to original condition.

B. Identification Equipment Items: At the time of shipping, each item of equipment shall have a legible identifying mark corresponding to the equipment number in the Contract Documents for the particular item.

C. Protective Coating: Equipment shall be painted or coated in accordance with manufacturer's standard system, unless otherwise indicated. Non-ferrous metal and corrosive-resisting steel surfaces shall be coated with grease or lubricating oil. Coated surfaces shall be protected from abrasion or other damage during handling, testing, storing, assembly and shipping.

D. Controls: Equipment and system controls shall be in accordance with Division 26 and Division 40.

E. All flanges on equipment and appurtenances provided under this Section shall conform to ANSI B16.1, Class 125; or B16.5, Class 150, unless otherwise shown. All pipe threads shall be in accordance with ANSI/ASME B1.20.1.

F. Nameplates: Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in an accessible location with No. 4 or larger oval head stainless steel screws or drive pins. Nameplates shall contain the manufacturer's name, model, serial number, size, characteristics, and appropriate date describing the machine performance ratings.

G. Tools: The Contractor shall furnish one complete set of special wrenches and other special tools necessary for the assembly, adjustment, and dismantling of the equipment. Tools shall be of best quality hardened steel forgoing with bright finish. Wrench heads shall have work faces dressed to fit nuts. Tools shall be suitable for professional work and manufactured by Snap On, Crescent, Stanley, or equal. The set of tools shall be neatly mounted in a labeled toolbox of suitable design provided with a hinged cover.

H. Lubricants: The Contractor shall install lubricants for all equipment during storage and prior to initial testing of the equipment. After successful initial testing, final testing, and satisfactory completion startup testing, the Contractor shall conduct one complete lubricant change on all equipment. In addition, the Contractor shall be responsible for the proper disposal of all used lubricants. The Owner will then be responsible for subsequent lubricant changes.

I. Hazardous Location Rating of Equipment: Equipment manufacturer shall reference the hazardous-area classification drawing in the Contract Documents and provide equipment in compliance with the defined NEC- classification requirements. It will be the manufacturer's sole responsibility to submit equipment in compliance with the Contract Documents, NFPA 820, and NEC requirements.

2.2 EQUIPMENT SUPPORTS

A. All pipe connections to equipment shall be supported, anchored and guided to avoid stresses and load on equipment flanges and equipment. Supports and hangers shall be in accordance with the requirements of Section 43 05 50 - Equipment Mounting.

2.3 NOISE REQUIREMENTS

A. Noise Level: When in operation, no single piece of equipment shall exceed the OSHA noise level requirement of 105 dBA for one-hour exposure per day.

B. High Noise Level Location: The Contractor shall provide two personal hearing protection stations at the Blower Room.

C. Personal Hearing Protection: In each hearing protection station, the Contractor shall furnish three pairs of high attenuation hearing protectors in the original unopened packaging. The ear protectors shall be capable of meeting the requirements of ANSI S12.6 and shall produce a noise level reduction of 25 dBA at a frequency of 500 Hz. The hearing protectors shall have fluid filled ear cushions and an adjustable, padded headband. The protectors shall be stored in a weatherproof, labeled, steel cabinet, provided at an approved location near the noise producing equipment.

2.4 VIBRATION LIMITATIONS

A. Vibration frequencies shall span the range from 5.0 to 5,000 Hz. Where specified, measurements shall be obtained while the installed equipment is operating within the specified speed range.

B. Centrifugal Machines with Sleeve Bearings: Unless otherwise specified, centrifugal machines with sleeve bearing shafts shall not exhibit unfiltered RMS readings for vibration displacement in excess of the following:

Shaft speed range range, rpm	Displacement peak to peak, mils
Up to 900	3.5
901-1800	3.0
1801-3000	2.5
3001-4500	2.0
Above 4500	1.6

Displacement measurements shall be taken radially on the shaft at two points at each bearing. Measuring points shall be 90 degrees apart.

C. Centrifugal Machines with Antifriction Bearings: Unless otherwise specified, centrifugal machines with antifriction bearing shafts shall not exhibit unfiltered RMS readings for vibration velocity in excess of 0.12 inch per second. Velocity measurements shall be taken on one point of each bearing housing.

D. Positive Displacement Machines: Unless otherwise specified, positive displacement machines of the rotary, reciprocating and controlled volume types shall operate without any lateral or torsional vibration characteristics that may accelerate wear of the equipment. The Contractor shall provide manufacturer's certification that the manufacturer has inspected the machine under operating conditions and found it to comply with the manufacturer's requirements.

E. Vibration Isolators: Air compressors, blowers, engines, inline fans shall be provided with restrained spring-type vibration isolators or pads per manufacturer's written recommendations. Vibration isolations shall be provided with seismic restraint.

2.5 CRITICAL SPEED REQUIREMENTS

A. Unless otherwise specified, rotating mechanical equipment shall not exhibit critical speeds within the specified range of operating speeds and impeller blade pass frequencies. Critical speeds for equipment with rigid rotor systems shall be at least 20 percent greater than maximum operating speed and maximum impeller blade pass frequency, whichever is greater. Critical speeds for equipment with flexible shaft-rotor systems shall be at least 15 percent below minimum operating speed and 20 percent above maximum operating speed and blade pass frequency.

2.6 DRIVE TRAINS AND SERVICE FACTORS

A. Drive Trains and Service Factors: Service factors shall be applied in the selection or design of mechanical power transmission components. All components of drive train assemblies between the prime mover and the driven equipment shall be designed and rated to deliver the maximum peak or starting torque, speed, and horsepower. All of the applicable service factors shall be considered, such as mechanical (type of prime mover), load class, start frequency, ventilation, ambient temperature, and fan factors. Drive train components include couplings, shafts, gears, and gear drives, drive chains, sprockets, and V-belt drives. Unless otherwise indicated, the following load classification shall apply in determining service factors:

Type of Equipment	Service Factor	Load Classification
Centrifugal Fans	1.0	Uniform
Pumps		
Centrifugal or Rotary	1.0	Uniform
Reciprocating	1.8	Moderate Shock
Cranes or Hoists	1.25	Moderate Shock

B. Mechanical Service Factors

	Mechanical Service Factors
Uniform	1.25
Moderate Shock	1.50
Heavy Shock	2.0

C. For thermal rating adjustments such as start frequency, ambient temperature, and hourly duty cycle factor, ventilation factor, and fan factor, refer to gear manufacturer sizing information.

D. For service factors of electric motor, see Section 40 05 93 – Motor Requirements for Process Equipment

Where load classifications are not indicated, service factors based on AGMA 514.02 shall be used for standard load classification and for flexible couplings.

2.7 SHAFTING

A. Shafting shall be continuous between bearings and shall be sized to transmit the power required. Keyways shall be accurately cut in line. Shafting shall not be turned down at the ends to accommodate bearings or sprockets whose bore is less than the diameter of the shaft. Shafts shall rotate in the end bearings and shall be turned and polished, straight, and true.

B. Design Criteria: All shafts shall be designed to carry the steady state and transient loads suitable for unlimited number of load applications, in accordance with ASME B 106.1 M - Design of Transmission Shafting. Where shafts are subjected to fatigue stresses, such as frequent start and stop cycles, the mean stress shall be determined by using the modified Goodman Diagram. The maximum torsional stress shall not exceed the endurance limit of the shaft after application of the factor of safety of 2 in the endurance limit and the stress concentration factor of the fillets in the shaft and keyway. Stress concentration factor shall be in accordance with ASME Standard B17.1 - Keys and KeySeats.

C. Materials: Shafting materials shall be appropriate for the type of service and torque transmitted. Environmental elements such as corrosive gases, moisture, and fluids shall be taken into consideration. Materials shall be as indicated unless furnished as part of an equipment assembly.

1. Low carbon cold-rolled steel shafting shall conform to ASTM A 108, Grade 1018.

2. Medium carbon cold-rolled shafting shall conform to ASTM A 108, Grade 1045.

3. Other grades of carbon steel alloys shall be suitable for service and load.

4. Corrosion-resistant shafting shall be stainless steel or Monel, whichever is most suitable for the intended service.

D. Differential Settlement: Where differential settlement between the driver and the driven equipment may occur, a shaft of sufficient length with sets of universal type couplings shall be provided.

2.8 BEARINGS

A. Bearings shall conform to the standards of the Anti-Friction Bearing Manufacturers Association, Inc. (AFBMA).

B. To assure satisfactory bearing application, fitting practice, mounting, lubrication, sealing, static rating, housing strength, and lubrication shall be considered in bearing selection.

C. All re-lubricatable type bearings shall be equipped with an hydraulic grease fitting in an accessible location and shall have sufficient grease capacity in the bearing chamber.

D. All lubricated-for-life bearings shall be factory-lubricated with the manufacturer's recommended grease to insure maximum bearing life and best performance.

E. Anti-Friction Type Bearing Life: Except where otherwise indicated, bearings shall have a minimum 10 life expectancy of 10 years or 20,000 hours, whichever occurs first. Where so indicated, bearings shall have a minimum rated L-10 life expectancy corresponding to the type of service, as follows:

Type of service	Design Life, years	L-10 Design Life, hours
	(Whichever comes first)	
8-hour shift	10	20,000
16-hour shift	10	40,000
Continuous	10	60,000

F. Bearing housings shall be of cast iron or steel and bearing mounting arrangement shall be as indicated or as recommended in the published standards of the manufacturer. Split-type housings may be used to facilitate installation, inspection, and disassembly.

G. Sleeve Type Bearings: Sleeve-type bearings shall have a steel, cast iron or ductile iron housing and Babbitt or bronze liner. Bearing housing shall be bolted and doweled to the lower casing half. These housings shall be provided with cast iron caps bolted in place and the bearing end caps shall be bored to receive the bearing shells. Sleeve bearings shall be designed on the basis of the maximum allowable load permitted by the bearing manufacturer. If the sleeve bearing is connected to an equipment shaft with a coupling, the coupling transmitted thrust will be assumed to be the maximum motor or equipment thrust. Lubricant, lubrication system, and cooling system shall be as recommended by the bearing manufacturer.

H. Plate Thrust Bearings: Thrust bearings shall be the Kingsbury Type, designed and manufactured to maintain the shaft in the fixed axial position without undue heating or the necessity of adjustment or attention. Bearings shall be oil lubricated to suit the manufacturer's standard method of lubrication for the specific bearing. If bearing cooling is required, manufacturer shall provide necessary piping, filters, and valves.

2.9 ELECTRIC MOTORS

A. All motors shall comply with requirements listed in Section 40 05 93 – Motor Requirements for Process Equipment. All variable frequency drive (VFD) controlled motors shall comply with NEMA MG-1 Design “B” requirements.

2.10 SPARE PARTS

A. Spare parts, where specified, shall be provided in clearly labeled boxes. Labels shall display “Mill City WPCF" a major piece of equipment to which the part belongs, the part name, and the manufacturer's part number.

PART 3 - EXECUTION

3.1 PROTECTION

A. Box, crate, or otherwise completely enclose and protect all equipment during shipment, handling, and off-site storage. Responsibility for storage on the job site will be assigned to the installing Contractor.

B. Protect equipment from exposure to elements and keep all items thoroughly dry at all times. Protect against impact, abrasion, discoloration and other damage. Protect electrical equipment, controls and insulation against moisture, freezing, or water damage.

3.2 INSTALLATION

A. Equipment shall be installed in accordance with the manufacturers written recommendations. The Contractor shall select or recommend the size and type of coupling required to suit each specific application; installation shall be per equipment manufacturer's printed recommendations. All insulating connections shall be installed in accordance with the manufacturer's printed instructions.

B. Alignment: Equipment shall be field tested to verify proper alignment.

3.3 SERVICES OF MANUFACTURER

A. Inspection, Startup, and Field Adjustment: Where required by individual sections, an authorized, experienced, and competent service representative of the manufacturer shall visit the Site for the number of days indicated in those sections to witness or perform the following and to certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation.

1. Installation of equipment

2. Inspection, checking, and adjusting the equipment and approving its installation

3. Startup and field testing for proper operation, efficiency, and capacity

4. Performing field adjustments during the test period to ensure that the equipment installation and operation comply with requirements

B. Instruction of the Owner's Personnel: Where required by the individual equipment sections, an authorized training representative of the manufacturer shall visit the Site for the number of days indicated in those sections to instruct the Owner's personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment. Instruction shall be specific to the models of equipment provided.

1. The representative shall have at least two years' experience in training. A resume of the representative shall be submitted.

2. Training shall be scheduled three weeks in advance of the scheduled session.

3. Proposed training material and a detailed outline of each lesson shall be submitted for review. Review comments from the Engineer shall be incorporated into the material.

4. The training materials shall remain with the trainees after the session. The Contractor shall videotape the training for later use by the Owner's personnel.

3.4 PACKAGED EQUIPMENT

A. When any system is furnished as pre-packaged equipment, the Contractor shall coordinate all necessary space and structural requirements, clearances, utility connections, signals, and outputs with subcontractors to avoid later change orders.

B. If the packaged system has any additional features (as safety interlocks, etc.) other than required by the Contract Documents, the Contractor shall coordinate such features with the Engineer and provide all material and labor necessary for a complete installation as required by the manufacturer.

3.5 FIELD TESTS

A. Where indicated by the individual equipment sections, equipment shall be field tested after installation to demonstrate satisfactory operation without excessive noise, vibration, or no overheating of bearings or motor.

B. The following field testing shall be conducted:

1. Start, check, and operate the equipment over its entire operating range. Vibration level shall be within the amplitude limits as indicated or as recommended by the reference applicable Standards.

2. Obtain, record and provide to Engineer concurrent readings of motor voltage, amperage, capacity, vibration, and bearing temperatures for each piece of major equipment.

C. The Engineer shall witness field testing. The Contractor shall notify the Engineer of the test schedule seven days in advance.

D. In the event that any equipment fails to meet the test requirements, the equipment shall be modified and resettled until it satisfies the requirement.

END OF SECTION 43 05 01

SECTION 43 05 50 - EQUIPMENT MOUNTING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This section specifies mounts, supports, and the anchorage for equipment, tanks, piping and accessories.

1.2 REFERENCE STANDARDS

A. Federal Specifications

1.	MIL-A-907E	Antiseize Thread Compound, High Temperature

B. Commercial Standards

1.	ASTM A 48	Gray Iron Castings
2.	ASTM A 193	Alloy Steel and Stainless Steel Building Materials for High Temperature Service
3.	ASTM A 194	Carbon and Allow Steel Nuts for Bolts for High Pressure and High Temperature Service
4.	ASTM A 307	Carbon Steel Bolts and Studs, 600,000 psi Tensile Strength
5.	ASTM A 325	Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

1.3 SUBMITTALS

A. Calculations and shop drawings shall be submitted for all of the work required above in accordance with Section 01 33 00 – Submittal Procedures. Anchor bolt and expansion bolt submittals shall be in accordance with requirements specified herein. All calculations must be made and signed by a civil or structural engineer currently registered in the State of Oregon.

B. Inasmuch as some anchorage or equipment mounting is to be made to poured-in-place concrete elements, it is imperative that these types of anchorage be coordinated with the concrete subcontractor so that anchorage may be installed at time of pouring. If calculations and anchorage details are not submitted prior to pouring of concrete, the Contractor shall become responsible for any strengthening of concrete elements because of superimposed seismic loading.

1.4 QUALITY ASSURANCE

A. Support, anchorage and mounting of all tanks, piping and equipment shall be designed and provided by Contractor according to manufacturer's recommendation, the latest version of the International Building Code and industry standards requirements, unless otherwise specified. All elements required to resist the calculated forces described herein or required by the equipment manufacturer shall be provided by the Contractor.

PART 2 - PRODUCTS

2.1 GENERAL

A. Equipment mountings shall be as shown. All equipment located in floor slabs shall be mounted on concrete pads. Where a steel or cast base is shown or specified between the equipment and the concrete pedestal, it shall be hot-dip galvanized after fabrication.

B. For belt driven equipment shown as in-line and piggyback, the base shall be, rectangular and the motor shall always be behind and above the driven equipment and never over the driven equipment unless approved by the Engineer. Motor mounting hardware for any belt driven configuration shall allow for belt tension adjustment.

2.2 EQUIPMENT SUPPORTS AND FOUNDATIONS

A. Steel Bases: Structural steel bases shall be rectangular in shape for all equipment other than centrifugal refrigeration machines and pump bases, which may be "T" or "L" 1 shaped where shown. Pump bases for split case pump shall include supports for suction and discharge base ells. All perimeter members shall be beams with a minimum depth equal to 1/10th of the longest dimension of the base. Beam depth need not exceed 14 inches provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Grout holes shall be provided for the bases of all equipment where vibration isolation is not specified. Where vibration isolation is required, height saving brackets shall be employed in all mounting locations to provide a base clearance of 1 inch.

2.3 CONNECTIONS

A. All pipe connections to equipment shall be supported, anchored, and guided to avoid stresses and loads on equipment flanges and equipment.

B. Flanges and Pipe Threads: All flanges on equipment and appurtenances provided under this Section shall conform to ANSI B16.1, Class 125; or B16.5, Class 150, unless otherwise shown. All pipe threads shall be in accordance with ANSI/ASME B1.20.1.

C. Unless otherwise indicated, equipment supports, anchors, and restrainers shall be adequately designed for static, dynamic, wind, and seismic loads. The design horizontal seismic force shall be the greater of: that noted in the general structural notes or as required by the governing building code, or 10 percent of gravity. Submitted design calculations for equipment supports shall bear the signature and seal of an engineer registered in the state wherein the project is to be built, unless otherwise indicted.

D. Equipment Foundations: Mechanical equipment, tanks, control cabinets, enclosures, and related equipment shall be mounted on minimum 4-inch high concrete bases unless otherwise indicated. Equipment foundations are indicated on Drawings. The Contractor through the equipment manufacturer shall verify the size and weight of equipment foundation to insure compatibility with equipment.

E. Couplings: Mechanical couplings shall be provided between the driver and the driven equipment. Flexible couplings shall be provided between the driver the driven equipment to accommodate sight angular misalignment, parallel misalignment, end float, and to cushion shock loads.

1. Unless otherwise indicated or recommended by the equipment manufacturer, coupling type shall be furnished with the respective equipment as follows:

Equipment Type	Coupling Type
Horizontal and end suction pumps	Gear or flexible spring
Vertical nonclog pumps, closed coupled	Flexible disk pack
Single stage centrifugal blowers	Flexible disk pack
Air compressors	Gear or flexible pack

2. Each coupling size shall be determined based on the rated horsepower of the motor, speed of the shaft, and the load classification service factor. The Contractor shall have the equipment manufacturer select or recommend the size and type of coupling required to suit each specific application.

3. Taper-Lock or equal bushing may be used to provide for easy installation and removal of shafts of various diameters.

2.4 ANCHOR BOLTS

A. The CONTRCTOR shall be responsible in providing anchor bolts for all owner–furnished equipment supplied to this project.

B. Anchor bolt holes in equipment support frames shall not exceed the bolt diameters by more than 25 percent, up to a limiting maximum oversizing of 1/4 inch. Minimum anchor bolt diameter shall be 1/2 inch. Anchor bolts shall be furnished with leveling nuts, the faces of which shall be tightened against flat surfaces as shown to not less than 10 percent of the bolt's safe tensile stress.

C. Tapered washers shall be provided where mating surface is not square with the nut.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Each piece of equipment shall be anchored to resist a minimum lateral force required by the code, the manufacturer of the equipment or a lateral seismic force of 40 percent of the

operating weight of the equipment, whichever is greater. This force shall be considered acting at the center of gravity of the piece under consideration. No equipment shall be anchored to vertical structural elements without written approval of the Engineer.

B. Equipment which is not vibration isolated shall be anchored directly to the, supporting floor system. In addition to the anchorage, all such equipment shall be internally designed so that all static and moving parts are anchored to the supporting framework to resist the imposed seismic force. All forces must be transmitted to the base in order to be anchored as required. Vibration isolated equipment shall be specially designed to meet these same requirements.

C. Equipment, tanks, piping supports, and anchorage located outside the building shall be designed to comply with the latest version of the International Building Code requirements.

D. All piping, raceways, accessories, and appurtenances, furnished with equipment shall be anchored to resist a lateral seismic force of 40 percent of its operating weight without excessive deflection. This force shall be considered acting at the center of gravity of the piece under consideration.

END OF SECTION 43 05 50

SECTION 43 05 60 – PROCESS EQUIPMENT TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes: Testing of mechanical equipment and systems.

B. Related Sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.

1.2 REFERENCES

A. American National Standards Institute (ANSI):

1. S1.4 Specification for Sound Level Meters.

B. Hydraulic Institute (HI).

1.3 SUBMITTALS

A. Test instrumentation calibration data.

B. Test plan specified in this Section.

C. Test result reports.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION

3.1 QUALITY CONTROL TESTING AND REPORTING

A. Scheduling and notification:

1. Witnessed source quality control tests: Schedule test date and notify Engineer at least 30 days prior to start of test.

2. Field quality control tests: Schedule test date and notify Engineer at least 7 days prior to start of test.

B. Testing levels:

1. Test equipment based on test levels specified in the equipment section of this Project.

2. Requirements for Test Levels 1 to 4 are defined below.

3. Test levels apply for both Source (Factory) Quality Control Tests and Field Quality Control Tests as specified in the equipment sections of this Project.

4. If testing is not specified in the equipment section, provide Level 1 testing.

C. Witnessing: Source Quality Control Tests not witnessed unless specified otherwise in the equipment section; Field Quality Control Tests shall be witnessed.

D. Instrumentation: Provide necessary test instrumentation which has been calibrated within 1 year from date of test to recognized test standards traceable to the National Institute of Standards and Technology, Washington, D.C. or approved source. Properly calibrated field instrumentation permanently installed as a part of the Work may be utilized for Field Quality Control Tests.

E. Temporary facilities and labor: Provide necessary fluids, utilities, temporary piping, temporary supports, temporary access platforms or access means and other temporary facilities and labor necessary to safely operate the equipment and accomplish the specified testing. With Owner's permission, some utilities may be provided by fully tested permanently installed utilities that are part of the Work.

F. Test fluids:

1. Factory tests: Use water or air as appropriate at ambient conditions unless specified otherwise in the equipment section.

2. Field tests: Use specified process fluid at available conditions.

G. Pressure testing: Hydrostatically pressure test pressure containing parts in the factory at the appropriate standard or code required level above the equipment component specified design pressure or operating pressure, whichever is higher. Submit pressure test reports before shipping.

H. Test measurement and result accuracy:

1. Use test instruments with accuracies as recommended in the appropriate referenced standards. When no accuracy is recommended in the referenced standard, use 1 percent or better accuracy test instruments. Improved (lower error tolerance) accuracies specified elsewhere prevail over this general requirement.

2. Do not adjust results of tests for instrumentation accuracy. Measured values and values directly calculated from measured values shall be the basis for comparing actual equipment performance to specified requirements.

I. Field testing:

1. Submit test plan as specified in this Section. Indicate test start time and duration, equipment to be tested, other equipment involved or required; temporary facilities required, number and skill or trade of personnel involved; safety issues and planned safety contingencies; anticipated effect on Owner's existing equipment and other information relevant to the test. Provide locations of all instruments to be used for testing. Provide calibration records for all instrumentation.

2. Prior to testing, verify equipment protective devices and safety devices have been installed, calibrated, and tested.

J. Reports: Submit reports for source and field-testing. Submit Source Quality Control Test result reports before shipping equipment to the field. Report features:

1. Report results in a bound document in generally accepted engineering format with title page, written summary of results compared to specified requirements, and appropriate curves or plots of significant variables in English units.

2. Include appendix with a copy of raw, unmodified test data sheets indicating test value, date and time of reading, and initials of person taking the data.

3. Include appendix with sample calculations for adjustments to raw test data and for calculated results.

4. Include appendix with the make, model, and last calibration date of instrumentation used for test measurements.

5. Include in body of report a drawing or sketch of the test system layout showing location and orientation of the test instruments relative to the tested equipment features.

3.2 EQUIPMENT TESTING, GENERAL

A. Tests for pumps, all levels of testing:

1. Test in accordance with applicable HI Standards in addition to the requirements in this and other sections.

2. Test tolerances: In accordance with appropriate HI Standards, except the following modified tolerances apply:

a. From 0 to plus 5 percent of head at the specified flows [rated design point flow].

b. From 0 to plus 5 percent of flow at the rated design point head.

c. No negative tolerance for the efficiency at the specified flows [rated design point].

d. No positive tolerance for vibration limits. Vibration limits and test methods in HI Standards do not apply, use limits and methods specified in this or other sections of the Specifications.

B. Tests for drivers: Test motors as specified in Section 40 05 93 – Motor Requirements for Process Equipment. Test other drivers as specified in the driver equipment section.

3.3 REQUIREMENTS FOR VIBRATION TESTING

A. Definitions:

1. Peak-to-peak displacement: The root mean squared average of the peak-to-peak displacement multiplied by the square root of 2.

2. Peak velocity: The root mean squared average of the peak velocity multiplied by the square root of 2.

3. Peak acceleration: The root mean squared average of the peak acceleration multiplied by the square root of 2.

4. High frequency enveloping: A process to extract very low amplitude time domain signals associated with impact or impulse events such as bearing or gear tooth defects and display them in a frequency spectrum of acceleration versus frequency.

a. Manufacturers: One of the following or equal:

1) Rockwell Automation, Entek Group, "Spike Energy" analysis.

2) CSI, "PeakVue."

5. Low speed equipment: Equipment or components of equipment rotating at less than 600 revolutions per minute.

6. High speed equipment: Equipment and equipment components operating at or above 600 revolutions per minute.

B. Vibration instrumentation requirements:

1. Analyzers: Use digital type analyzers or data collectors with anti-aliasing filter, 12 bit A/D converter, fast fourier transform circuitry, phase measurement capability, time wave form data storage, high frequency enveloping capabilities, 35 frequency ranges from 21 to 1,500,000 cycles per minute, adjustable fast fourier transform resolution from 400 to 6,400 lines, storage for up to one hundred 3,200 line frequency spectra, RS232C data output port, circuitry for integration of acceleration data to velocity or double integration to displacement.

a. Manufacturers: One of the following or equal:

1) Entek-IRD, Division of Rockwell Automation, Enpac 1200 with applicable data analysis software or Entek Model 838 analyzer with built in printer.

2) Computational Systems Inc., (CSI) Division of Emerson Electric, Model 2120A, Data Collector/analyzer with applicable analysis software.

2. Analyzer settings:

   a. Units: English, inches/second, mils, and gravitational forces.

   b. Fast fourier transform lines: Most equipment 1,600 minimum; for motors, enough lines as required to distinguish motor current frequencies from rotational frequencies, use 3,200 lines for motors with a nominal speed of 3,600 revolutions per minute; 3,200 lines minimum for High Frequency Enveloping; 1,600 lines minimum for low speed equipment.

   c. Sample averages: 4 minimum

   d. Maximum frequency (Fmax): 40 times rotational frequency for rolling element bearings, 10 times rotational frequency for sleeve bearings.

   e. Amplitude range: Auto select but full scale not more than twice the acceptance criteria or the highest peak, whichever is lower.

   f. Fast fourier transform windowing: Hanning Window.

   g. High pass filter: Minus 3 dB at 120 cycles per minute for high speed equipment. Minus 3 dB at 21 cycles per minute for low speed equipment.

3. Accelerometers:

   a. For low speed equipment: Low frequency, shear mode accelerometer, 500 millivolts per gravitational force sensitivity, 10 gravitational force range, plus/minus 5 percent frequency response from 0.5 hertz to 850 hertz, magnetic mount.

      1) Manufacturers: One of the following or equal:

         a) Wilcoxon Research, Model 797L.

         b) PCB, Model 393C.

   b. For high speed equipment: General purpose accelerometer, 100 millivolts per gravitational force sensitivity, 50 gravitational force range, plus/minus 3dB frequency response range from 2 hertz to 12,000 hertz when stud mounted, with magnetic mount holder.

      1) Manufacturers: One of the following or equal:

         a) Wilcoxon Research, Model 793.

         b) Entek-IRD Model 943.

C. Accelerometer mounting:

   1. Use magnetic mounting or stud mounting.

2. Mount on bearing housing in location with best available direct path to bearing and shaft vibration.

3. Remove paint and mount transducer on flat metal surface or epoxy mount for High Frequency Enveloping measurements.

D. Vibration testing results presentation:

1. Provide equipment drawing with location and orientation of measurement points indicated.

2. For each vibration measurement take and include appropriate data on equipment operating conditions at the time vibration data is taken; for pumps, compressors, and blowers record suction pressure, discharge pressure, and flow.

3. When Vibration Spectra Data required:

a. Plot peak vibration velocity versus frequency in cycles per minute.

b. Label plots showing actual shaft or part rotation frequency, bearing inner and outer race ball pass frequencies, gear mesh frequencies and relevant equipment excitation frequencies on the plot; label probable cause of vibration peaks whether in excess of specification limits or not.

c. Label plots with equipment identification and operating conditions such as tag number, capacity, pressure, driver horsepower, and point of vibration measurement.

d. Plot motor spectra on a log amplitude scale versus frequency.

4. For low speed equipment, plot peak vibration displacement versus frequency as well as velocity versus frequency.

5. Provide name of manufacturer and model number of the vibration instrumentation used, including analyzer and accelerometer used together with mounting type.

3.4 TESTING LEVELS

A. Level 1 Quality Control Tests:

1. Level 1 General Equipment Performance Test:

a. For equipment, operate, rotate, or otherwise functionally test for 15 minutes minimum after components reach normal operating temperatures.

b. Operate at rated design load conditions.

c. Confirm that equipment is properly assembled, equipment moves or rotates in the proper direction, shafting, drive elements and bearings are installed and lubricated in accordance with proper tolerances, and that no

unusual power consumption, lubrication temperatures, bearing temperatures, or other conditions are observed.

2. Level 1 Pump Performance Test:

   a. Measure flow and head while operating at or near the rated condition; for factory testing, testing may be at reduced speeds with flow and head corresponding to the rated condition when adjusted for speed using the appropriate affinity laws.

   b. Use of a test driver is permitted for factory tests when actual driver is given a separate test at its point of manufacture as specified in Section 26 08 00 – Field Electrical Acceptance Tests or the applicable equipment section. Use actual driver for field tests.

   c. Record measured flow, suction pressure, discharge pressure, and make observations on bearing temperatures and noise levels.

3. Level 1 Vibration Test:

   a. Test requirement:

      1) Measure filtered vibration spectra versus frequency in 3 perpendicular planes at each normally accessible bearing housing on the driven equipment, any gears and on the driver; 1 plane of measurement to be parallel to the axis of rotation of the component.

      2) Vibration spectra versus frequency shall be in accordance with Vibration Acceptance Criteria.

   b. Equipment operating condition: Test at specified maximum speed.

4. Level 1 Noise Test:

   a. Measure unfiltered overall A-weighted sound pressure level in dBA at 3 feet horizontally from the surface of the equipment and at a mid-point of the equipment height.

B. Level 2 Quality Control Tests:

1. Level 2 General Performance Test:

   a. For equipment, operate, rotate, or otherwise functionally test for at least 2 hours after components reach normal operating temperatures.

   b. Operate at rated design load conditions.

   c. Confirm that equipment is properly assembled, equipment moves or rotates in the proper direction, shafting, drive elements and bearings are installed and lubricated in accordance with proper tolerances, and that no unusual power consumption, lubrication temperatures, bearing temperatures, or other conditions are observed.

2. Level 2 Pump Performance Test:

   a. Test 2 hours minimum for flow and head at the rated condition; for factory testing, testing may be at reduced speeds with flow and head corresponding to the rated condition when adjusted for speed using the appropriate affinity laws.

   b. Use of a test driver is permitted for factory tests when actual driver is given a separate test at its point of manufacture as specified in Section 26 08 00 – Field Acceptance Tests. Use actual driver for field tests.

   c. Test for flow and head at 2 additional conditions; 1 at 25 percent below the rated flow and 1 at 10 percent above the rated flow.

   d. Record measured flow, suction pressure, discharge pressure, and observations on bearing temperatures and noise levels at each condition.

3. Level 2 Vibration Test:

   a. Test requirement:

      1) Measure filtered vibration spectra versus frequency and measure vibration phase in 3 perpendicular planes at each normally accessible bearing housing on the driven equipment, any gears and on the driver; 1 plane of measurement to be parallel to the axis of rotation of the component; measure actual rotational speeds for each vibration spectra measured using photometric or other tachometer input connected directly to the vibration data collector.

      2) Vibration spectra versus frequency shall be in accordance with Vibration Acceptance Criteria.

   b. Equipment operating condition: Repeat test requirements at design specified maximum speed and at minimum speed for variable speed equipment.

   c. Natural frequency test of field installed equipment:

      1) Excite the installed equipment and support system in 3 perpendicular planes, use same planes as operating vibration measurement planes, and determine the as-installed natural resonant frequency of the driven equipment, the driver, gears and supports.

      2) Perform test at each bearing housing, at each support pedestal, and for pumps on the suction and discharge piping.

      3) Perform with equipment and attached piping full of intended service or process fluid.

4. Level 2 Noise Test:

a. Measure filtered A-weighted overall sound pressure level in dBA for each of 8 octave band mid-points beginning at 63 hertz measured at 3 feet horizontally from the surface of the equipment at mid-point height of the noise source.

C. Level 3 Quality Control Tests:

1. Level 3 General Equipment Performance Tests:

a. For equipment, operate, rotate, or otherwise functionally test for at least 4 hours after components reach normal operating temperatures.

b. Operate at rated design load conditions for 1/2 the specified time; operate at each of any other specified conditions for a proportionate share of the remaining test time.

c. Confirm that equipment is properly assembled, equipment rotates in the proper direction, shafting and bearings are installed and lubricated in accordance with proper tolerances, and that no unusual noise, vibration or temperatures are observed.

d. Take appropriate capacity, power or fuel consumption, torque, revolutions per minute, pressure and temperature readings using appropriate test instrumentation to confirm equipment meets specified performance requirements at the design rated condition.

e. Bearing temperatures: During maximum speed or capacity performance testing, measure and record the exterior surface temperature of each bearing versus time.

2. Level 3 Pump Performance Test:

a. Test 4 hours minimum for flow and head at or near the rated condition; for factory testing, testing may be at reduced speeds with flow and head corresponding to the rated condition when adjusted for speed using the appropriate affinity laws.

b. Use of a test driver is permitted for factory tests when actual driver is given a separate test at its point of manufacture as specified in Section 26 08 00 – Field Electrical Acceptance Tests. Use actual driver for field tests.

c. Test each specified flow and head condition at the rated speed and test at minimum as well as maximum specified speeds; operate at each test condition for a minimum of 15 minutes; for factory testing, test at other speeds may be omitted if test driver at reduced speeds is used for rated condition testing.

d. Record measured shaft revolutions per minute, flow, suction pressure, discharge pressure; record measured bearing temperatures (bearing housing exterior surface temperatures may be recorded when bearing temperature devices are not required by the equipment section) and record observations on noise levels.

3. Level 3 Vibration Test:

   a. Requirements: Same as Level 2 vibration test except data taken at each operating condition tested and with additional requirements below.

   b. Perform High Frequency Enveloping Analysis for gears and bearings.

      1) Measure bearing element vibration directly on each bearing cap in a location close as possible to the bearing load zone that provides a smooth surface and direct path to the bearing to detect bearing defects.

      2) Report results in units of acceleration versus frequency in cycles per minute.

   c. Perform Time Wave Form analysis for gears, low speed equipment and reciprocating equipment; plot true peak amplitude velocity and displacement versus time and label the period between peaks with the likely cause of the periodic peaks (relate the period to a cause).

   d. Plot vibration spectra on 3 different plots; peak displacement versus frequency, peak acceleration versus frequency and peak velocity versus frequency.

4. Level 3 Noise Test: Measure filtered, un-weighted overall sound pressure level in dB at 3 feet horizontally from the surface of the equipment at mid-point height and at 4 locations approximately 90 degrees apart in plan view; report results for each of 8 octave band mid-points beginning at 63 hertz.

D. Level 4 Quality Control Tests:

1. Level 4 General Equipment Performance Test:

   a. For equipment, operate, rotate, or otherwise functionally test for at least 8 hours after components reach normal operating temperatures.

   b. Operate at rated design load conditions for1/2 the specified time; operate at each of any other specified conditions for a proportionate share of the remaining test time.

   c. Confirm that equipment is properly assembled, equipment rotates in the proper direction, shafting and bearings are installed and lubricated in accordance with proper tolerances, and that no unusual noise, vibration or temperatures are observed.

   d. Take appropriate capacity, power or fuel consumption, torque, revolutions per minute, pressure and temperature readings using appropriate test instrumentation to confirm equipment meets specified performance requirements at the design rated condition.

e. Bearing temperatures: During maximum speed or capacity testing, measure and record the exterior surface temperature of each bearing versus time.

2. Level 4 Pump Performance Test:

a. Test 8 hours minimum for flow and head; begin tests at or near the rated condition; for factory and field-testing, test with furnished motor at full speed.

b. Test each specified flow and head condition at the rated speed and test at minimum as well as maximum specified speeds; operate at each test condition for a minimum of 20 minutes or longer as necessary to measure required performance, vibration and noise data at each test condition.

c. Record measured shaft revolutions per minute, flow, suction pressure, discharge pressure; record measured bearing temperatures (bearing housing exterior surface temperatures may be recorded when bearing temperature devices not required by the equipment section) and record observations on noise levels.

d. Bearing temperatures: During maximum speed or capacity testing, measure and record the exterior surface temperature of each bearing versus time.

e. Perform efficiency and/or Net Positive Suction Head Required (NPSHr) and/or priming time tests when specified in the equipment section in accordance with the appropriate HI standard and as follows:

1) Perform NPSHr testing at maximum rated design speed, head and flow with test fluids at ambient conditions; at maximum rated speed, test at 15 percent above rated design flow, and 25 percent below rated design flow.

2) Perform efficiency testing with test fluids at maximum rated speed.

3) Perform priming time testing with test fluids at maximum rated speed.

3. Level 4 Vibration Test: Same as Level 3 vibration test.

4. Level 4 Noise Test: Same as Level 3 Noise Test except with data taken at each operating condition tested.

3.5 SOURCE QUALITY CONTROL

A. Test equipment as specified for each type of test at the test levels specified in equipment sections. Prepare and submit test reports as specified.

B. Inspection and balancing:

1. Statically and dynamically balance each of the individual rotating parts as required to achieve the required field vibration limits. Statically and dynamically balance the completed equipment rotating assembly and drive shaft components.

2. Furnish copies of material and component inspection reports including balancing reports for equipment system components and for the completed rotating assembly.

C. Critical speed of rotating equipment: Satisfy the following:

1. The first lateral and torsional critical speed of all constant, variable, and 2-speed driven equipment that is considered rigid such as horizontal pumps, all non-clog pumps, blowers, air compressors, and engines shall be at least 25 percent above the equipment's maximum operating speed.

2. The first lateral and torsional critical speed of all constant, variable, and 2-speed driven equipment that is considered flexible or flexibly mounted such as vertical pumps (vertical in-line and vertical non-clog pumps excluded) and fans shall at least 25 percent below the equipment's lowest operating speed.

3. The second lateral and torsional critical speed of all constant, variable, and 2-speed equipment that is considered flexible or flexibly mounted shall be at least 25 percent above the maximum operating speed.

3.6 FIELD QUALITY CONTROL

A. Test equipment as specified for each type of test at the test levels specified in equipment sections. Prepare and submit test reports as specified. Comply with latest version of applicable standards.

B. For variable speed equipment, conduct test to establish performance over the entire speed range and at the average operating condition. Establish performance curves for:

1. The speed corresponding to the rated maximum capacity.

2. The speed corresponding to the minimum capacity.

3. The speed corresponding to the average operating conditions.

3.7 VIBRATION ACCEPTANCE CRITERIA

A. Testing of rotating mechanical equipment: Tests are to be performed by an experienced, factory trained, and independent authorized vibration analysis expert.

B. Vibration displacement limits: Unless otherwise specified, equipment operating at speeds 600 revolutions per minute or less is not to exhibit unfiltered readings in excess of following:

Operating Speed (revolutions per minute)	Unfiltered (Overall) Peak-to-Peak Amplitude (mils)
	All Rotating Equipment
0 - 300	6.5
301 - 600	4.5
Note: For all equipment, axial shaft displacements not to exceed 50 percent of the maximum radial shaft displacements shown in the table relative to the casing.	

C. Vibration velocity limits: Unless otherwise specified, equipment operating at speeds greater than 600 revolutions per minute is not to exceed the following peak velocity limits:

Item	Unfiltered Overall Limit (inches per second)	Any Filtered Peak Limit (inches per second)
Non-Clog Solids Handling Centrifugal Pumps	0.35	0.25
Horizontal and Vertical In-Line Centrifugal Pumps (other than Non-Clog type)	0.18 (Input BHP 25 or less)	0.14 (Input BHP 25 or less)
	0.22 (Input BHP more than 25 but less than 100)	0.18 (Input BHP more than 25 but less than 100)
	0.25 (Input BHP 100 or more)	0.20 (Input BHP 100 or more)
Vertical Turbine, Mixed Flow, and Propeller Pumps	0.31 (Input BHP 100 or less)	0.22
	0.35 (Input BHP 125 or more)	0.25
Vertical Turbine, Mixed Flow, and Propeller Short Set Pumps	0.28 (Input BHP 100 or less)	0.21
	0.33 (Input BHP 125 or more)	0.24
Motors	See Applicable Motor Specification	
Gear Reducers, Radial	Not to exceed AGMA 6000-A88 limits	
Other Reducers, Axial	0.10	0.10
Centrifugal Fans and Blowers	0.15	0.10
Other Equipment, Radial	0.16	0.10
Other Equipment, Axial	0.10	0.10

D. Equipment operation: Measurements are to be obtained with equipment installed and operating within capacity ranges specified and without duplicate equipment running.

E. Additional criteria:

1. No narrow band spectral vibration amplitude components, whether sub-rotational, higher harmonic, or synchronous multiple of running speed, are to exceed 40 percent of synchronous vibration amplitude component without manufacturer's detailed verification of origin and ultimate effect of such excitation.

2. The presence of discernable vibration amplitude peaks in Test Level 2 or 3 vibration spectra at bearing inner or outer race frequencies shall be cause for rejection of the equipment.

3. For motors, the following shall be cause for rejection:

a. Stator eccentricity evidenced by a spectral peak at 2 times electrical line frequency that are more than 40 percent of the peak at rotational frequency.

b. Rotor eccentricity evidenced by a spectral peak at 2 times electrical line frequency with spectra side bands at the pole pass frequency around the 2 times line frequency peak.

c. Other rotor problems evidenced by pole pass frequency side bands around operating speed harmonic peaks or 2 times line frequency side bands around rotor bar pass frequency or around 2 times the rotor bar pass frequency.

d. Phasing problems evidenced by 1/3 line frequency side band spectral peaks around the 2 times electrical line frequency peak.

4. The presence of peaks in a High Frequency Enveloping spectra plot corresponding to bearing, gear or motor rotor bar frequencies or harmonics of these frequencies shall be cause for rejection of the equipment; since inadequate lubrication of some equipment may be a cause of these peaks, lubrication shall be checked, corrected as necessary and the high frequency envelope analysis repeated.

3.8 NOISE REQUIREMENTS AND CONTROL

A. Make measurements in relation to reference pressure of 0.0002 microbar.

B. Make measurements of emitted noise levels on sound level meter meeting or exceeding ANSI S1.4, Type II.

C. Set sound level meter to slow response.

D. Unless otherwise specified, maximum free field noise level not to exceed 85 dBA measured as sound pressure level at 3 feet from the equipment.

3.9 FUNCTIONAL AND OPERATIONAL TESTING OF EQUIPMENT

A. General checkout: Prior to operating equipment, inspect, test, and check supporting systems, including but not limited to power systems, control systems, piping systems, lubrication systems, and safety systems.

1. Test and calibrate instrumentation and electrical devices as specified in Section 26 08 00 - Field Electrical Acceptance Tests and Section 40 79 23 - Testing, Calibration, and Commissioning.

2. As a minimum for control systems associated with the equipment, perform the following:

a. Individual Loop Tests: Test from field device to intermediate terminations to controller and back to controlled element.

b. End-to-end test: Simulate input at field device and observe control system response at the final field control element.

3. Prior to testing, provide signed and dated certificates of calibration for test instrumentation and equipment.

B. Operation of related existing equipment: Owner will operate related existing equipment or facilities necessary to accomplish the testing.

C. Acceptable tests: Demonstrate the equipment performance meets the requirements of this Section and the equipment section; when the equipment fails to meet the specified requirements, perform additional more detailed testing to determine the cause, correct, repair, or replace the causative components and repeat the testing that revealed the deficiency.

END OF SECTION 43 05 60

SECTION 43 11 31 – ROTARY HELICAL SCREW BLOWERS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This Section specifies the rotary screw positive displacement blowers used for mixing and process air for the activated sludge aeration basins.

B. The blower supplier shall furnish blowers complete with intake filter, intake and discharge silencers, pressure relief valve, full bore flapper type check valve, discharge butterfly valve, pressure and temperature gauges, motor, v-belt drive, base plate, and all appurtenances specified. All piping required between the blower and the discharge butterfly valve shall be provided. Complete unit shall be assembled at the manufacturer's factory so that testing of operation and noise levels can be conducted and then disassembled for shipment to the jobsite.

C. Acoustic enclosures shall be provided with each blower.

D. Provide four (4) blowers for process air and for mixing of the aeration basins.

1.2 QUALITY ASSURANCE

A. Factory Testing: The supplier shall perform an open field noise test on the complete blower assembly (per ISO R495) and submit certified noise test curves prior to shipment. The noise level shall be measured at four separate locations around the blower at the specified distance. The Owner reserves the right to witness this test at his own expense.

B. The blower shall be factory performance tested prior to shipment. A factory slip test of 1 psi shall be conducted. In addition, a performance test in accordance with ISO 1217 and the draft ASME PTC-13 shall be conducted. Certified test results shall be submitted.

C. Blower and blower accessories described by this Section shall be furnished by one supplier who shall be responsible for equipment start-up and the blower warranty.

D. Warranty: Manufacturer shall warrant all parts to be free from defects in materials and workmanship for a period of two (2) years after installation. Manufacturer shall replace any items found to be defective within the two (2) year period.

1.3 SUBMITTALS

A. The following submittals shall be made in accordance with Section 01 33 00 – Submittal Procedures:

1. Drawings showing general dimensions and confirming blower's piping connections, construction details, wiring diagrams and weight of major components.

2. Complete Performance Data at the Design Point and all specified operating points including:

   a. Actual Operating Speed (RPM) and % of maximum rated speed

   b. Capacity – scfm and icfm

   c. Design inlet conditions, pressure, temperature and RH%

   d. Discharge pressure

   e. dB(A) noise pressure level

   f. Blower Shaft HP, Motor HP and Package HP

3. List of recommended spare parts broken down into on hand parts and long term for 2 years operation and 3 to 5 years operation.

4. Descriptive Brochures

5. Performance Curves (for VFD applications)

6. Premium Efficiency Motor Data

7. Instrumentation and Wiring Diagram

8. ISO 1217 Factory Performance Test Results

9. Wire-to-Air Factory Performance Test Results based on the draft publication of PTC-13

10. ISO 8573-1 Class Zero Oil Free Certificate

11. Vibration isolation system.

B. Operation and Maintenance Manual consistent with Section 01 78 23 – Operation and Maintenance Data and including the following information:

   1. V-belt drive adjustment instructions including sheave changes to adjust blower rotary speed

   2. Impeller replacement

   3. Bearing replacement

1.4 UNIT RESPONSIBILITY

A. The Contractor shall assign unit responsibility for the complete blower package, including blower, silencers, filter, pressure relief valve, motor and other appurtenances specified to the blower supplier. This provision, however, shall not be construed to relieve the Contractor or other suppliers of responsibility for their portion of the work.

B. Said assignment of unit responsibility does not alleviate the Contractor of responsibilities related to project warrantees.

PART 2 - PRODUCTS

2.1 ENVIRONMENTAL CONDITIONS

A. Refer to Section 46 53 53 – Sequencing Batch Reactors.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

A. Each blower shall meet the performance requirements given in Section 46 53 53 – Sequencing Batch Reactors.

B. The blowers shall meet the minimum performance requirements specified below.

Design Point	Corresponding Influent Load	% RH	Inlet Temp
1	25% More Air than needed for Design Load	20	105°F
2	Design Load	20	105°F
3	75% of Design Load	0	30°F
4	40% of Design Load	0	30°F

C. The blower noise shall not exceed 85 dBA at 3 feet per ISO Standard 2151. The blower manufacturer shall perform open field noise test as specified in paragraph 1.3 of this Section meeting the above condition. A sound attenuating enclosure shall be provided to meet the noise limitations.

1. The sound attenuating enclosure shall completely enclose the blower and intake/discharge silencers.

2. The sound attenuating enclosure shall accommodate HVAC ductwork to separately vent the blower from the rest of the building.

D. All blowers to be same size and model. The blower shall be of the positive displacement type and rated for continuous duty.

E. Balance: Accurately machine rotating parts and place these parts in as perfect rotational balance as practicable.

1. The mass of each unit shall be such that resonance at normal operating speeds is avoided.

2. Excessive vibration shall be sufficient cause for rejection of the equipment.

F. Testing Requirements

1. The following set of testing procedures shall be followed, and the corresponding test results shall be provided by the manufacturer as described in section 1.3 Submittals. Tests shall be witnessed by a registered professional engineer in the state of the test location. The manufacturer shall allow witness of the testing by the Owner, at the Owner's expense. Testing much be performed within the contiguous United States.

2. The performance test shall be conducted per ISO 1217 and the draft ASME PTC-13 at each of the design points.

3. During each performance test, total wire power entering the blower system shall be measured directly, per IEEE-120, with a Fluke model 1735 Power Quality Analyzer, or engineer approved equal device.

4. A sound attenuating enclosure shall be provided to meet the noise limitations.

   a. The sound attenuating enclosure shall completely enclose the blower and intake/discharge silencers.

   b. The sound attenuating enclosure shall accommodate HVAC ductwork to separately vent the blower from the rest of the building.

G. All blowers to be same model series. The blower shall be of the positive displacement type and rated for continuous duty.

H. Balance: Accurately machine rotating parts and place these parts in as perfect rotational balance as practicable.

1. The mass of each unit shall be such that resonance at normal operating speeds is avoided.

2. Excessive vibration shall be sufficient cause for rejection of the equipment.

2.3 CONSTRUCTION

A. GENERAL

1. Blower Packages shall be designed to minimize the life-cycle costs and maximize plant reliability. The design and the selection of the components shall be based on a minimum useful life of 20 years and a Mean Time between Overhauls of 5 years of continuous operation.

2. No special foundations shall be required. The packages will be installed directly on a concrete slab without grouting the base frame. There shall be only 4 easily accessible anchor points.

3. Manufacturer shall guarantee that the blower shall provide oil-free operation and be certified to ISO 8573-1 Class Zero.

4. The casing shall be of one-piece construction, with separate sideplates that are bolted and pinned to the housing. Materials shall be close-grained cast iron ASTM A48 suitably ribbed to prevent distortion under the specified operating conditions. Inlet and outlet shall be flanged connections, not threaded.

5. The vibration level as measured at the casing, in the X/Y planes of the bearings, shall not exceed 0.3 "/ sec RMS when operating at the specified operating pressure and speed. The vibration level shall be checked at start-up and documented in the field start up report.

6. Each blower stage shall be factory performance tested in accordance with ISO 1217 and the draft ASME PTC-13 standards to verify flow and brake horsepower. A slip test shall not be acceptable. The acceptance criteria are +5% tolerance on power and –5% tolerance on flow regardless of the size of the machine.

7. Each rotor (male and female) shall be of the "stiff" design with first lateral critical speed at least 120% of the maximum allowable operating speed. The rotors shall operate without rubbing and shall not require lubrication. Rotors shall be drop forged in one single piece of AISI 1043 or equivalent. GG20 Cast Iron and open rotors are not acceptable. Rotors shall be statically and dynamically balanced per ISO1940/ANSI S2.19 G2.5.

8. Each impeller/shaft shall be supported by anti-friction bearings and fixed to control the axial location of the impeller/shaft in the unit. Regardless of theoretical bearing life calculations, the bearings shall be sized for a minimum expected life of 5 years between overhauls.

9. The impellers shall be timed by a pair of single helical gears with quality equivalent to AGMA 12. Gears shall have hardened and ground teeth and a minimum AGMA service factor of 1.70. Gears shall be mounted via hydraulic expansion onto the shafts with a tapered interference fit and secured by a locknut.

10. Seals shall be designed to prevent lubricant from leaking into the air stream as well as to prevent oil from leaking out of the machine. The seal shall consist of four rotary slip rings mounted in a retainer with an atmospheric air gap in the center. The rotor shaft shall be protected by a shaft sleeve. An O-ring shall be provided under the shaft sleeve to prevent oil migration along the shaft into the air conveying chamber.

11. The timing gears and the bearings shall be oil lubricated. Grease lubrication shall be not acceptable.

12. An oil sight glass shall be provided on the exterior of the noise enclosure so the operator can easily view the oil level. Sight glasses inside the enclosure or that cannot be easily viewed by the operator are not acceptable.

13. Painting shall be per supplier's standard meeting the following criteria. Excepted for machined sealing and machined mounting surfaces, the package shall be painted dark blue. Aluminum, stainless steel, and brass shall not be painted. The supplied motor shall not be over sprayed and will be supplied with the motor manufacturer's standard protection and paint color. Painted Cast Iron and Carbon Steel shall be Alkyd Resin Primer and Final coat with a total dry film thickness of 70 mils. Surface preparation SSPC10 or better. Sound enclosure shall be powder-coated polyester base total dry film thickness 80 mils. Galvanized components may only be painted with appropriate surface preparation.

B. BLOWER ACCESSORIES

1. Each package shall be supplied with one combination inlet filter and silencer. The filter media efficiency must meet the requirements of ASHRAE 52.2 MERV7 50-70% @3-10 microns corresponding to EN779 G4. The inlet filter and silencer shall be mounted directly to the inlet flange of the blower. The silencer portion shall be located upstream of the inlet filter. The filter element shall be designed to trap dirt on the inside so that upon changing, dirt does not fall into the machinery. Filter and silencer performance losses (clean element) shall be included in the entire package performance calculation.

2. Each package shall be supplied with one combination base frame / discharge silencer.

   a. The silencer shall be a chamber type design for maximum sound attenuation and shall not use internally any absorption materials of any kind (fibrous or otherwise). Fabricated of a single shell of pressure vessel quality steel with continuous welds, the silencer must be subject to a pressure test for tightness and strength at a minimum of 1.65 times the maximum design pressure. The silencer shall have a machined flanged inlet connection and bolts directly (to the discharge flange of the blower, with no intermediary or interconnecting pieces. Insulation shall be provided surrounding the discharge silencer to reduce the heat loss within the sound enclosure and keep the air temperature at the inlet of the blower as low as possible therefore contributing to a high -compression efficiency. Discharge silencer performance losses shall be included in the entire package pressure calculation.

   b. The base frame is to be constructed from welded carbon steel that shall be designed to maintain alignment of the blower internal components and the drive during operation. It shall be designed to resist distortion while being installed on vibration isolating mounts. The manufacturer shall supply a stainless-steel grounding lug fully welded to the base.

3. Each package shall be provided with a flexible ANSI style discharge connector (and inlet connector if the specifications require the inlet air to be piped from outside). They shall prevent the transmission of noise and vibrations from the blower package into the piping. The flexible connectors shall be Proco or similar, with a standard ANSI flange connection.

4. Each package shall be supplied with a WEG manufactured TEFC high efficiency EFF1 motor that shall operate on 460 Volts, 3 Phase, 60 Hertz current, 3600 RPM, or equal. The motor will be mounted on a pivoting base to provide automatic tensioning of the belts. The motor nominal rating after any corrections for ambient conditions shall be 10% above the maximum operating horsepower. The motor shall have a 1.15 service factor and designed for inverter duty operation with a minimum 4 to 1 turndown. Domestic NEMA frame motors must be supplied. Imported IEC motors are not acceptable. Motor shall be supplied with an Aegis SGR bearing protection ring on the drive end and insulated bearings on the non-drive end of the motor to discharge capacitive induced shaft voltage.

5. Manufacturer shall be responsible for coordinating the starting torque requirement of the blower and the motor. Should an unloading valve be required, the blower manufacturer shall supply it. It shall be an automatic type pneumatically operated valve requiring no electrical nor compressed air connections mounted upstream of the check valve.

6. Each package shall be supplied with a V-belt drive that shall be of the high capacity type, oil and heat resistant. Drive shall be designed for a minimum service factor of 1.4 times operating power (bHp), or 1.1 times the motor nameplate Hp, whichever is larger to allow a minimum of 1.4-service factor based on the maximum blower bHp. Belt tensioning shall be automatic without the use of any spring devices or interaction on the part of the operator. Slide rails shall not be used as a tensioning device. Sheaves shall be dynamically balanced regardless of the operating speed and hydraulically mounted on the blower drive shaft.

7. Each package shall be supplied with vibration isolating feet with a minimum efficiency of 80%. The manufacturer shall be responsible for attenuating noise and vibration in the package such that no special installation base shall be required, nor shall any additional measures be required to reduce vibrations from the package being transmitted to the base or the piping.

8. The belt drive shall be guarded in compliance with OSHA regulations. Portions of the guard shall be easily removable allowing for belt inspection and replacement. Guard material shall be perforated galvanized carbon steel.

9. Each package shall be supplied with a single pressure safety valve on the discharge side of the blower mounted downstream of the discharge silencer and upstream of the check valve. The safety valve shall be set to protect the machine from exceeding its maximum pressure rating and shall be sized to pass 100% of the design flow. The valve shall be field adjustable, spring loaded, and have a certificate of conformity to PED if operating above 15 psig. Since the package is supplied with a sound enclosure, the pressure safety valve shall also be housed inside and attenuated by the sound enclosure. The safety valve shall relieve hot air into a segmented and sealed section of the sound enclosure so that the hot air cannot re-enter the inlet of the machine.

10. Each package shall be supplied with one check valve that shall be installed on the discharge line. It shall be of the full-bore low pressure-drop, flapper type design with a steel body, and steel flap embedded in EPDM with full-contact seal. The valve shall be easily removable without disturbing the piping. Pressure losses produced by the check valve shall be included in the entire package performance calculation.

11. Each package shall be supplied with the following instrumentation:

    a. Digital Controller option, complete with:

        1) Intuitive TFT color touch screen display

        2) Display, monitoring, alarm, and shutdown of inlet pressure, discharge pressure, and discharge temperature.

        3) Display run hours

        4) Log errors and first out indication

        5) Track and log maintenance

        6) Equipped with Ethernet IP communication for integration with an Allen Bradley PLC.

12. Each blower shall receive its initial oil filling at the factory. Oil to be fully synthetic and rated for 16,000 hours of operation between change intervals.

13. Each package shall be supplied with a sound enclosure covering the entire blower package. The enclosure shall provide suitable protection for outdoor installation under the specified site conditions (wind load and snow load). The enclosure shall be designed to be able to install them side-by-side with all maintenance done from the front or back of the package. Details are as follows:

    a. Enclosure Panels shall be made of galvanized steel sheet, powder coated in a light reflecting, blue color per RAL 5001. The skid shall be of the same color. Sound enclosure acoustic material shall comply with UL 94 - HF1 for fire-retardant, self-extinguishing, non-dripping materials.

    b. The enclosure and the blower package must be both mounted on a skid / oil-drip pan designed for meeting environment protection standards and for easy transportation and installation.

    c. A grounding strap shall be installed between the blower base and the package skid to bypass any vibration isolating mounts for grounding continuity.

    d. Quick release panels, each less than 50 lbs. (as mandated by MSHA) must provide easy and quick access for routine maintenance of the blower and the package components.

e. Ventilation fan shall be provided for cooling the sound enclosure. The fan shall be sized for sufficient heat removal from the sound enclosure, even when the blower is operated with a VFD. Cooling fan shall be driven separately by an electric motor (460v/60Hz). With the digital controller, a simple 460v/60Hz feed to the controller is sufficient and a built-in starter will feed power to the fan. The Contractor shall provide wiring with the enclosure as well as a safety interlock that will shut down the main motor if the cooling fan stops operating.

f. To prevent possible operator damage, electrical components, instrumentation and instrument connections shall not be mounted or interface with moving panels of the sound enclosure.

g. Both blower oil sumps shall be piped to a common fill and drain, located at the front of the package for easy maintenance. An oil level indicator shall be mounted on the outside of the enclosure, which gives an accurate oil level indication while the blower is in operation. All oil lines shall be industrial-quality hydraulic hose and fittings.

14. Inlet Filter: The inlet filter shall be of heavy-duty flanged construction with high quality black paint and shall employ a high efficiency paper element. The paper element shall be replaceable and shall be of the dry, pleated paper type. The removal efficiency shall be 99.5 percent on 2-micron particles and 97 percent on 1-micron particles. The filter assembly shall be CCF series as manufactured by Universal Silencers or equal. The maximum initial pressure drop across the filter at the rated flow shall not exceed 2.5 inches W.C.

15. Pressure and Temperature Gauges: Each blower shall be provided with a 0-20 psig dial type discharge pressure gauge, a 0 to -40 inches water dial type inlet vacuum gauge, and a 0-350°F dial type temperature gauge connected to the discharge piping.

a. Pressure Gauges:

1) Inlet: The range shall be 0 to 40 inches water column vacuum and provide with vent valve.

2) Discharge: Provide a stainless-steel case, stem mount gauge with a shatter resistant window and a 2½-inch diameter face. The gauge shall be oil-filled measured units in psi. Suitable for use with 275 °F process air.

3) Minimum Accuracy: plus or minus 1.5% of full scale

4) Measurement Range: 0 to 20 psi

5) Furnish with compatible gage cock, snubber, and fittings for mounting to tap in side of blower piping.

b. Temperature Gauges: Provide suction and discharge gauges with stainless steel housing, multi-angle dial or straight form, Industrial bimetal type, Single scale, with a stem length sufficient to extend to middle of blower pipe plus or minus 1 inch (minimum length of 4 inches). The gauge shall measure in Degrees Fahrenheit and have two degrees maximum scale range. The blower suction shall read from -20 to 120 Degree F and the blower discharge shall read from 50 to 300 Degree F.

1) Minimum Accuracy: plus or minus 1.5% of full scale

2) Furnish with compatible fittings for mounting to tap in side of blower piping.

16. Air High Temperature Switch: A high temperature switch shall be mounted in the discharge piping of the blower. The switch shall be set at the maximum operating temperature of the blower and shall be wired to shut down the blower motor via the MCC in the event of excess discharge temperature. The temperature switch shall feature two normally opened and one normally closed contacts. Include a red-light alarm indicator and a manual reset pushbutton at the MCC.

C. Drives

1. Variable Frequency Drives shall be provided for each blower in accordance with Division 26 by Contractor.

2.4 CONTROLS

A. Blower controls shall be provided by the blower Manufacturer. The blower controls shall allow temporary access to the blower control screens to the blower Manufacturer for troubleshooting purposes. The Owner shall be able to enable and disable the blower Manufacturer's access to the control screens.

2.5 ACCEPTABLE MANUFACTURERS

A. The blower shall be furnished by one of the following manufacturers, or equal:

1. Aerzen

2. Equal must be approved during bidding process.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

A. Follow manufacturer's recommendations for equipment storage and handling.

B. Ship with openings sealed after injection of rust inhibiting powder.

C. Protect equipment, materials and accessories form exposure to the elements and keep thoroughly dry.

D. Store blowers, blower accessories, motors, and electrical equipment in a weathertight warehouse or comparable enclosure.

E. Box, crate and properly wrap and protect all spare parts.

F. Label spare parts containers indicating contents.

G. Hand rotate motor and blower shafts at frequency required by manufacturer to keep bearings properly lubricated and prevent flat spots form forming.

3.2 INSTALLATION

A. The Contractor shall install the blowers in accordance with the manufacturer's written instructions.

B. The Contractor shall make all electrical and process connections to the blower package prior to the arrival of the manufacturer's representative.

C. Manufacturer's authorized service technician shall visit the site to certify proper installation, electrical connections and equipment alignment prior to start up.

3.3 START-UP AND TESTING

A. After installation of all equipment has been completed and as soon as conditions permit, the manufacturer shall provide one (1) trip for a total of four (4), 8-hour days to verify the installation and conduct an acceptance test under actual operating conditions. The test shall consist of 3 hours operation of each package. The test shall insure that all package components are working properly, and vibration levels are within acceptable limits. Where possible, flow and pressure readings shall be recorded at 30-minute intervals.

B. If required, Contractor shall make any changes, at his own expense, to the installation that may be necessary to assure satisfactory operation. Contractor shall be held liable for changes needed in the installation.

C. Open field noise tests shall be performed on each blower using metering equipment provided by the manufacturer. Noise levels shall be measured four (4) separate times at four (4) separate locations at a distance of three (3) feet from the blower. In the event the test results show that the blowers do not meet the specified noise level, modifications shall be made, and noise testing shall be repeated as required until the specified noise level is attained.

D. Manufacturer shall provide a written field test / start up report after completion of testing.

E. The manufacturer's representative shall provide onsite operation and maintenance training to the Owner's personnel for a minimum of four (4) hours. The Contractor shall video tape the training session and provide a copy on DVD to the Owner.

END OF SECTION 43 11 31

SECTION 43 11 33 – ROTARY LOBE BLOWERS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The secondary treatment process Vendor (Section 46 53 53) shall provide positive displacement blowers for the secondary treatment process.

B. Furnish blowers complete with intake filter, intake and discharge silencers, pressure relief valve, check valve, motor, coupling, base plate, and all appurtenances specified. Complete unit shall be assembled at the manufacturer's factory so that testing of operation and noise levels can be conducted and then disassembled for shipment to the jobsite.

C. Acoustic enclosures shall be provided with each blower.

D. Blowers will be installed by the Installation Contractor.

1.2 QUALITY ASSURANCE

A. Blower and blower accessories described by this Section shall be furnished by the blower manufacturer to the Vendor (Section 46 53 53 – Sequencing Batch Reactors). A packager who does not manufacture the specified blower will not be acceptable.

B. Factory Testing: The blower manufacturer shall perform an open field noise test on the complete blower assembly (per ISO 2151) and submit certified noise test curves prior to shipment. The noise level shall be measured at four separate locations around the blower at the specified distance. The Owner reserves the right to witness this test at his own expense.

C. The blower shall be factory performance tested prior to shipment. A factory slip test of 1 psi shall be conducted. In addition, a performance test in accordance with DIN / ISO 1217, Part 1, Annex C shall be conducted. Certified test results shall be submitted.

D. Warranty: A written manufacturer’s warranty shall be provided for the equipment specified in this Section. The warranty shall be for a minimum period of two (2) years from the date of Substantial Completion equipment. The manufacturer shall repair or replace all defects of materials or workmanship in the equipment within the two (2) year period.

1.3 SUBMITTALS

A. The following submittals shall be made in accordance with Section 01 33 00 – Vendor Submittals:

1. Motor data submittal information.

2. Drawings showing general dimensions and confirming blower's piping connections, construction details, wiring diagrams and weight of major components.

3. Parts list noting materials of construction.

4. Performance curves showing rated capacity, pressure, horsepower, and efficiency. Data shall include predicted temperature increase at each specified operating condition.

5. Lubrication requirements.

6. Estimation of bearing life.

7. Manufacturer's descriptive literature for intake filter and inlet and discharge silencers, including dimensional drawings, materials of construction and weights. Include noise attenuation data for silencers and particle removal efficiency data for filter.

8. The Vendor shall provide anchor bolt calculations made and signed by a civil or structural engineer currently registered in the State of Idaho.

B. The Vendor shall submit a copy of the equipment specification section with all addenda and all referenced specification sections. Each paragraph shall be check-marked to indicate specification compliance or marked to indicate deviations from the specification requirements. Check marks shall indicate complete compliance with the paragraph requirements. Deviations from the specification shall be indicated by underlining the deviation and marking the paragraph or line with a number or letter. The remainder of the paragraph not marked as a deviation shall indicate compliance with the requirements of the paragraph. The manufacturer shall prepare a detailed justification for each deviation. Failure to include the required specification sections and justification for deviations will indicate non-compliance and shall be rejected without further consideration.

C. Operation and Maintenance Manual consistent with Section 01 78 23 – Operation and Maintenance Data.

PART 2 - PRODUCTS

2.1 ENVIRONMENTAL CONDITIONS

A. Refer to Section 46 53 53 – Sequencing Batch Reactors.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

A. The blowers shall meet the minimum performance requirements specified below.

Design Point	Corresponding Influent Load	% RH	Inlet Temp
1	25% More Air than needed for Design Load	20	105°F
2	Design Load	20	105°F
3	75% of Design Load	0	30°F
4	40% of Design Load	0	30°F

B. The blower noise shall not exceed 85 dBA at 3 feet per ISO Standard 2151. The blower manufacturer shall perform open field noise test as specified in paragraph 1.3 of this Section meeting the above condition. A sound attenuating enclosure shall be provided to meet the noise limitations.

1. The sound attenuating enclosure shall completely enclose the blower and intake/discharge silencers.

2. The sound attenuating enclosure shall accommodate HVAC ductwork to separately vent the blower from the rest of the building.

C. All blowers to be same size and model. The blower shall be of the positive displacement type and rated for continuous duty.

D. Balance: Accurately machine rotating parts and place these parts in as perfect rotational balance as practicable.

1. The mass of each unit shall be such that resonance at normal operating speeds is avoided.

2. Excessive vibration shall be sufficient cause for rejection of the equipment.

2.3 CONSTRUCTION

A. General

1. Blower shall be installed indoors and have a direct intake from the outside of the building.

B. Materials

1. Casing and Impellers: Cast or ductile iron

2. Shaft: High carbon steel or ductile iron; turned, ground, and polished

3. Timing Gears: Alloy steel

4. Bearings: Antifriction, grease packed or oil lubricated. AFBMA rated L10 for 60,000 hours minimum life, continuous operation

5. Base: Fabricated steel; minimum moment of inertia 20 inches to the fourth power in X axis

6. Vibration Isolators: Rubber, Cork, or Cork-Rubber

7. Gaskets (if applicable): Durabala, Durlon 8500 Green

C. Casing

1. One piece with headplate(s).

2. Design to withstand at least twice the maximum required discharge pressure and reinforce with integrally cast ribs.

D. Impellers

1. Reinforced by internal ribs with outside surfaces machined.

2. Two lobe involute type, straight, and operate without rubbing.

3. Operate without liquid seals or lubrication and be positively timed by a pair of accurately machined heat-treated alloy steel, spur tooth, timing gears.

4. Statically and dynamically balance each impeller.

5. Impeller permanently fastened or part of the shaft.

E. Shaft

1. Cast integrally with the impeller or shall pass completely through the impeller, or stub shafts with impeller securely fastened.

F. Timing Gears and Lubrication

1. Mount on impeller shafts on a tapered fit and properly secured.

2. Enclosed in oil-tight housings.

3. Timing gears and bearings splash oil lubricated from oil slingers mounted on the driven shaft and dipping in oil.

4. Provide a lip type or piston ring oil seal, designed to prevent lubricant from leaking into the air stream.

5. Provide rotary piston ring shaft seals at the point where the shaft passes through the headplate.

6. Make provision to vent the impeller side of the oil seal to atmosphere to eliminate carry-over of lubrication into the air stream.

7. Provide lubricant level sight glass.

G. Drives

1. Type: Simple V-belt

2. V-belt Sheaves: Split tapered keyed hubs

3. V-belt drive guard

a. Enclose V-belt drives in a separate OSHA-approved sheet metal guard.

b. Guards of rugged design and fabricated from 16 gage steel (minimum).

c. Smooth exterior finish.

H. Base

1. Mount each blower and motor unit on a single full-length base with anchor bolt holes and jack screws for leveling.

2. If fabricated steel bases are furnished, continuously weld and grind smooth all seams and contact edges, plates and shapes. The base shall have an OSHA approved coupling guard and also anchor bolt holes and jack screws for leveling.

3. If cast iron bases are furnished, machine mounting surfaces.

4. Mount each base on suitable isolation pad.

2.4 ACCESSORIES

A. Inlet Filter: The inlet filter shall be of heavy-duty construction. The removal efficiency shall be 99.5 percent on 2-micron particles and 97 percent on 1-micron particles. The maximum initial pressure drop across the filter at the rated flow shall not exceed 2.5 inches W.C.

B. Inlet/Outlet Silencer: The inlet/outlet silencers shall be a chamber-absorptive type designed to provide pulse and noise control. The silencer shall be heavy duty, all welded construction, of carbon steel sheet and plate. Inlet and discharge nozzles shall be flanged. Exterior surfaces shall be shop-coated with a rust inhibitive primer and finish painted in the field. The silencer shall feature a drain plug. The blower inlet silencer shall be RIS series silencer and the blower discharge silencer shall be RD series silencer, both as manufactured by Universal Silencer, or preapproved equals.

C. Valves: A weight-loaded type pressure relief valve shall be provided on the blower discharge. The relief valve shall be sized to discharge 100 percent of the blower capacity and shall be set 0.5 psig above maximum blower discharge pressure.

1. Check valves shall also be supplied with each unit.

D. Flexible Connectors: The blower shall be provided with single arch flexible connectors on the outlet and inlet to eliminate any stresses on the blower. The flexible connectors shall have flanged ends suitable for service pressure of 15 psig maximum and 300°F temperature. The connector shall be constructed of chlorobutyl with a fiberglass/Kevlar fabric and shall be specifically designed for service at elevated temperatures.

E. Pressure and Temperature Gauges: Each blower shall be provided with a 0-20 psig dial type discharge pressure gauge, a 0-20 inch water column dial type inlet vacuum gauge, and a 0-350°F dial type temperature gauge connected to the discharge piping. Furnish with compatible fittings for mounting to tap in side of blower piping.

1. Pressure Gauges:

a. Inlet: Provide a Dwyer Series 2000 Magnehelic, Manotherm/Beierfeld, or preapproved equal. The range shall be a minimum of 0 to 20 inches water column vacuum and provided with vent valve.

b. Discharge: Provide a stainless steel case, stem mount gauge with a shatter resistant window and a minimum 2 ½-inch diameter face. The gauge shall be oil-filled measured units in psi and suitable for use with 275°F process air.

c. Minimum Accuracy: plus or minus 1% of full scale

d. Minimum Measurement Range: 0 to 20 psig

e. Manufacturer

1) Ashcroft Type 1009 Duralife

2) Manotherm/Beierfeld

3) Or preapproved equal

2. Temperature Gauges: Provide gauge with stainless steel housing, multi-angle dial or straight form, Industrial bimetal type, Single scale, with a stem length sufficient to extend to middle of blower pipe plus or minus 1 inch (minimum length of 4 inches). The gauge shall measure in Degrees Fahrenheit and have two degrees maximum scale range. The blower suction shall read from -20 to 120 Degree F and the blower discharge shall read from 50 to 300 Degree F.

a. Minimum Accuracy: plus or minus 1% of full scale

b. Manufacturer

1) Cole-Parmer Instrument Company

2) Or preapproved equal

F. Air High Temperature Switch: A high temperature switch shall be mounted in the discharge piping of the blower. The switch shall be set at the maximum operating temperature of the blower and shall be wired to shut down the blower motor via the MCC in the event of excess discharge temperature. The temperature switch shall feature two normally opened and one normally closed contacts. Include a red light alarm indicator and a manual reset pushbutton at the MCC.

G. V-Belts and Sheaves: The blowers shall be driven by a motor utilizing a V-belt and sheaves which shall be designed for a minimum service factor of 1.5. Two sets of V-belts and one set of sheaves shall be supplied for each operating condition specified.

H. Vibration Sensor: A vibration sensor and cut-out switch shall be included to shut down the unit in the event of excessive vibration.

I. Vibration Isolation Pad: Suitable vibration isolators shall be furnished with the blower base.

2.5 MOTORS

A. Polyphase induction design, rating and speed to meet blower requirements with a 1.15 service factor. The service factor shall not be used in establishing the nameplate rating.

B. Horizontal, TEFC, 1800 rpm (nominal, maximum). Power: 480 volts, 3 phase 60 hertz. Motor shall not overload over range of inlet air temperatures and discharge pressures.

C. Motors shall be high efficiency as tested per IEEE Procedure 112A, Method B.

D. Motor shall be provided with an OSHA approved belt guard.

E. Motors shall meet requirements specified in Section 40 05 93 - Motor Requirements for Process Equipment.

F. Blowers shall have inverter type motors for VFD drives.

2.6 SPARE PARTS

A. The following spare parts, unless not applicable to a certain blower, shall be furnished for each blower unit:

Blower Spare Parts	Quantity Furnished
Shaft Bearings	2
End Cover Oil Seal	1
Main Oil Seals	2
Gear Keys	1 pair
End Cover O-Rings	1
Gearbox Gasket	1
Gear End Bearing Carrier Gasket	1
Drive Belts	1

2.7 ANCHORAGE AND FASTENERS

A. GENERAL

1. The Installation Contractor shall furnish all anchoring hardware for the supplied equipment.

2. The Installation Contractor shall furnish all epoxy and dispensing equipment for chemical anchoring.

3. The Vendor shall provide anchor bolt calculations made and signed by a civil or structural engineer currently registered in the State of Idaho.

2.8 MANUFACTURER

A. The blower shall be furnished by one of the following manufacturers:

1. Gardner Denver

2. Kaeser

3. Aerzen

4. Or preapproved equal.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

A. Follow manufacturer's recommendations for equipment storage and handling.

B. Ship with openings sealed after injection of rust inhibiting powder.

C. Protect equipment, materials and accessories form exposure to the elements and keep thoroughly dry.

D. Store blowers, blower accessories, motors, and electrical equipment in a weather-tight warehouse or comparable enclosure.

E. Box, crate and properly wrap and protect all spare parts.

F. Label spare parts containers indicating contents.

G. Hand rotate motor and blower shafts at frequency required by manufacturer to keep bearings properly lubricated and prevent flat spots form forming.

3.2 START-UP AND TESTING

A. After installation of all equipment has been completed and as soon as conditions permit, the manufacturer shall provide one (1) trip for a total of four (4), 8-hour days to verify the installation and conduct an acceptance test under actual operating conditions. The test shall consist of 3 hours operation of each package. The test shall insure that all package components are working properly, and vibration levels are within acceptable limits. Where possible, flow and pressure readings shall be recorded at 30-minute intervals.

B. If required, the manufacturer shall make any changes, at his own expense, to the installation that may be necessary to assure satisfactory operation.

C. Open field noise tests shall be performed on each blower using metering equipment provided by the manufacturer. Noise levels shall be measured four (4) separate times at four (4) separate locations at a distance of three (3) feet from the blower. In the event the test results show that the blowers do not meet the specified noise level, modifications shall be made, and noise testing shall be repeated as required until the specified noise level is attained.

D. Manufacturer shall provide a written field test / start up report after completion of testing.

E. The manufacturer's representative shall provide onsite operation and maintenance training to the Owner's personnel for a minimum of four (4) hours. The Installation Contractor shall video tape the training session and provide a copy on DVD to the Owner.

END OF SECTION 43 11 33

SECTION 43 25 00 - SUBMERSIBLE NON-CLOG PUMPS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install submersible non-clog pumping equipment, associated appurtenances and controls as specified herein and as shown on the Drawings.

1.2 REFERENCE STANDARDS

A.	ASTM - A36/A36M-04	Standard Specification for Carbon Structural Steel
B.	ASTM A 48/A 48M	(2008) Standard Specification for Gray Iron Castings
C.	NFPA 820	Standard for Fire Protection in Wastewater Treatment and Collection Facilities

D. NEMA Standards Publication MG 1-1998 (latest version) Motors and Generators

E. National Electric Code (NEC)

1.3 SUBMITTALS

A. Shop Drawings, at a minimum, shall have the following information and be submitted with each pump supplied:

1. Pump performance curves showing the following:

   a. head, capacity, horsepower demand, NPSH required, pump efficiency over the entire operating range of the pump, performance curves at intervals of 5 Hz from minimum speed to maximum speed for each centrifugal pump equipped with a variable speed drive; the head, capacity, horsepower demand, overall efficiency, and minimum submergence required at the design flow conditions and the maximum and minimum flow conditions; and

   b. the limits on the performance curves recommended for stable operation without surge, cavitation, or excessive vibration with the stable operating range as wide as possible based on actual hydraulic and mechanical tests.

2. assembly and installation drawings including shaft size, seal, coupling, bearings, anchor bolt plan, part nomenclature, material list, outline dimensions, and shipping weights

3. bearing life calculations

4. rail system

5. typical installation guides

6. Electrical motor data

7. Technical manuals and parts list

8. Printed warranty

9. Management system certificate ISO 9001

10. Manufacturer's equipment storage recommendations

B. Factory Test Data shall be signed, dated, and certified factory test data for each pump system which requires factory testing, submitted before shipment of equipment.

C. The Contractor shall provide Manufacturer's Certification of proper installation and certification of satisfactory field testing.

D. Submit Owner's Manual as specified in Special Provisions, to include operation and maintenance data and other information for the equipment.

1.4 QUALITY ASSURANCE

A. Pump, motor, and controls shall be coordinated by the Contractor to provide operable pumping systems as indicated by the Drawings and Specifications.

B. The motor horsepower shall not be exceeded when the pump is operating anywhere on its curve.

C. Pump seals shall be designed for complete water-tightness at 65 feet submergence for 30 minutes, and data on factory testing and quality control shall be submitted with the Shop Drawings.

D. Firms regularly engaged in manufacture of pumping equipment of types required, whose equipment has been in satisfactory use in similar service for not less than 5 years. Manufacturer shall have authorized factory warranty service for pumps supplied available within 50-mile driving distance of the Owner.

E. The Contractor shall correct all defects in the pumping system upon notification from the Owner within 1 years from the date of Substantial Completion. Corrections shall be completed within 5 days after notification.

PART 2 - PRODUCTS

2.1 DESIGN CRITERIA

A. Submersible Wastewater Pumps shall be submersible non-clog wastewater pumps capable of pumping raw unscreened sewage in a NEC Class 1, Division 1, Group D hazardous location. Three identical pumps shall be furnished and installed in the Old Valley Lift Station wet well.

B. The submersible pumps shall have a semi open multi vane self-cleaning impeller designed to transport wastewater with fibrous materials like wet wipes. Pumps shall be capable of pumping sewage under the following conditions of service:

C. Operating Conditions

Criteria	Unit	EQ Pumps	WAS Pumps
Design Flow Capacity (per pump) Max. point	gpm	240	40
Design Flow Pump Head, TDH	ft	12-20	10
Design Flow minimum efficiency (wire-to-water)	Percent	60	60
Driver			
Duty	Continuous		
Drive	Variable Speed		
Maximum Pump Speed	rpm	1800	
Maximum Motor Speed	rpm	1800	
Motor Size	hp	**5**	**3**

Item	Unit	Value
Fluid Service		Raw Wastewater
Ambient Environment		Wet well, submerged
Ambient Temperature	Degrees F	30 to 120
Ambient Relative Humidity	Percent	30 to 100
Fluid Temperature	Degrees F	40 to 80
Fluid pH Range		5 to 8.5
Fluid Specific Gravity		1.0
Project Site Elevation	Feet	700

D. The Contractor shall ensure the pump vendor examines the site conditions, intended application, and operation of the pump system and recommends the pump that will best satisfy the indicated requirements.

E. Pumps shall be designed and provided to be raised, lowered, and supported on a vertical stainless steel guide rail system.

2.2 MATERIALS OF CONSTRUCTION

A. Unless otherwise specified elsewhere, all non-clog submersible pumps shall be constructed of the following materials:

Item	Material	Construction
Pump Casing	Casing and motor housing shall be close-grain cast iron conforming to ASTM A-48 Class 40 standards. Insert rings shall be made of Hard-Iron™ (ASTM A-532 (Alloy III A) 25% chrome cast iron)	Casing shall form the volute and shall be a single piece with smooth flow passages. A replaceable bottom plate assembly shall be used to seal between the impeller and the casing. The casing shall have a centerline discharge to allow for guide rails.
Connections	Machined metal-to-metal quick disconnect type	The pump(s) shall be automatically and firmly connected to the discharge connection, guided by no less than two parallel guide bars extending from the top of the station to the wet well mounted discharge connection. The material of the guide bars shall Stainless steel AISI 316.
Impeller	Impeller shall be of Hard-Iron™ (ASTM A-532 (Alloy III A) 25% chrome cast iron)	Impellers shall be dynamically balanced, semi-open, multi-vane, back swept, screw-shaped, non-clog design. The impeller shall have vanes hardened to Rc 60 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter found in wastewater.
Shaft	ASTM A479 S43100-T	The shaft shall be totally isolated from the liquid being pumped and shall have a maximum deflection at the lower seal of .002 inches.
Shaft Seals	Stainless steel, Tungsten carbide or silicon carbide rings	The pump shall have two mechanical shaft seals. The upper seal shall be a corrosion resistant Tungsten carbide WCCR mechanical seal running in an oil bath below the stator housing. The lower seal shall be the primary seal and consist of a corrosion resistant Tungsten carbide WCCR mechanical seal. Seals shall contain one stationary and one positively driven tungsten-carbide seal ring. A separate seal leakage chamber shall be provided so that any leakage that may occur past the

Item	Material	Construction
		upper, secondary mechanical seal will be captured prior to entry into the motor stator housing. Such seal leakage shall not contaminate the motor lower bearing. The leakage chamber shall be equipped with a float type switch that will signal if the chamber should reach 50% capacity.
Bearings		The pump shaft shall rotate on two bearings. Motor bearings shall be permanently grease lubricated and have a nominal L10 lifetime of 50.000 hours. The upper bearing shall be a single deep groove ball bearing. The lower bearing shall be a two row angular contact bearing to compensate for axial thrust and radial forces. Single row lower bearings are not acceptable.
Oil Chamber		To supply oil for lubrication and cooling of shaft seals. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside.
Pump Base	For each pump the contractor shall supply and install a discharge connection made of cast iron ASTM A-48, Class 35B	The sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal contact. Sealing of the discharge interface with a diaphragm, O-ring or profile gasket will not be accepted. The entire weight of the pump/motor unit shall be borne by the pump discharge elbow. No portion of the pump/motor unit shall bear on the sump floor directly or on a sump floor mounted stand.
Fasteners	Type 316 stainless steel	All exposed fasteners
Pump Coating	All castings must be blasted before coating. All wet surfaces are to be coated with two-pack oxyrane ester Duasolid 50. The total layer thickness should be	All metal surfaces (except stainless steel) coming into contact with pumped media shall be protected by specified coating

Item	Material	Construction
	at least 120 microns. Zink dust primer shall not be used.	
Cable Entry		The cable entry shall consist of dual cylindrical elastomer sleeves, flanked by washers, all having a close tolerance fit against the cable and the cable entry. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.

2.3 COOLING SYSTEM

A. The motor shall be provided with an integral motor cooling system. A stainless steel cooling jacket shall encircle the stator housing, providing for dissipation of motor heat regardless of the type of pump installation. An impeller, integral to the cooling system and driven by the pump shaft, shall provide the necessary circulation of the cooling liquid through the jacket. The cooling liquid shall pass about the stator housing in the closed loop system in turbulent flow providing for superior heat transfer. The cooling system shall have one fill port and one drain port integral to the cooling jacket.

2.4 LIFTING SYSTEM

A. Provide dual 316 SS guide rails extending from the base to the top of the wet well to provide for removal of the pump by lifting the pump without entering the wet well. The guide rail system shall be non-sparking.

B. Each pump shall be furnished with a stainless-steel bracket permanently mounted to the top of the pump, with a large loop for accommodating a lift hook. Each pump shall be fitted with a stainless steel lifting chain or lifting cable of adequate length. The working load of the lifting system shall be 50% greater than the pump unit weight.

C. The guide rail system shall include a sliding guide bracket that allows removal of the pump without binding, and properly aligns the pump to automatically seat with the pump discharge connection. Each pump shall have permanently installed discharge elbow that seats against the pump discharge connection by a machined metal to metal contact. The use of a diaphragm, O-ring, or profile gasket will not be accepted.

2.5 ELECTRICAL REQUIREMENTS

A. Pump Controls

1. Provide VFD for each pump as specified in Section 26 29 23 – Variable-Frequency Motor Controllers. The VFD shall include H-O-A-Reverse selector switch, and I/O to the PLC. In addition, provide outputs to PLC for hour meter display and alarm lights for moisture and thermal switches and pump failure for each pump.

B. Motor

1. Pump motors shall be of explosion-proof design conforming to NFPA 820 requirements. In addition, pump motors shall conform to NEMA MG-1 Part 31 requirements and shall be a premium efficiency squirrel cage induction NEMA Design B electric motor conforming to the following:

Item	Value
Installation Environment	Submersible, Air Filled
Enclosure	Explosion Proof
Insulation Class	NEMA Class H or higher
Insulation	Non-Hygroscopic Polyester
Service Factor	1.15 Minimum
Synchronous Speed	1800 RPM Maximum (Variable)
Voltage	460
Phase	3
Frequency	60 Hz

C. Moisture Sensor

1. Provide moisture sensor in the seal oil chamber to detect moisture leakage through the outer shaft seal. The moisture sensor shall be wired to the pump control system to provide seal failure protection indication for the pump. Provide a moisture detection relay for each pump suitable for connection to SCADA network for detection of moisture in the seal chamber. The moisture detection relay shall be powered by 24-volt AC/DC and shall close a set of contacts in the relay when moisture is present in the pump seal chamber.

2. Moisture sensor shall be Flygt MiniCASII.

D. Thermal Sensors

1. Thermal sensors shall be used to monitor stator temperatures by the use of 3 thermal switches embedded in the coils of the stator winding. The thermal sensors shall be wired to the pump control system to provide overheat protection for the motors and be connected to the SCADA network similar to moisture sensor.

2. Thermal sensors shall be Flygt MiniCASII.

E. Electric Cable

1. The pump motor cable and control cable shall be FM-approved for use with motors for Class 1, Division 1, Group C & D Locations.

2.6 SPARE PARTS

A. Parts to be furnished include

1. 2 sets of mechanical shaft seals
2. 2 sets of bearings each for pump and motor
3. 3 sets of O-rings
4. 1 submersible cable of required length

2.7 MANUFACTURER

A. Flygt

B. Or Approved Equal

PART 3 - EXECUTION

3.1 DELIVERY AND STORAGE

A. All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt or dust, or other contaminants.

B. All parts shall be properly lubricated and protected so that no damage or deterioration will occur even during a prolonged delay from the time of shipment until installation is completed and the pumps are ready for operation. Pump impellers shall be rotated at least every 30 days.

C. Finished ferrous surfaces not painted shall be properly protected to prevent rust and corrosion.

D. The finished surfaced of exposed flanges shall be protected by strong wooden blind flanges.

E. Each pump shall be properly crated to protect against damage during shipment.

3.2 INSTALLATION

A. Install pump as shown in the drawings and as recommended by the Pump Manufacturer.

B. The Contractor shall ensure that anchor bolts are set only after the discharge piping has been properly installed, to ensure exact fit with embedded piping components.

3.3 SERVICES OF MANUFACTURER

A. Secure start-up service for the pump as specified below:

Schedule of Field Service Representative on Site Time		
Service	On Site Time (Days)	Trips to Site
Equipment delivery verification and installation instruction	1	1
Installation verification, start-up and instruction of the Owner's personnel	1	1

B. A "Day on Site" is defined as a conventional 8-hour workday excluding travel time. A "Trip to Site" is defined as complete round trip travel from the Manufacturer's factory. All expenses including salary, local/long distance travel, lodging, meals and any other per diem or miscellaneous expenses of the authorized service representative shall be the responsibility of the Contractor.

C. A factory representative of the pumping equipment shall be present to supervise start-up and ensure proper operation of all components. The Contractor shall obtain and pay for the factory representative start-up service.

D. The Contractor shall video tape the training session and provide a DVD to the Owner.

END OF SECTION 43 25 00

SECTION 46 53 53 - SEQUENCING BATCH REACTORS

PART 1 - GENERAL

1.1 SUMMARY

A. Contractor shall provide and install all equipment for a complete and functional sequencing batch reactor (SBR) treatment process. The system shall be a 2-basin sequencing batch activated sludge process with a post equalization basin. The SBR system shall be based on either a continuous feed or batch-type treatment process. The requirements for either system is listed in Parts 2.3 and 2.4 below, respectively. The SBR area electrical classification is Class I Division II Group D. All equipment, instrumentation and controls shall be rated for this classification. The contractor shall mount all equipment in accordance with Section 43 05 50 – Equipment Mounting.

B. The SBR treatment process shall include all components required for a complete and operable system, including, but not limited to the following equipment:

1. Effluent decanters with an automated decant valve.
2. Basin mixers for each SBR Basin.
3. Waste Activated Sludge (WAS) pumps, accessories, and supports.
4. Fine bubble diffusers.
5. Positive displacement blowers with variable speed control and isolation valves.
6. SBR process control system with all required instrumentation and controls.
7. Additional valves, instrumentation and controls recommended by manufacturer and as specified herein.
8. All the equipment and associated designs must comply with Oregon Administrative Rules (OAR) Chapter 340 Division 45.

1.2 SUBMITTALS

A. Submit in accordance with Section 01 33 00 – Submittal Procedures. Submittals shall include but not be limited to the following:

1. A complete set of drawings, specifications, catalog cut-sheets, and detailed descriptive material. This information shall identify all technical and performance requirements stipulated on the drawings and in the specification.
2. Detailed information shall be submitted for all items such as hardware, motors, reducers, motor controllers and instrumentation (field devices, major control panel devices, and anticipated control panel layout).
3. Vendor data shall be furnished to confirm the torque and thrust rating of the drive.
4. List showing materials of construction of all components.

5. Manufacturer's recommended spare parts.

6. Submit anchoring calculations in accordance with Section 43 05 50 – Equipment Mounting sealed by a civil or structural engineer currently licensed in the State of Oregon.

7. Information on equipment field erection requirements including total weight of assembled components and weight of each sub-assembly.

8. A maintenance schedule showing the required maintenance, frequency of maintenance, lubricants and other items required at each regular preventive maintenance period, including all buy-out items.

9. Process equipment electrical requirements and schematic diagrams.

10. Functional control description.

11. Complete list of deviations from the drawings and specifications.

12. Process Guarantee.

13. Shop test results.

14. Equipment Warranties.

B. Submit Operation and Maintenance Data in accordance with Section 01 78 23 – Operation and Maintenance Data. Manuals shall address:

1. General project information.

2. Installation and start-up.

3. Process design and operational control description.

4. Mechanical, electrical and field instrumentation component descriptions.

5. Maintenance and troubleshooting.

6. Mechanical and electrical drawings.

1.3 SYSTEM RESPONSIBLITY

A. The Contractor shall assign full responsibility for the functional operation of all SBR System components to a Single Source Supplier. This Supplier shall be responsible for all engineering necessary in order to select, furnish, inspect the installing contractor's equipment installation and connections, calibrate, and place into operation the SBR System along with all other equipment and accessories as specified herein.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: The SBR System shall be supplied by a company of good reputation that is regularly engaged in the manufacture and fabrication of SBR wastewater treatment systems. The manufacturer's experience shall include a minimum of fifty (50) installations in North America where equipment of similar size and design (continuous or batch fed SBR system) has been in operation successfully in a similar process for a minimum of fifteen (15) years. As a minimum, the supplier shall be the manufacturer of the following components: mixer(s), decanter(s), diffuser system(s), and controls.

B. Electrically actuated valves: Actuated valves shall be tested to specified test protocol prior to shipment. Testing shall consist of the following:

1. Project and nameplate data verification per assembly documentation.

2. Limit switch and torque switch setup and cycle test.

3. Hydrostatic test (two pressurization cycles) for all plug and butterfly valves.

C. Mixer: The mixer(s) shall be shop inspected and tested prior to shipment. Testing shall consist of the following:

1. Project and nameplate data verification per assembly documentation.

2. Dynamic balancing.

3. Final inspection.

1.5 MOTOR COMPLIANCE

A. Motors shall be in compliance with the Energy Independence and Security Act of 2007 (EISA 2007).

1. All three phase motors and components shall be 460-volt, 60 hertz.

2. All single-phase components shall be 115-volt, 60 hertz.

1.6 PROCESS GUARANTEE

A. The SBR Equipment Vendor/Manufacturer shall provide a process guarantee that the SBR process will produce effluent quality listed in Part 2.2 of this specification. This guarantee shall begin upon substantial completion and remain in effect for a period of two years. The process guarantee shall include modifying equipment and controls to achieve these discharge limits at no additional cost to Owner if the process is operated within the specified design guidelines.

1.7 PROCESS PERFORMANCE REQUIREMENTS

A. The effluent quality performance of the Treatment Process will be demonstrated via one (1) thirty-day process performance test period during the first twelve (12) months of operation, following stabilization of the process. The process performance test will demonstrate and document the effluent quality for the purpose of determining whether the effluent process performance guarantees have been satisfied.

B. Guaranteed Process Performance is based upon a process designed in accordance with the influent and effluent wastewater criteria from Section 2.2. Additionally, the following conditions shall be met:

1. Process performance tests shall be performed in accordance with Section 01 75 00 – Equipment Testing and Startup.

2. The pH entering the secondary treatment shall be in the range of 6.5 - 8.5 to maintain biological activity.

3. The wastewater shall be biodegradable with no inhibitory concentrations of toxic compounds present. Testing of the influent, if necessary, shall be provided by the Vendor.

C. Process Performance Testing

1. The Owner shall be responsible for carrying out the process performance testing, for collecting all samples, for carrying out all laboratory tests and for keeping such detailed records as may be necessary for determining whether the process performance guarantees have been met. The said records shall be retained until the process performance guarantee has been satisfied or until expiration of the period during which the process performance test is to be performed whichever occurs earlier, and such records shall include all daily log sheets, operator notes, sample inspections, and instrument charts produced in operation of the plant. The Owner shall provide one copy of such records to the Vendor free of charge. The Owner shall make copies of such records available to the Vendor for inspection or copying at the Vendor's expense.

2. The process performance test shall be subject to the following general conditions:

   a. The process performance test shall be in accordance with Section 01 75 00 – Equipment Testing and Startup.

   b. All analyses, data reduction or tests not otherwise specified shall be carried out by procedures furnished or approved by Standard Methods for the Examination of Water and Wastewater, most recent edition; unless a different source is agreed upon by Owner and the Vendor.

   c. The Owner shall furnish all materials, utilities, services and personnel as required to operate the plant during the process performance tests.

   d. The Owner will notify the Vendor in writing thirty (30) days in advance of beginning the process performance test.

3. The following are specific responsibilities of the Vendor and Owner with respect to the process performance test and guarantees:

a. Owner will carry out the thirty (30) day process performance test at such conditions and at such time as the Vendor and Owner mutually agree for purposes of determining whether the process performance guarantees are met. The 30 day time frame within which the process performance test is to be carried out may be extended by the length of any period of down time required for correcting any failure or deficient performance.

b. The Owner shall provide the labor required to obtain samples and measurements and shall pay for all laboratory analyses of the samples.

c. If during the process performance test it appears that the process guarantees are not being met, the Vendor shall have the right to have the plant operated at such reasonable conditions as it may deem necessary or advisable for the purpose of determining the nature or cause of the failure of the plant to meet such guarantee, provided such operating conditions are in accordance with good engineering practice and Owner's operating rules enforced at the plant site. Thereafter, the Vendor shall have the right to make or have made such adjustments in order to meet such guarantee and the right to make or have made such alterations or modifications to the plant necessary to correct deficiencies in the process design basis as it deems necessary or advisable. Such alterations or modifications shall be subject to review and approval by an appropriate State Agency and the Owner.

d. The following recordings and samples shall be taken and analyzed. The samples shall be taken at the Treatment Process influent and effluent, unless noted otherwise. The following are the minimum samples and recording points:

1) Plant Flow: Influent/Effluent (MGD)

2) BOD_5: Influent/Effluent (mg/L)

3) TSS: Influent/Effluent (mg/L)

4) TKN: Influent (mg/L as N)

5) Total Ammonia: Influent/Effluent (mg/L as N)

6) Nitrate: Influent/Effluent (mg/L as N)

7) Total Phosphorus: Influent

8) pH: Influent/Effluent (S.U.)

9) Temperature: Influent/Effluent (°C)

10) Dissolved Oxygen (DO): Secondary Biological Tanks (mg/L)

11) Alkalinity: Secondary Biological Tanks (mg/L) (one sample shall be taken during first week of testing only.)

e. The Vendor and Owner will jointly review performance of the process system to determine compliance with performance guarantees. Performance shall be based on 24-hour composite sample results. Review will include, but not be limited to, a comparison of influent and process design basis with the actual performance results. The effluent quality shall meet the requirements specified for 30 consecutive days based on 24-hour composite sample results.

f. The Owner will promptly notify the Vendor of the failure to meet any process guarantee and specify the respect in which such guarantee has not been met.

g. If the Vendor disputes any claimed failure, notice of such dispute shall be furnished promptly to Owner.

D. Performance Standards and Exclusive Remedy

1. In the event that the Treatment Process does not achieve the required level of process performance (as set forth in Section 2.2) during the test period, the Vendor shall be permitted to conduct a maximum of two (2) additional 30-day tests to meet the specified process guarantee criteria at Vendor's expense. Prior to either of these additional tests the Vendor may undertake modifications, (at Vendor's expense), to improve effluent quality.

2. Upon successful completion of the specified testing requirements, the Vendor's total liability, with the exception of equipment warranties, under this Agreement shall be discharged.

3. If the Treatment Process fails to achieve the required effluent quality during the process performance test period and fails the additional test(s), the Vendor shall have failed the process performance test.

1.8 WARRANTY

A. The Manufacturer shall provide a written warranty against defects in materials and workmanship. Manufacturer shall warrant the goods provided by the Manufacturer to be free from defects in materials and workmanship under normal conditions and use for a period of one (2) years from the date of substantial completion. The manufacturer shall repair or replace all defects of materials or workmanship in the equipment during the warranty period.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Acceptable Manufacturers for Continuous-Feed SBR are as follows:

1. Sanitaire, a Xylem Brand

2. Or approved equal

B. Acceptable Manufacturers for Batch-Type SBR are as follows:

1. Aqua-Aerobics Systems, Inc.

2. Or approved equal

C. Approval Requirements

1. Pre-approval requests shall be complete to the extent that the Engineer can determine if the system will function as an equivalent to that specified and that the materials and equipment are of equal or better quality. This includes the following:

a. A letter signed by an officer of the company certifying compliance with the specifications without exception. In addition, the supplier must certify the proposed motors will be warranted by the motor supplier as outlined in the specified Warranty.

b. A field test report documenting the proposed or similar units have been field tested.

c. Proof of manufacturing and testing facilities.

d. Installation list with contacts and phone numbers for a minimum of ten installations of similar size in operation for ten years.

e. Design calculations, equipment sizing and selection cutsheets and information, sample control narrative and other information requested by the Engineer for consideration.

2.2 SBR FUNCTIONAL REQUIREMENT AND DESIGN CRITERIA

A. The manufacturer of the SBR system shall be completely responsible for the proper design of their system, including but not limited to; diffused aeration equipment, transfer pump(s), mixer(s), decanter(s), and controls. All equipment shall perform as specified and the completed installation shall operate in accordance with the requirements of the plans and specifications. The SBR system shall be either continuous flow or a batch treatment process. The SBR system shall meet the requirements provided below.

B. Design Criteria

Parameter	Current	20-Year Design	Units
Annual Average Daily Flow (AADF)	0.177	0.223	MGD
Max Month Wet Weather Flow ($MMWWF_5$)	0.207	0.262	MGD
Peak Day Average Flow ($PDAF_5$)	0.335	0.423	MGD
Peak Hour Flow (PHF)	0.541	0.682	MGD
Peak Instantaneous Flow (PIF)*	0.590	0.907	MGD
Assumed Influent pH	6.5-8.5		SU
Assumed Influent Alkalinity	280		mg/L as $CaCO_3$
Minimum Influent Temperature	8		˚C
Maximum Influent Temperature	20		˚C
Max Month BOD_5 Loading	280	490	ppd
Max Month TSS Loading	137	277	ppd
Max Month TKN Loading (as N)	100	155	ppd
Max Month Phosphorus Loading (as P)	20	24	ppd
Effluent BOD_5 Concentration	20		mg/L
Effluent TSS Concentration	20		mg/L
Effluent Ammonia Concentration (as N)	1		mg/L
Effluent Nitrate Concentration (as N)	5		mg/L
Effluent pH	6.5-8.5		SU
Minimum Process Basin DO	2		mg/L
Maximum MLSS at LWL	4,500		mg/L
Maximum Number of Cycles at Max. Daily Flow	4		Per day/Basin
Minimum Reactor Volume at Low Level	0.202		MG/Basin
Minimum Reactor Volume at High Level	0.254		MG/Basin
Minimum Settling Cycle Time	1		Hour/cycle at Max. Daily Flow

* Peak instantaneous flowrate represents the maximum flowrate that can be delivered to the SBR basins based on the capacity of the influent pump station.

C. Oxygen Demand Parameters

Jobsite Elevation	860	Ft MSL
Alpha	0.65	
Beta	0.95	
Oxygen Requirements		
	1.25	lbs O_2/lb BOD_5 applied
	4.6*	lbs O_2/lb TKN applied
Actual Oxygen Requirement	1,328	lbs O_2/day
Minimum Blower Air Capacity per Blower	640	SCFM
Blower Discharge Pressure	10.7**	PSIG
Minimum Ambient Temperature	10	˚F
Maximum Ambient Temperature	115	˚F
Total # Blowers	Min. 3	1 Blower dedicated to each SBR basin with one shared standby blower (largest size) for redundancy

*Oxygen requirements based on total influent TKN. Denitrification credit may be used as 2.86 lbs O_2/lb NO_3-N removed. No credit shall be used for cell-nitrogen assimilated during the biological process. Diurnal load peaking factor of 1.25 to be applied following addition of denitrification oxygen credit.

** Actual discharge pressure may vary by up to 10%. Proposed equipment shall be provided with this additional amount.

D. .Basin Dimensions

SBR Basin Quantity	2	
Post-Equalization Basin Quantity	1	
Required Volume	52,860	gal

2.3 CONTINUOUS FEED SBR SYSTEM SPECIFICATIONS

A. PROCESS BLOWERS

1. Furnish one of the following blower types in accordance with associated specifications:

    a. Rotary lobe type, positive displacement blowers: 43 11 33 – Rotary Lobe Blowers

    b. Screw type blowers: 43 11 31 – Rotary Helical Screw Blowers

2. Each blower assembly shall be complete and mounted on a base weldment with four corner anti-vibration mountings, designed for direct application on a concrete slab or other solid foundation. Each assembly shall be suitable for shipment as a complete unit, factory assembled (less discharge pipe fittings) as much as possible to facilitate shipping and handling.

3. Equipment shall include a blower, electric motor, belts and sheaves, inlet package, discharge silencer, discharge check valve, rubber inlet sleeve and discharge connection, pressure relief valve, butterfly discharge isolation valve, and rubber expansion joint. A personnel protection guard shall be included over the belts and sheaves.

B. AIR CONTROL VALVES

1. Furnish motor operated air control valves to control aeration in the SBR basins in accordance with 40 05 64.36 – High-Performance Air Control Valves.

C. INFLUENT CONTROL VALVES

1. Furnish 8" motor operated influent flow control plug valves to control influent into the SBR basins in accordance with 40 05 62 – Plug Valves. Valves will be manually operated.

D. FIXED FINE BUBBLE AERATION SYSTEM

1. Furnish all materials, equipment, services, and testing for the fine bubble aeration system. Equipment Components Included:

    a. Stainless steel droplegs, supports, and anchors.

    b. PVC manifolds, air distributors, diffuser holders, and retainer rings

    c. Bolts, nuts and gaskets for aeration system flange connections.

    d. Air distributor purge systems.

    e. Membrane disc diffusers with integral O-ring gaskets.

f. Diffuser pressure monitoring systems

g. Cooling Legs

h. Diffuser grid isolation valves

2. System Design and Performance: Design aeration system to transfer not less than the following pounds of oxygen per day in clean water at 14.7 PSI, 20°C and zero dissolved oxygen at the specified submergence, air rate and pressure.

3. Design air distributors with centerline spacing not to exceed 4 feet to maximize oxygen transfer efficiency and mixing efficiency and to minimize solids deposition between air distributors.

4. Valves shall meet the requirements of Section 40 05 64 – Butterfly Valves.

5. Materials, Fabrication, and Finishing

a. Stainless Steel – Pipe, Fittings and Supports

1) Fabricate all welded parts and assemblies from sheets and plates of 304L stainless steel with a 2D finish conforming to ASTM A240, 554, 774, 778.

2) Fabricate non-welded parts and flanges from sheets, plates or bars of 304 stainless steel conforming to ASTM A240 or ASTM A276.

3) Welds & Welding Procedure: Weld in the factory using latest standards according to AWS. Continuously weld both sides of face rings and flanges to eliminate potential for crevice corrosion.

4) Corrosion Protection and Finishing: Clean all welded stainless steel surfaces and welds after fabrication by using the following procedure: Preclean outside and finish clean all interior and exterior welds and piping by full immersion pickling and rinse with water to remove all carbon deposits and contaminants to regenerate a uniform corrosion resistant chromium oxide film per ASTM A380 Section 6.2.11, Table A2.1 Annex A2 and Section 8.3.

b. Natural Rubber – Furnish all fixed and expansion joint O-ring gaskets of natural rubber/SBR with a Shore A durometer of 45 ± 5.

c. Polyvinyl Chloride (PVC) – Pipe and Fittings

1) Produce all PVC pipe and fittings from PVC compound with a minimum tensile strength of 48,000kPa. Lower drop pipe, manifold and air distributors shall be schedule 40 PVC or better, meeting the applicable requirements of ASTM D1784, D1875, D2466 and 12454-B.

2) Design air distributors and manifolds to withstand maximum temperature expected from blowers.

3) Add two parts by weight of titanium dioxide per 100 parts of resin to PVC compounds for manifolds, air distributors, joints and PVC diffuser assembly components to minimize ultraviolet light degradation.

4) Factory solvent weld all PVC joints and fittings. Field solvent welding will NOT be permitted.

d. EPDM – Membrane Diffusers and Gaskets

1) Manufacture circular membrane diffuser discs with integral O-ring of EPDM synthetic rubber compound with precision die formed slits. Thermoplastic materials (i.e. plasticized PVC or polyurethane) are not acceptable.

2) Quality Control – Test diffuser using primary sampling criteria outlined in Military Standard 105E.

6. Fine Bubble Aeration System Components

a. Droplegs - Provide a stainless steel dropleg from the air main connection to the dropleg connection on the manifold.

b. Cooling Legs – Where required, provide an extension of stainless steel piping between the dropleg and the manifold to serve as a heat exchanger to cool air prior to contact with the PVC piping, and prevent thermal damage to aeration system.

1) Provide heat loss calculations to confirm that cooling leg length is adequate.

c. Manifolds – Provide PVC manifolds for connection to the air distribution headers.

1) Fabricate manifolds with 4-inch diameter fixed threaded union positive locking anti rotational or flanged joints for connection to the air distributors.

d. Air Distributors and Diffuser Holders - 4-inch diameter PVC air distributors perpendicular to the air manifold

1) Fabricate distributors with single diffuser holders solvent welded to the crown of the air distributor for complete air seal and strength.

2) Provide 4-inch diameter threaded removable end caps complete with gasket, threaded coupling and end plate for clean out at the end of each distributor.

e. Air Distributor and Manifold Connection Joints

1) Join air distributor sections with positive locking anti rotational fixed threaded union or flange type joints for all submerged header joints to prevent blow apart and rotation.

2) Design flanged joints with a 56.7 kg drilling angle face ring, follower flange and stainless steel hardware.

f. Supports - Provide each section of manifold and air distributor with a minimum of two (2) supports.

1) Limit maximum support spacing to 2.5 meters.

2) Design all supports to allow for thermal expansion and contraction forces over a temperature range of 52° C and to minimize stress build up in the piping system.

g. Diffuser Assemblies - Furnish diffuser assemblies including diffuser, diffuser gasket, holder, retaining ring and air flow control orifice.

h. Membrane Diffuser: Incorporate an integral check valve into the membrane diffuser.

1) Design and test diffusers for a dynamic wet pressure (DWP) of 12 inches +/- 20% water column @ 1.0 SCFM/diffuser and 2 inches submergence.

2) Visual Uniformity – Observe diffusers for uniform air distribution across the active surface of the diffuser at 1.0 SCFM/diffuser and 2 inches submergence. Active surface is defined as the perforated horizontal projected area of the diffuser.

3) Quality Control – Test diffuser using primary sampling criteria outlined in Military Standard 105E.

i. Diffuser Holders and Retainer Rings

1) Design holder with air flow control orifice. Holder to provide peripheral support for the diffuser.

2) Design retainer ring to seal the diffuser and O-ring in the holder to prevent air leakage around gasket.

3) Design retainer rings threads with minimum cross section of 1/8-inch and allow for one complete turn to engage threads.

j. Anchor Bolts

1) Provide a mechanical 304 SS anchor bolts for embedment in 4000 psi concrete with a pullout safety factor of 4.

E. SUBMERSIBLE MIXERS

1. The SBR system supplier shall furnish submersible mixer(s) in each tank as required to completely mix the tank and shall be the manufacturer's standard product. Performance testing of the mixers shall be conducted by taking mixed liquor samples at various locations and depths throughout the tank.

2. Each mixer shall be equipped with a submersible electric motor with submersible cable (SUBCAB) suitable for submerged mixer applications. All cables shall be oil resistant chlorinated polyethylene rubber jacketed. Each mixer shall be fitted with an appropriate length of stainless-steel cable of adequate strength to permit raising and lowering the mixer. Leak sensors shall be used to sense water presence in the oil and stator housings.

3. Mixer Design

   a. The mixer(s) shall be capable of handling raw, screened sewage. The mixer(s) shall be able to be raised and lowered and shall be easily removed for inspection or service without the need for personnel to enter mixing vessel or reactor tank. A sliding guide bracket shall be an integral part of each mixer unit. The entire weight of each mixer unit shall be guided by a single bracket which must be able to handle all thrust created by the mixer. Each mixer, with its appurtenances and cable, shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 ft.

4. Mixer Construction

   a. Each mixer shall be of the integral gear, close coupled, submersible type. All components of the mixer, including motor and gearbox shall be capable of continuous underwater operation while the mixer blade is completely submerged.

   b. All surfaces coming into contact with the mixed media, other than stainless steel and fiberglass, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with an epoxy finish coat on the exterior of the mixer.

   c. Major mixer components shall be of 304 Stainless Steel construction. The oil housing cover plate shall be of corrosion resistant composite. All exposed fasteners shall be of stainless steel. In order to ensure that the low velocity area around the motor remains impervious to low pH solids and or liquid attack, the motor housing exterior shall be made of 316 Stainless Steel.

5. Elastomers

   a. All mating surfaces where watertight sealing is required shall be machined and fitted with a double set of Nitrile rubber or O-rings. Fitting shall be such that sealing is accomplished by metal-to-metal contact between machined surfaces, resulting in controlled compression of the o-rings

without requiring a specific torque limit. No secondary sealing compounds, rectangular gaskets, elliptical O- rings, grease, or other devices shall be used.

6. Cable Entry

   a. The cable entry housing shall be an integral part of the back plate. The cable entry shall have a double set of elastomer grommets in order to ensure a redundant system in the event of a cable entry failure. Single sealing systems will not be deemed acceptable. The cable entry shall be comprised of two cylindrical elastomer grommets, each flanked by washers and a ferrule designed with close tolerance fit against the cable outside diameter and the entry inside diameter. This will provide a leak proof seal at the cable entrance without the need for specific torque requirements. The assembly shall bear against a shoulder in the stator casing opening and be compressed by a gland nut threaded into it. Interaction between the gland nut and the ferrule should move the grommet along the cable axially instead of with a rotary motion. The junction chamber and motor compartment shall be separated by a terminal board which shall protect the motor interior from foreign material gaining access into the mixer top. Connection shall be made between the threaded compressed type binder posts thus securely affixing the cable wires to the terminal board. The use of the terminal compressed type post and a terminal board O-ring shall render the motor compartment leak proof from any liquid which may enter the terminal compartment.

7. Motor (Non-explosion proof)

   a. The multi-pole motor shall be directly connected to the propeller (gearbox designs are not acceptable). The mixer motor shall be squirrel cage, induction, shell type design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180°C (356°F). The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31. The motor shall be designed for continuous duty, capable of no less than 30 evenly spaced starts per hours. The rotor bars and short circuit rings shall be made of aluminum. Thermal sensors shall be used to monitor stator temperatures. The stator shall be equipped with three (3) thermal switches embedded in the end coils of the stator winding and set for 284°F (140°C). These shall be used in conjunction with, and supplemental to, external motor overload protection, and wired to the control panel.

8. Propeller

   a. The propeller shall be of 316 stainless steel, dynamically balanced, non-clogging backward curved design. Each blade shall be laser cut and welded to the hub to ensure that the propeller is properly balanced.

9. Bearings

a. All bearings shall have a minimum L-10 rated life of 100,000 hours and shall have inner and outer races of metal construction. Bearings with races made of nonmetallic construction will not be deemed acceptable or meeting the load handling and environmental requirements of this application. The outboard propeller bearing shall be an angular contact bearing. The motor shaft end shall be supported by two bearings. A roller and an angular contact ball bearing shall take up the axial and radial loads while an angular contact ball bearing shall take up the axial loads. The bearings shall be pre-loaded by a bearing loading nut located on the motor end of the shaft in order to reduce shaft deflection and increase bearing life and seal life. Mixers (and pumps) without pre-loaded bearings will not be considered acceptable or equal.

10. Mechanical Seals

a. The standard inner mechanical seal is corrosion resistant Tungsten Carbide/Aluminum Oxide. The outer seal faces are Tungsten Carbide/Tungsten Carbide. One face of the inner seal ring pair shall have spiral grooves laser etched in it, to provide a pumping action to move leakage from the stator housing back into the oil chamber. In order to avoid seal failure due to sticking, clogging, and misalignment from elements contained in the mixed media, only the seal faces of the outer seal assembly and its retaining clips shall be exposed to the mixed media. All other components shall be contained in the oil housing. The mixer shall be equipped with a seal shield that prevents fibrous material from winding up around the shaft and outer seal. The shield shall be welded to the propeller hub and extend towards the motor. The shield shall rotate with the propeller and there shall be a radial micro-gap between the shield and oil-housing.

11. Oil Housing

a. The oil housing shall contain two compartments consisting of an inner and an outer section with four ports to connect and facilitate oil flow. In the event that the mixed media bypasses the other seal, this design will allow the outer compartment to collect the heavier (denser) fluids by means of a simple gravity process. Mixers which require propeller removal for oil change shall not be acceptable. Separate fill and drain plugs shall be provided to facilitate oil replacement.

12. Mixer Control System

a. An integrated mixer control system installed in the mixer/motor housing shall ramp up the speed at start-up of the mixer to reduce the start-up current and secure that the direction of the impeller rotation is always correct. There shall be no need for any human intervention to ensure that the impeller is rotating in the correct direction.

b. The mixer and control system shall meet all requirements outlined in Division 26 of the specifications.

c. The control system that is integrated within the mixer/motor housing shall be encapsulated to protect it against moisture ingress, and vibrations.

d. The motor, mixer and control system shall be designed and produced by the same manufacturer.

e. The integral control system mounted within the mixer/motor housing shall be capable of autonomously adjusting the motor/impeller speed so that the mixer can safely operate without overloading.

f. The mixer shall incorporate a "propeller-cleaning" function to remove debris from the propeller. The cleaning function shall be initiated when the integral control system senses an increase in current draw due to debris on the propeller. The cleaning function shall consist of forced slowdown of the propeller to allow for debris to fall from the propeller. After cleaning cycle is complete, the mixer shall resume automatic operation.

13. Mounting Mast Assembly (Direct Drive Mixers)

a. Mast shall be constructed of 316 stainless steel.

b. Mast shall enable the operator to position and lock the mounting mast and mixer at different operating angles along the horizontal and vertical planes respectively.

c. Mixer mounting system shall be designed to accommodate tanks with sloped walls and floors.

d. For deep tanks, mixer mounting masts will include the use of additional intermediate mast mounting brackets, preventing mast deflection.

e. For closed tanks, utilizing the adjustable 316 stainless steel cable, the mixer shall be supported at the desired operating level, allowing the davit's lifting cable to be slackened and removed from the winch. This feature shall enable the portable davit to be removed from its mounting socket and stored, while the davit's lifting cable may be secured below the roof of the tank. This in turn permits the tank roof doors to be closed during mixer operation.

14. Davit and Winch Assembly

a. A socket for mounting a portable davit crane shall be provided at each mast assembly station to raise and lower the mixer(s) and pumps(s) for installation and service. One (1) portable davit crane shall be provided, consisting of a lifting davit, winch, hook and 40 feet of 316 stainless steel lifting cable.

F. DECANT MECHANISM

1. The SBR supplier to furnish decanter assemblies with drive actuator for each SBR basin. The decanters shall be designed to remove clarified effluent and shall be the

manufacturer's standard product.

2. Design Parameters

a. The maximum decanter loading at Normal Flow Mode condition shall not exceed 20 ft3/ft/min. The maximum decanter loading at High Flow Mode condition shall not exceed 30 ft3/ft/min.

b. The decanter weir and trough shall always be visible from the basin side wall thereby providing the operator with a visual check of the effluent quality during the decant phase of the cycle.

c. The decanter shall be parked above the design top water level during aeration and settling phases, thereby eliminating any possibility of solids carryover during these phases. Fixed decanters will not be acceptable.

d. At top park position, the decanter shall provide 'fail safe' overflow protection in the event of a power failure. Settled supernatant will flow via gravity, under the scum guard, over the weir, and into the decanters.

e. The decanter shall be designed with a scum guard mechanism to prevent the discharge of scum and floatables during decanter or overflow operation.

f. All in-basin seals and bearings shall be maintenance free.

g. Decanter assembly components requiring routine maintenance shall be accessible.

h. The drive mechanism or actuator shall be designed for a continuous duty, variable speed mode of operation thereby producing a uniform effluent flow rate throughout the decant phase.

i. Actuator limit switches and motor shall be integrated with process control system to prevent blower operation during the decant phase of the cycle.

j. The decanter assembly shall not require flex joints, throttling capabilities, or dewatering supports.

3. Equipment

a. The decanters shall be supplied with the following components:

1) Upper collection trough with integral, overflow weir

2) Scum guard mechanism

3) Downcomer pipes

4) Collector pipe (for decanters >6ft)

5) Swivel Joint or Seals & bearings, as required

6) Electro-mechanical actuator

b. The drive mechanism or actuator shall consist of an electro-mechanical screw jack with protective boot and end position limit switches. The actuator shall be equipped with a VFD rated motor suitable for continuous duty in an outdoor, moist environment. The motor shall be driven by a variable frequency drive allowing the controls to vertically lower the decanter at a continuous and uniform rate.

c. The decanter shall not require spring loaded valves, flexible joints, and/or throttling effluent valves to control discharge rate.

d. The decanter must be self-supporting when the basin is drained.

4. Controls

a. Decanters shall be operated per the hydraulic controller described in the controls section.

5. Materials

a. All in-basin welded decanter components, except seals and bearings, shall be constructed of corrosion and ultra-violet resistant stainless steel. All fasteners shall be constructed of stainless steel.

b. The decanter seals and bearings shall be constructed of maintenance free, synthetic materials for the longest possible service life. All seals and bearings shall be shipped factory assembled, simplifying installation.

6. Fabrication and Finishing

a. All decanter welding must be conducted by welders certified under ASME Code 9.

b. All joints to be finished tested for integrity by either air pressure (3.0 psi) or dye penetrate methods.

c. All finished decanter units to be free of abrasions, damage, flaws, carbon contamination and discoloration. All weld burn and discoloration shall be removed with pickle paste. All stainless-steel surfaces shall be passivated and shall have a pleasing and uniform passivated appearance. Decanters shall be power washed for final cleaning prior to shipment.

G. SCUM REMOVAL SYSTEM

1. The SBR supplier to furnish a scum removal system consisting of 6” motor actuated telescoping valves for each basin.

H. WAS PUMPS

1. Furnish submersible non-clog pump(s) for each basin in accordance with Section

43 25 00 – Submersible non-clog pumps.

I. POST-EQUALIZATION TRANSFER PUMPS

1. Furnish Flygt submersible non-clog pump(s) for each basin in accordance with 43 25 00 – Submersible non-clog pumps. Each pump shall be equipped with a submersible electrical motor connected for three phase operation.

J. POST EQUALIZATION BASIN MIXING

1. Provide one blower and coarse air diffusers as required for adequate mixing. Blowers shall meet the requirements of 43 11 33 – Rotary Lobe Blowers or 43 11 31 – Rotary Helical Screw Blowers. Blowers shall be the same type as the process blowers. Coarse air diffusers shall have adequate floor coverage and shall be constructed of stainless steel. Manufacturer shall provide diffusers and drop legs. Contractor shall provide interconnecting piping and isolation valves.

K. PROCESS INSTRUMENTATION

1. The SBR supplier shall furnish, configure and commission the instrumentation for the SBR system. At a minimum, the system shall include the following instruments:

   a. One (1) DO and pH probe (per basin) with required controllers in accordance with 40 75 43 – Dissolved Oxygen Measuring Systems, and 40 75 13 – pH-ORP Analyzers, respectively.

   b. One (1) pressure transducer (per basin) in accordance with 40 73 00 – Pressure Measuring and Detection Systems.

   c. One (1) low level float (per basin) in accordance with 40 72 00 – Level Measuring System

   d. Position indication for decanters

   e. High and low level floats for post-equalization basin

   f. One (1) pressure transducer for post-equalization basin in accordance with 40 73 00 – Pressure Measuring and Detection Systems.

2. Instrumentation shall meet the requirements of the applicable Sections of Division 40.

3. Controllers: Provide controllers as required for DO and pH probes. The controller will communicate with the main PLC via 4-20 mA signals. The controller will have a NEMA 4X enclosure with corrosion-resistant finish and shall be AC powered from a 100-230VAC, power source. Each probe module shall include a sun shield.

L. CONTROL PANEL

1. The control system shall be designed to optimize the SBR process while minimizing operator attention and to accommodate the continuous maximum daily flow without adjusting cycle structures. The control software program shall be factory tested prior to installation at the jobsite.

2. Electrical components, such as motor starters, VFDs and MCCs, shall be provided by the contractor. Vendor shall not be required to provide space in vendor supplied panels to accommodate contractor supplied equipment.

3. The control system shall be a timer based system with level overrides and shall provide control, sequence, monitoring, and alarm annunciation capabilities. The operator shall be able to access the timer values and set points through the operator interface panel to allow for adjustment of cycle times and system flexibility. The control system shall be designed to automatically accommodate the plant's full range of loads and flows.

4. A complete control system shall be provided as described in the following and as shown on the contract drawings. The control system shall include 115 volt control circuit breaker, microprocessor control, operator interface display, indicator lights, and HAND-OFF-AUTOMATIC selector switches.

5. The incoming service of the control system shall be 115 volt, 60 hertz, single-phase. Controls for the equipment listed below shall be provided within the SBR control panel. Elapsed time indication shall be provided for equipment indicated by an asterisk (*).

SBR Equipment Description
Mixer(s)*
Pump(s)*
Blowers*
Influent Valve(s)
Decanter Actuator(s)
Decanter Valve(s)
Air Control Valves

6. CONTROL PANEL WIRING AND ASSEMBLY

a. All control enclosures shall be custom assembled and wired in an Underwriters Laboratories (UL) certified cabinet shop using quality materials and labor. Short circuit rating of control enclosure shall be 5 kA RMS symmetrical @ 120VAC maximum.

b. All control panel single conductor wire shall be 16 AWG multi-strand machine tool wire (MTW) minimum, with PVC insulation.

c. All wires shall be clearly marked with an identification number consistent with the wiring schematic drawing. Wire markers shall be a thermal

transfer printable type. The material shall be a self-laminating vinyl. Labels shall be Brady THT-9-427-10 or approved equal.

d. Wiring inside the control panel shall be run in PVC wiring duct rated for continuous temperatures up to 122° F (50°C). Devices mounted in the enclosure door shall have wires run in spiral wrap to avoid pinch points when opening and closing the door.

e. Control components mounted internal and external to the enclosure shall be mounted with stainless steel hardware and clearly labeled with a plastic identification nametag. The tag shall be white with black lettering.

7. CONTROL PANEL QUALITY ASSURANCE

a. All Control panels shall be UL certified. Testing by manufacturer's electrical engineering prior to releasing for shipment shall be completed. Testing shall consist of the following:

1) Point to point testing of all wiring prior to application of power

2) Intended supply voltage shall be applied to the enclosure

3) All components shall be tested for proper operation and calibration

4) The PLC and operator interface program shall be loaded and functionally checked

5) All components shall be checked to confirm proper mounting specifications have been followed

6) Enclosure shall be inspected for defects and repaired if necessary

7) All labeling of wires and devices are correct, properly installed and clean

b. The manufacturer shall finalize the factory checkout by completing a control panel checklist to document all testing completed above.

c. Upon the successful completion of the control testing of the enclosure assembly, all applicable documentation (i.e., finalized drawing set, signed control checklist cover page, device data sheets, etc.) shall be placed in the drawing pocket of the enclosure.

8. Control Enclosure: The automatic controls shall be provided in a UL listed, NEMA Type 12 floor mount enclosure that provides a degree of protection for electrical controls and components from dust, dripping water and external condensation of non-corrosive liquids. The enclosure is intended for outdoor installation. Enclosure shall include gasketed overlapping doors with a 3-point latch mechanism operated by an oil tight key-lock handle. The enclosure shall have a brushed finish. The enclosure shall include a painted white mild steel (10 gauge)

sub-panel mounted with collar studs. Enclosure shall be manufactured by Hoffman or approved equal.

a. The control enclosure shall be mounted remotely.

9. Corrosion Inhibitor: Each control enclosure assembly shall be provided with corrosion inhibitors to protect interior electrical components from damage caused by high humidity. The corrosion inhibitors shall be installed prior to shipment to provide protection during shipment and storage of the enclosure.

a. The corrosion inhibitor shall be Hoffman AHCI5E or approved equal.

10. Main Disconnect Circuit Breaker: A UL listed; automatic molded case 3-pole disconnect breaker shall be provided in the control enclosure(s). The primary function of the disconnect switch shall be to provide a means to manually open a circuit and automatically open a circuit under overload or short circuit conditions. The disconnect breaker shall have a door mounted operating mechanism with trip indication. Power distribution connectors shall be mounted integrally to the circuit breaker for multiple load connections. Integral connectors shall be provided. The disconnect circuit breaker shall be a Square D/FAL, HDL, JDL, LAL, MGL, PGL or approved equal.

11. Circuit Breaker: All single phase branch or supplementary circuits shall be protected with a single-pole, C-Curve rated circuit breaker. Circuit breakers shall be rated for 240 VAC maximum, 50/60 Hz and UL 489 listed. Supplementary and branch protection circuit breakers shall be Merlin Gerin Multi 9 or approved equal.

12. Fuse: Properly rated fuses and fuse holders shall be provided for protection of individual control devices (discrete and analog signals) mounted outside of the enclosure. Each fuse shall be housed in a hinged type fuse block to protect against contact with the fuse. Fuses shall be rated up to 250 VAC and be Littelfuse or approved equal. Fuse holders for discrete devices shall be rated to 600 VAC and 30 Amps. Fuse holders for analog devices shall be rated to 300 VAC and 15 Amps. Fuse holders shall be Allen Bradley 1492 or approved equal.

13. Operator Device: Operator devices (pushbuttons and selector switches) shall be mounted through the control enclosure door for all automatic controlled equipment. Transformer type pilot lights and illuminated pushbuttons shall be provided for indication of an operation status. Lights shall be a 6 VAC incandescent type lamp.

a. All operator devices shall be UL Listed, 30.5mm style, NEMA Type 4X rated, oil and water tight with finger safe guards located on the contact blocks to prevent accidental contact with wire connections. Operator device function shall be identified with an engraved white Gravoply nameplate with black letters. Operator devices shall be Allen-Bradley 800H, Square D 9001, or approved equal.

14. High Frequency Noise Filter: A UL listed active tracking filter shall be provided to protect the PLC and HMI power feeds from high-frequency noise and low-energy transients. It shall be designed for a single phase input voltage of

120/240VAC operating at 47 to 63 Hz. The unit shall reduce normal mode transients to plus or minus 2 volts, provide surge capacity of 45,000 amps and protect in all modes (Line to neutral, line to ground and neutral to ground). The noise filter shall be an Islatrol IC+ or approved equal.

15. Uninterruptible Power Supply: A UL listed uninterruptible power supply suitable for location in a UL 508 panel shall be provided to protect the HMI and PLC from short power outages by switching to an emergency battery backup without data loss or downtime. Nominal input voltage and output voltage shall be 120VAC with an autosensing input frequency of 47 to 63 Hz. The output power capacity shall be 650W / 1000VA. The UPS shall be provided with an audible alarm and LED status indicators and operate from 32° to 122°F (0° to 50°C). The UPS shall be an Allen Bradley 1609-B1000N.

16. Ground Fault Duplex Receptacle: A UL listed ground fault circuit interrupter (GFCI) duplex receptacle shall be provided within the panel for instrument (e.g., programming terminal, modem, etc.) use only. The receptacle shall be protected with a 5 Amp circuit breaker. The receptacle shall carry a 20A / 120VAC rating. The electro-mechanical circuit interrupter shall be double-pole and trip free (GFCI protection and shall not be overridden by holding reset button). Built-in transient suppression shall protect GFCI's internal circuitry from voltage transients. Receptacle shall be Hubbell DRUBGFI20 or approved equal.

17. 24 Volt Dc Power Supply: A UL listed, industrial grade, compact power supply shall be supplied to provide 24 VDC power to such rated components. The power supply shall be DIN rail mounted and functional with input voltage of 100 to 240 VAC (single-phase) incoming control power. The power supply shall have a green LED which shall be illuminated when output voltage is "OK". The power supply shall be an Allen Bradley 1606 or approved equal.

18. Control Relay: UL listed control relays for general control purposes shall be supplied with a pilot light to indicate when the coil is in an energized state. The relay socket shall be panel or DIN rail mounted inside the enclosure. The relays shall provide the following ratings: 120VAC coil, 10A contact rating (thermal), 250 VAC insulation rating and 5 million mechanical life cycles. Relays shall be Allen Bradley 700-HK, Square D, or approved equal.

19. Terminal Block: Standard feed-through screw terminal blocks, DIN rail mounted, shall be supplied for all point to point wiring connections. All terminals shall be numbered per the wiring schematic with printed markers. Terminals shall carry a 600V AC/DC voltage rating. Terminal blocks shall be Allen-Bradley 1492-J4 (35A max) and 1492-J16 (85A max) or approved equal.

20. Programmable Logic Controller: Automatic operation of the SBR shall be controlled through a programmable logic controller (PLC) mounted inside the main control panel. The PLC components shall consist of a power supply, CPU, discrete input and output modules and analog input and output modules. The processor unit shall include built-in USB and two (2) Ethernet IP communication ports. All input and output points supplied (including unused) shall be wired to terminal blocks. Processor design characteristics shall include: 1.0MB user memory size, real-time clock and calendar, battery backed RAM and an operating

temperature range between 32 °F and 140°F. The PLC processor shall be an Allen-Bradley CompactLogix 5069-L30ER or approved equal.

Modular equipment shall be provided to complete the PLC system. These Allen-Bradley components include: 1606-XLE120E – Power Supply, 5069 IB16– Discrete input (16 point) modules, 5069 -OB16– Discrete output (16 point) modules and 5069-IF8– Analog input (8 point) modules, 5069-OF8– Analog output (4 point) modules.

a. At minimum, the following alarms will be available via Ethernet/IP produce or message function or hard-wired dry contacts:

1) SBR Common alarm

2) Power failure alarm

21. Ethernet Switch: The unit shall be DIN rail mounted and require 24VDC/100mA power. Diagnostic LEDs for power, link status, data, and data rate shall be provided. The Ethernet switch shall be UL listed and manufactured by Allen-Bradley/Hirschmann, or approved equal.

22. Remote Access Ethernet Modem: A UL listed, remote access Ethernet modem shall be supplied to provide connection capability between the Ethernet PLC network to vendor through a cellular connection.

23. Human Machine Interface: The operator interface shall be a NEMA Type 12 rated, color touchscreen display with Ethernet and serial communications. The interface shall be a liquid crystal display (LCD). The display type shall be color active matrix thin-film transistor (TFT) with 640 x 480 pixel resolution. The rated operating temperature shall be 32° to 131° F (0° to 55° C). The operator interface shall be an Allen Bradley PanelView Plus 7 Performance 15".

24. Control Logic

a. The SBR controls shall operate on a time cycle basis. The process elapsed time will be displayed on the display terminal. Each pair of SBR tanks will operate on a complimentary basis, so that while one tank is in aeration the other tank is in settling or decant phase. The cycle will automatically adjust for high flow conditions to increase the throughput capacity in high flow conditions. In automatic operation, the processor shall at all times maintain the proper sequence of operation even in the event of power failure. All phases of the process and equipment shall be interlocked so that the process cannot be upset. If an equipment failure takes place an alarm will be displayed on the operator terminal until cleared. The display will indicate the time of the alarm and status.

b. Time critical sequences and other process variables can be adjusted via the operator interface terminal as follows:

1) SBR Sequences shall consist of [1] Aeration blower run time, [2] The waste sludge pump start time and running time, [3] The decanter lowering rate, and [4] Special process variables including

DO control setpoints.

2.4 BATCH FEED SBR SYSTEM SPECIFICATIONS

A. PROCESS BLOWERS

1. Furnish one of the following blower types in accordance with associated specifications:

   a. Rotary lobe type, positive displacement blowers: 43 11 33 – Rotary Lobe Blowers

   b. Screw type blowers: 43 11 31 – Rotary Helical Screw Blowers

2. Each blower assembly shall be complete and mounted on a base weldment with four corner anti-vibration mountings, designed for direct application on a concrete slab or other solid foundation. Each assembly shall be suitable for shipment as a complete unit, factory assembled (less discharge pipe fittings) as much as possible to facilitate shipping and handling.

3. Equipment shall include a blower, electric motor, belts and sheaves, inlet package, discharge silencer, discharge check valve, rubber inlet sleeve and discharge connection, pressure relief valve, butterfly discharge isolation valve, and rubber expansion joint. A personnel protection guard shall be included over the belts and sheaves.

4. Provide one blower and coarse air diffusers as required for adequate mixing. Blowers shall meet the requirements of 43 11 33 – Rotary Lobe Blowers or 43 11 31 – Rotary Helical Screw Blowers. Blowers shall be the same type as the process blowers. Coarse air diffusers shall have adequate floor coverage and shall be constructed of stainless steel. Manufacturer shall provide diffusers and drop legs. Contractor shall provide interconnecting piping and isolation valves.

B. AIR CONTROL VALVES

1. Furnish motor operated air control valves to control aeration in the SBR basins in accordance with 40 05 64.36 – High-Performance Air Control Valves.

C. INFLUENT CONTROL VALVES

1. Furnish motor operated influent flow control plug valves to control influent into the SBR basins in accordance with 40 05 62 – Plug Valves.

D. RETRIEVABLE FINE BUBBLE AIR DIFFUSER SYSTEM

1. The aeration system shall be a fine bubble diffused air system and shall be a retrievable configuration as shown on the contract drawings. Systems with fixed diffuser configuration or jet aeration are not acceptable.

2. Furnish retrievable air diffuser assemblies for each basin. Each assembly shall consist of membrane diffusers, frame assembly, manifold weldment, vertical air column, track/beam, flexible airline, isolation valve, and lifting mechanism.

Duplex diffuser tubes total that specified herein shall be provided for each diffuser rack. The 4" diffuser manifold weldment shall be constructed of stainless steel. The entire assembly shall be located such that each diffuser centerline is twelve (12) inches above the basin floor.

3. Air diffuser assemblies shall be of the tubular, non-clog, fine bubble type with a flexible perforated air release membrane. Disc and panel diffuser designs are not acceptable. The diffuser membrane shall be constructed from EPDM rubber and be suitable for continuous or intermittent aeration. Each membrane shall be held in place by two 304 stainless steel band clamps. The membrane shall include UV inhibitor and compounds designed for resistance to chemical attack, weathering, fatigue, and aging. The diffuser assemblies shall have double backflow prevention to prevent liquid from passing into the aeration header. Backflow prevention shall consist of self sealing slits and membrane clamping over the circumference of the diffuser support pipe. The membrane exterior surface shall be smooth as to inhibit biological film growth. The membrane shall inflate during aeration and deflate when the airflow is discontinued, further restricting biological film growth. The membrane shall be cleanable in place with water from a high pressure wash. Each diffuser membrane shall be supported over its' full length and circumference by a support tube. Tube diffuser shall be of non-buoyant design. Diffusers which are of buoyant design are not acceptable.

4. Each assembly shall include a diffuser hoist assembly with base socket to receive a portable electric winch. A total of one (1) portable electric winch shall be provided for the diffuser assemblies. The winch mechanism shall be of sufficient design capacity to raise the diffuser rack assembly to the servicing position. The portable electric winch shall operate from a single phase, electrical supply rated for 12.6 full load amps. The winch shall be provided with a total of 8 feet of electrical cable. Supply of electrical power supply, wiring and junction box for winch shall be the responsibility of the installing contractor.

5. The lifting mechanism shall consist of a hoist, polyolefin guide wheels, stainless steel sheave with bronze bushing, and 304 stainless steel lifting cable. The lifting mechanism shall be of sufficient design capacity to raise the diffuser rack assembly to the servicing position. In addition, the mechanism shall be designed to allow the diffuser rack to be pivoted 360° when in the service position for ease of diffuser inspection and servicing.

6. Each diffuser assembly shall include a 3" diameter wire reinforced EPDM flexible air line with quick disconnect end fittings, and a threaded flange, elbow and quick disconnect adapters. All air distribution piping, gaskets, and hardware beyond the threaded flange shall be supplied by the installing contractor. The vertical track/beam shall support the lifting mechanism assembly during operation and servicing.

7. Each diffuser assembly shall include a 3" diameter manually operated isolation butterfly valve for connection to the main air distribution piping by the installing contractor. Valve gaskets and hardware are to be provided by the installing contractor. Valve shall be a butterfly valve with cast iron body, seat as specified herein, disk and one-piece stainless-steel shaft.

8. Cooling Legs – Where required, provide an extension of stainless steel piping between the dropleg and the manifold to serve as a heat exchanger to cool air prior to contact with the PVC piping, and prevent thermal damage to aeration system.

E. FLOATING MIXERS

1. The SBR system supplier shall furnish submersible mixer(s) in each tank as required to completely mix the tank and shall be the manufacturer's standard product. Performance testing of the mixers shall be conducted by taking mixed liquor samples at various locations and depths throughout the tank.

2. Furnish mechanical floating mixer(s) and related equipment accessories as described herein for each basin. Each mixer shall consist of a motor, direct-drive impeller driven at a constant speed, an integral flotation unit, and impeller volute. The mixers shall incorporate design enhancements that provide for three (3) years without routine maintenance (greasing).

3. Mixer Drive Motor

a. The motor shall be vertical P base design, totally enclosed fan cooled TEFC, and generally rated for severe duty. The motor shall in all cases equal or exceed standard NEMA specifications. A minimum service factor of 1.15 shall be furnished.

b. The motor winding shall be nonhygroscopic, and insulation shall equal or exceed NEMA Class "F". A lip seal shall be provided below the bottom bearing to prevent moisture from penetrating around the motor shaft. A condensate drain shall be located at the lowest point in the lower-end bell housing. Unit shall have a one-piece motor shaft continuous from the top motor bearing, through the lower bearing and down to and through the propeller. The shaft shall be manufactured from 17-4 PH stainless steel.

c. Motor bearings shall be regreasable. Sealed bearings are not acceptable. Top bearing shall be shielded on the bottom side only. Bottom bearing shall be open. The top and bottom motor bearings shall be of combined radial and axial thrust type. The lower motor bearing inner brace shall be locked to the motor shaft via a special washer and locking nut arrangement. The shaft shall be threaded just below the lower bearing and shall have a keyway cut into the motor shaft. This key shall accept a tab from the inner diameter of the locking washer, and the locking nut shall have recesses to accept a tab from the outer diameter of the locking washer to prevent the nut from backing off. Snap ring type bearing retainers will not be acceptable.

4. Motor Mounting Base

a. The motor shall be securely mounted onto a solid base which is integral with the motor base extension. All submersed wetted motor mounting base components shall be constructed of 304 stainless steel.

b. The upper portion of the motor mounting base, immediately below the

lower motor bearing, shall include two independent acting air seals. The two seals shall be capable of sealing off the flow of air from the suction action of the pumped flow and prevent backflow of liquid during impeller reversal. The lower end of the motor base extension shall be provided with a rotating backflow seal that will prevent grit from being introduced into the anti-deflection insert reservoir but shall allow liquid to contact the shaft. The backflow seal shall not require scheduled lubrication or maintenance.

5. Floatation: Each unit shall be equipped with a modular float with a central float passage of a size to allow installation and removal of the pump impeller. The float shall be foamed full of polyurethane foam of the closed cell type and shall be totally sealed to prevent the foam from being in contact with the external environment.

6. Impeller: The impeller shall be designed to pump the liquid from near the surface and direct it down toward the vessel/basin bottom. The impeller shall be a two-blade marine type precision casting of 316 and shall be specifically designed for the application intended. It shall be dynamically and hydraulically balanced. The propeller must be attached to the motor shaft with a hardened stainless-steel pin and set screw. Impeller shall be capable of being reversed to cause back flow liquid movement without causing damage to the mixer chassis and without causing upflow liquid damage to the motor bearing and windings. No liquid spray or other liquid leakage upward onto the surface of the motor support surface or flotation chassis will be allowed.

7. Intake Volute Assembly: The impeller shall operate in a volute made of stainless steel plate, minimum 3/16 inch thick.

8. Testing: The entire rotating assembly including the motor rotor, shaft, shaft accessories, and impeller shall be dynamically balanced within 2.0 mils peak-to-peak horizontal displacement measured at the upper and lower motor bearing. Measurements shall be taken at a frequency equivalent to the motor RPM. Measurements shall be taken with the motor in a vertical, shaft down position with the entire power section mounted on resilient pads

9. Cable Mooring System: Each unit shall be provided with a mooring system with 304 SS cables and anchors. Each unit shall be provided with a maintenance cable mooring system complete with mooring cable, clips, thimbles, quick disconnects, anchors (if necessary), and extension springs as shown on the drawings. Field attachment of mooring points to the tank shall be the responsibility of the installing contractor.

10. Electrical Power Cable: Each unit shall include power cable wired into the motor conduit box and terminating at the basin wall. Electrical cable shall be supplied with kellems grips at the motor and basin wall terminations. Electrical cable(s) shall be attached with cable ties provided by the equipment supplier. Attachment of cable and supply of junction box/disconnect at the basin wall shall be the responsibility of the installing contractor.

F. DECANT MECHANISM

1. Furnish floating decanter(s) and related equipment accessories as described herein for each basin. Each decanter shall consist of an integral flotation unit, a stainless steel movable weir assembly, and an electric motor driven actuator to open and close the weir. Due to the risk of ragging, spring loaded valves are not an acceptable means to seal the decanter. Fixed decanters, or decant weirs lifted above the water surface are not acceptable.

2. Each decanter shall be capable of withdrawing decant fluid from 4 6 inches beneath the liquid surface, regardless of liquid depth, down to the minimum allowable water level specified below. The decant liquid shall be drawn through an adjustable weir opening of 26 inches. The weir shall permit liquid to enter the decanter from the entire 360 degrees without obstruction. The centerline of each decant pipe must be located at the elevation stated within this section by the installing contractor.

3. Weir Actuator: Weir actuator shall include a reversible electric motor operated linear actuator. The actuator shall be capable of operating with a closing force as required above and shall operate from a remote power source as required above. Adjustable limit switches shall be included to permit adjustment of the weir opening. A spring shall be included to provide for travel after the weir has closed and provide desired closure pressure. A corrosion resistant removable cover shall be included to provide protection to the actuator and motor during normal operation. Power cable(s) as specified above shall be provided from the junction box of the unit to the basin wall. Supply of junction box/disconnect at the basin wall shall be the responsibility of the installing contractor.

4. Weir: The weir shall include vortex control baffles permanently affixed to the weir. The weir shall be attached to the actuator through a removable single shaft or linkage which shall also function as the torque restraint.

5. Floatation: Each unit shall be equipped with a modular float filled with closed cell polyurethane foam having a minimum 2.0 lbs./ft3 density. Float shall be completely sealed to prevent the foam from being in contact with the external environment. Float shall have adequate reserve buoyancy as specified within this section to ensure stability and to provide support flotation required during decanter servicing. A urethane type seal shall be molded into the bottom of the float assembly to receive the decanter weir.

1. Decanter Discharge Pipe

   a. Each decanter shall include a stainless-steel elbow with schedule 10 stainless steel discharge pipe as specified above. Decanters with FRP or PVC discharge pipe are not acceptable. The installing contractor shall provide a ¾" valve with hose bib connection on the decant line between the decanter and the decant valve.

   b. Each decanter shall include two stainless steel flex joints sized at the same diameter as the discharge pipe. Flex joints shall be constructed of stainless-steel flanges and 321 stainless steel bellows. Flex joints shall

utilize heavy-duty stainless-steel hinges with over-travel stops and full perimeter welds. Flex joints shall carry a rating per EJMA calculations, the Elastic Joint Manufacturer's Association. Flex joints shall be full port diameter, and not reduce flow area of the nominal pipe size. Flex joints shall be fully crated and provided with shipping bars that immobilize and protect the flex joint prior to final installation. Flex joints constructed of plastic or rubber material are not acceptable.

c. All piping, supports, gaskets, and hardware beyond the terminating flange of the decant pipe flexible joint shall be supplied by the installing contractor.

2. Decanter Restrained Mooring System

a. Furnished as part of the decanter assembly shall be a mooring frame, which shall permit the assembly to move up and down following the change in liquid level while restrained within the vertical pylons.

b. Each decanter shall be moored with a restrained mooring system consisting of vertical pylon(s) with base plate and/or supports as specified above. Each pylon/support with base plate shall be attached to the basin floor and filled with concrete by the installing contractor.

c. Mooring post supports, if specified within this section shall be provided for attachment to the basin wall by the installing contractor.

G. SCUM REMOVAL SYSTEM

1. The SBR supplier to furnish a scum removal system consisting of 6" motor actuated telescoping valves for each basin.

H. WAS PUMPS

1. Furnish submersible non-clog pump(s) for each basin in accordance with 43 25 00 – Submersible non-clog pumps.

I. POST-EQUALIZATION

1. Pumps: Furnish Flygt submersible non-clog pump(s) for each basin in accordance with 43 25 00 – Submersible non-clog pumps. Each pump shall be equipped with a submersible electrical motor connected for three phase operation.

2. Provide one blower and coarse air diffusers as required for adequate mixing. Blowers shall meet the requirements of 43 11 33 – Rotary Lobe Blowers or 43 11 31 – Rotary Helical Screw Blowers. Blowers shall be the same type as the process blowers. Coarse air diffusers shall have adequate floor coverage and shall be constructed of stainless steel. Manufacturer shall provide diffusers and drop legs. Contractor shall provide interconnecting piping and isolation valves.

J. PROCESS INSTRUMENTATION

1. The SBR supplier shall furnish, configure and commission the instrumentation for the SBR system. At a minimum, the system shall include the following instruments:

   a. One (1) DO and pH probe (per basin) with required controllers in accordance with 40 75 43 – Dissolved Oxygen Measuring Systems, and 40 75 13 – pH-ORP Analyzers, respectively.

   b. One (1) pressure transducer (per basin) in accordance with 40 73 00 – Pressure Measuring and Detection Systems.

   c. One (1) low level float (per basin) in accordance with 40 72 00 – Level Measuring System

   d. Position indication for decanters

   e. High and low level floats for post-equalization basin

   f. One (1) pressure transducer for post-equalization basin in accordance with 40 73 00 – Pressure Measuring and Detection Systems.

2. Instrumentation shall meet the requirements of the applicable Sections of Division 40.

3. Controllers: Provide controllers as required for DO and pH probes. The controller will communicate with the main PLC via 4-20 mA signals. The controller will have a NEMA 4X enclosure with corrosion-resistant finish and shall be AC powered from a 100-230VAC, power source. Each probe module shall include a sun shield.

K. CONTROL PANEL

1. The control system shall be designed to optimize the SBR process while minimizing operator attention and to accommodate the continuous maximum daily flow without adjusting cycle structures. The control software program shall be factory tested prior to installation at the jobsite.

2. Electrical components, such as motor starters, VFDs and MCCs, shall be provided by the contractor. Vendor shall not be required to provide space in vendor supplied panels to accommodate contractor supplied equipment.

3. The control system shall be a timer based system with level overrides and shall provide control, sequence, monitoring, and alarm annunciation capabilities. The operator shall be able to access the timer values and set points through the operator interface panel to allow for adjustment of cycle times and system flexibility. The control system shall be designed to automatically accommodate the plant's full range of loads and flows.

4. A complete control system shall be provided as described in the following and as shown on the contract drawings. The control system shall include 115 volt control circuit breaker, microprocessor control, operator interface display, indicator lights,

and HAND-OFF-AUTOMATIC selector switches.

5. The incoming service of the control system shall be 115 volt, 60 hertz, single-phase. Controls for the equipment listed below shall be provided within the SBR control panel. Elapsed time indication shall be provided for equipment indicated by an asterisk (*).

SBR Equipment Description
Mixer(s)*
Pump(s)*
Blowers*
Influent Valve(s)
Decanter Actuator(s)
Decanter Valve(s)
Air Control Valves

6. CONTROL PANEL WIRING AND ASSEMBLY

   a. All control enclosures shall be custom assembled and wired in an Underwriters Laboratories (UL) certified cabinet shop using quality materials and labor. Short circuit rating of control enclosure shall be 5 kA RMS symmetrical @ 120VAC maximum.

   b. All control panel single conductor wire shall be 16 AWG multi-strand machine tool wire (MTW) minimum, with PVC insulation.

   c. All wires shall be clearly marked with an identification number consistent with the wiring schematic drawing. Wire markers shall be a thermal transfer printable type. The material shall be a self-laminating vinyl. Labels shall be Brady THT-9-427-10 or approved equal.

   d. Wiring inside the control panel shall be run in PVC wiring duct rated for continuous temperatures up to 122° F (50°C). Devices mounted in the enclosure door shall have wires run in spiral wrap to avoid pinch points when opening and closing the door.

   e. Control components mounted internal and external to the enclosure shall be mounted with stainless steel hardware and clearly labeled with a plastic identification nametag. The tag shall be white with black lettering.

7. CONTROL PANEL QUALITY ASSURANCE

   a. All Control panels shall be UL certified. Testing by manufacturer's electrical engineering prior to releasing for shipment shall be completed. Testing shall consist of the following:

      1) Point to point testing of all wiring prior to application of power

2) Intended supply voltage shall be applied to the enclosure

3) All components shall be tested for proper operation and calibration

4) The PLC and operator interface program shall be loaded and functionally checked

5) All components shall be checked to confirm proper mounting specifications have been followed

6) Enclosure shall be inspected for defects and repaired if necessary

7) All labeling of wires and devices are correct, properly installed and clean

b. The manufacturer shall finalize the factory checkout by completing a control panel checklist to document all testing completed above.

c. Upon the successful completion of the control testing of the enclosure assembly, all applicable documentation (i.e., finalized drawing set, signed control checklist cover page, device data sheets, etc.) shall be placed in the drawing pocket of the enclosure.

8. Control Enclosure: The automatic controls shall be provided in a UL listed, NEMA Type 12 floor mount enclosure that provides a degree of protection for electrical controls and components from dust, dripping water and external condensation of non-corrosive liquids. The enclosure is intended for outdoor installation. Enclosure shall include gasketed overlapping doors with a 3-point latch mechanism operated by an oil tight key-lock handle. The enclosure shall have a brushed finish. The enclosure shall include a painted white mild steel (10 gauge) sub-panel mounted with collar studs. Enclosure shall be manufactured by Hoffman or approved equal. Control panel widths shall be limited to 72" wide. Where this is not possible, multiple panels shall be provided.

a. The control enclosure shall be mounted remotely.

9. Corrosion Inhibitor: Each control enclosure assembly shall be provided with corrosion inhibitors to protect interior electrical components from damage caused by high humidity. The corrosion inhibitors shall be installed prior to shipment to provide protection during shipment and storage of the enclosure.

a. The corrosion inhibitor shall be Hoffman AHCI5E or approved equal.

10. Main Disconnect Circuit Breaker: A UL listed; automatic molded case 3-pole disconnect breaker shall be provided in the control enclosure(s). The primary function of the disconnect switch shall be to provide a means to manually open a circuit and automatically open a circuit under overload or short circuit conditions. The disconnect breaker shall have a door mounted operating mechanism with trip indication. Power distribution connectors shall be mounted integrally to the circuit breaker for multiple load connections. Integral connectors shall be provided. The

disconnect circuit breaker shall be a Square D/FAL, HDL, JDL, LAL, MGL, PGL or approved equal.

11. Circuit Breaker: All single phase branch or supplementary circuits shall be protected with a single-pole, C-Curve rated circuit breaker. Circuit breakers shall be rated for 240 VAC maximum, 50/60 Hz and UL 489 listed. Supplementary and branch protection circuit breakers shall be Merlin Gerin Multi 9 or approved equal.

12. Fuse: Properly rated fuses and fuse holders shall be provided for protection of individual control devices (discrete and analog signals) mounted outside of the enclosure. Each fuse shall be housed in a hinged type fuse block to protect against contact with the fuse. Fuses shall be rated up to 250 VAC and be Littelfuse or approved equal. Fuse holders for discrete devices shall be rated to 600 VAC and 30 Amps. Fuse holders for analog devices shall be rated to 300 VAC and 15 Amps. Fuse holders shall be Allen Bradley 1492 or approved equal.

13. Operator Device: Operator devices (pushbuttons and selector switches) shall be mounted through the control enclosure door for all automatic controlled equipment. Transformer type pilot lights and illuminated pushbuttons shall be provided for indication of an operation status. Lights shall be a 6 VAC incandescent type lamp.

    a. All operator devices shall be UL Listed, 30.5mm style, NEMA Type 4X rated, oil and water tight with finger safe guards located on the contact blocks to prevent accidental contact with wire connections. Operator device function shall be identified with an engraved white Gravoply nameplate with black letters. Operator devices shall be Allen-Bradley 800H, Square D 9001, or approved equal.

14. High Frequency Noise Filter: A UL listed active tracking filter shall be provided to protect the PLC and HMI power feeds from high-frequency noise and low-energy transients. It shall be designed for a single phase input voltage of 120/240VAC operating at 47 to 63 Hz. The unit shall reduce normal mode transients to plus or minus 2 volts, provide surge capacity of 45,000 amps and protect in all modes (Line to neutral, line to ground and neutral to ground). The noise filter shall be an Islatrol IC+ or approved equal.

15. Uninterruptible Power Supply: A UL listed uninterruptible power supply suitable for location in a UL 508 panel shall be provided to protect the HMI and PLC from short power outages by switching to an emergency battery backup without data loss or downtime. Nominal input voltage and output voltage shall be 120VAC with an autosensing input frequency of 47 to 63 Hz. The output power capacity shall be 650W / 1000VA. The UPS shall be provided with an audible alarm and LED status indicators and operate from 32° to 122°F (0° to 50°C). The UPS shall be an Allen Bradley 1609-B1000N.

16. Ground Fault Duplex Receptacle: A UL listed ground fault circuit interrupter (GFCI) duplex receptacle shall be provided within the panel for instrument (e.g., programming terminal, modem, etc.) use only. The receptacle shall be protected with a 5 Amp circuit breaker. The receptacle shall carry a 20A / 120VAC rating. The electro-mechanical circuit interrupter shall be double-pole and trip free (GFCI

protection and shall not be overridden by holding reset button). Built-in transient suppression shall protect GFCI's internal circuitry from voltage transients. Receptacle shall be Hubbell DRUBGFI20 or approved equal.

17. 24 Volt Dc Power Supply: A UL listed, industrial grade, compact power supply shall be supplied to provide 24 VDC power to such rated components. The power supply shall be DIN rail mounted and functional with input voltage of 100 to 240 VAC (single-phase) incoming control power. The power supply shall have a green LED which shall be illuminated when output voltage is "OK". The power supply shall be an Allen Bradley 1606 or approved equal.

18. Control Relay: UL listed control relays for general control purposes shall be supplied with a pilot light to indicate when the coil is in an energized state. The relay socket shall be panel or DIN rail mounted inside the enclosure. The relays shall provide the following ratings: 120VAC coil, 10A contact rating (thermal), 250 VAC insulation rating and 5 million mechanical life cycles. Relays shall be Allen Bradley 700-HK, Square D, or approved equal.

19. Terminal Block: Standard feed-through screw terminal blocks, DIN rail mounted, shall be supplied for all point to point wiring connections. All terminals shall be numbered per the wiring schematic with printed markers. Terminals shall carry a 600V AC/DC voltage rating. Terminal blocks shall be Allen-Bradley 1492-J4 (35A max) and 1492-J16 (85A max) or approved equal.

20. Programmable Logic Controller: Automatic operation of the SBR shall be controlled through a programmable logic controller (PLC) mounted inside the main control panel. The PLC components shall consist of a power supply, CPU, discrete input and output modules and analog input and output modules. The processor unit shall include built-in USB and two (2) Ethernet IP communication ports. All input and output points supplied (including unused) shall be wired to terminal blocks. Processor design characteristics shall include: 1.0MB user memory size, real-time clock and calendar, battery backed RAM and an operating temperature range between 32 °F and 140°F. The PLC processor shall be an Allen-Bradley CompactLogix 5069-L30ER or approved equal.

21. Modular equipment shall be provided to complete the PLC system. These Allen-Bradley components include: 1606-XLE120E – Power Supply, 5069 IB16– Discrete input (16 point) modules, 5069 -OB16– Discrete output (16 point) modules and 5069-IF8– Analog input (8 point) modules, 5069-OF8– Analog output (4 point) modulesAt minimum, the following alarms will be available via Ethernet/IP produce or message function or hard-wired dry contacts:

    1) SBR Common alarm

    2) Power failure alarm

22. Ethernet Switch: The unit shall be DIN rail mounted and require 24VDC/100mA power. Diagnostic LEDs for power, link status, data, and data rate shall be provided. The Ethernet switch shall be UL listed and manufactured by Allen-Bradley/Hirschmann, or approved equal.

23. Remote Access Ethernet Modem: A UL listed, remote access Ethernet modem shall be supplied to provide connection capability between the Ethernet PLC network to vendor through a cellular connection.

24. Human Machine Interface: The operator interface shall be a NEMA Type 12 rated, color touchscreen display with Ethernet and serial communications. The interface shall be a liquid crystal display (LCD). The display type shall be color active matrix thin-film transistor (TFT) with 640 x 480 pixel resolution. The rated operating temperature shall be 32° to 131° F (0° to 55° C). The operator interface shall be an Allen Bradley PanelView Plus 7 Performance 15".

PART 3 - EXECUTION

3.1 ONSITE SERVICES

A. The manufacturer shall provide the services of a qualified factory representative for three (3) trips including a total of twelve (12) workdays to advise the Installation Contractor on proper installation, setting, piping, wiring procedures, and provide operator training on the extended aeration secondary treatment.

B. Six (6) months after Substantial Completion the Vendor shall provide the services of a qualified factory representative for one (1) trip including a total of four (4) workdays to advise the Owner on process improvement and provide continued operator training.

3.2 SITE STORAGE AND HANDLING OF EQUIPMENT

A. The Vendor shall provide instruction to Installation Contractor on how to unload, handle and store the equipment.

3.3 INSTALLATION

A. The Vendor shall provide complete installation instructions to the Installation Contractor and the Installation Contractor shall be required to follow Vendor's installation instructions.

3.4 START-UP

A. Before the equipment is started, the manufacturer shall make a thorough inspection of the installation to make sure equipment has been installed properly. Equipment shall not be energized without the qualified factory representative present.

a. Perform Level 2 Testing in accordance with Section 43 05 60 – Process Equipment Testing except vibration testing.

END OF SECTION 46 53 53

SECTION 46 61 27 – UPFLOW MOVING BED FILTERS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Vendor shall furnish a complete filtration system as specified herein. Filters shall be provided with all required equipment, and filtration media. Filters shall be modular and will be installed in concrete basins outdoors. Where possible, the filters will be constructed with a common wall with the SBR basins. The Contractor shall install all structures including any required wall thimbles and external piping.

B. The Vendor shall size the filter equipment to meet the performance specifications below. The filter systems shall be designed so that the peak flow can be treated with one unit offline.

C. Air compressor: Vendor shall provide a compressed air system sized to deliver sufficient air to each airlift for backwashing, as well as any ancillary air requirements for the system, including pneumatic actuation of inlet valves (valves and actuators to be provided by the contractor). The compressed air system shall include a dual air compressor with reservoir, air dryer, compressed air control panel, air panels for the control of air to the air lifts, and valves. The Contractor shall install the air system in a conditioned building near the filters and provide and install the interconnecting piping.

D. The installation contractor shall provide the carbon chemical dosing system, to be controlled by others. The vendor shall identify all mixing and injection requirements necessary to meet the performance requirements listed herein. Where filters are to be operated in a duty/standby configuration, vendor shall provide a control strategy, with controls to be provided by others.

E. The installation contractor shall mount all equipment in accordance with Section 43 05 50 – Equipment Mounting.

1.2 DESIGN REQUIREMENTS

A. Influent Design Criteria: Secondary effluent from the sequencing batch reactors will be provided to the sand filter system with the following flow and water quality. Note that the flowrates listed below do not include return flows from sand filter backwash. Vendor design shall account for this return flows.

1.	Annual Average Daily Flow:	0.223 MGD
2.	Max Month Wet Weather Flow:	0.262 MGD
3.	Peak Day Average Flow:	0.423 MGD
4.	Peak Hour Flow:	0.682 MGD

5. Max Total Suspended Solids (from secondary effluent): 20 mg/L

6. Influent Ammonia: 1 mg/L

7. Influent Nitrate: 5 mg/L

8. Minimum Influent Temperature: 9° C

B. Effluent Design Criteria: The sand filter vendor shall meet the following effluent water quality:

1. Total Suspended Solids: 5 mg/L

2. Total Nitrate: 1 mg/L

C. The maximum allowable hydraulic loading shall not exceed 5 gpm/ft^2 at the peak hour flow with one unit offline.

D. The headloss through the filter shall not exceed 60" (as measured from the influent to the filter module to the crest of the effluent weir).

E. Media depth shall be a minimum of 60".

1.3 SUBMITTALS

A. The submittal shall be made in accordance with Section 01 33 00 – Submittal Procedures.

1. The Vendor shall submit a copy of the equipment specification section with all addenda and all referenced specification sections. Each paragraph shall be check-marked to indicate specification compliance or marked to indicate deviations from the specification requirements. Check marks shall indicate complete compliance with the paragraph requirements. Deviations from the specification shall be indicated by underlining the deviation and marking the paragraph or line with a number or letter. The remainder of the paragraph not marked as a deviation shall indicate compliance with the requirements of the paragraph. The Vendor shall prepare a detailed justification for each deviation. Failure to include the required specification sections and justification for deviations will indicate non-compliance and shall be rejected without further consideration.

2. Submit to the Engineer for review, filtration calculation, headloss calculations, air flow requirements, complete drawings showing installation details, materials of construction, arrangement details, loadings, elevations, and all items furnished under this Section.

3. Complete instructions on installation of the equipment, air compressor, air lift system, controls, and filter media.

4. Design calculation for anchor bolts. Design calculations shall include dead, live, and dynamic loadings for normal and seismic conditions (see Drawings for seismic design standards). Design calculations shall be stamped by a professional engineer registered in the State of Oregon.

5. Start-up instructions.

B. Operation and Maintenance Data: Submit operation and maintenance data and equipment parts list in manual, in accordance with Section 01 78 23 – Operation and Maintenance Data.

1.4 QUALITY ASSURANCE

A. To ensure that all the equipment required for the installation of the filter modules and air supply is properly coordinated and will function as a unit in accordance with the intent of these Specifications, the Vendor shall provide all the equipment specified under this Section.

B. The Filter Vendor shall have a minimum of 10 years' experience in the manufacture of this type of filter equipment and shall have completed at least 10 successful installations of the same type proposed.

1.5 PROCESS GUARANTEE

A. The Upflow Moving Bed Filter Equipment Vendor/Manufacturer shall provide a process guarantee that the SBR process will produce effluent quality listed in Part 1.2 of this specification. This guarantee shall remain in effect for a period of one year. The process guarantee shall include modifying equipment and controls to achieve these discharge limits at no additional cost to Owner if the process is operated within the specified design guidelines.

1.6 PROCESS PERFORMANCE REQUIREMENTS

A. The effluent quality performance of the Treatment Process will be demonstrated via one (1) thirty-day process performance test period during the first twelve (12) months of operation, following stabilization of the process. The process performance test will demonstrate and document the effluent quality for the purpose of determining whether the effluent process performance guarantees have been satisfied.

B. Guaranteed Process Performance is based upon a process designed in accordance with the influent and effluent wastewater criteria from Section 1.2.

C. Process Performance Testing

1. The Owner shall be responsible for carrying out the process performance testing, for collecting all samples, for carrying out all laboratory tests and for keeping such detailed records as may be necessary for determining whether the process performance guarantees have been met. The said records shall be retained until the process performance guarantee has been satisfied or until expiration of the period during which the process performance test is to be performed whichever occurs earlier, and such records shall include all daily log sheets, operator notes, sample inspections, and instrument charts produced in operation of the plant. The Owner shall provide one copy of such records to the Vendor free of charge. The Owner shall make copies of such records available to the Vendor for inspection or copying at the Vendor's expense.

2. The process performance test shall be subject to the following general conditions:

3. Process performance testing shall be performed in accordance with Section 01 75 00 – Equipment Testing and Startup.

   a. All analyses, data reduction or tests not otherwise specified shall be carried out by procedures furnished or approved by Standard Methods for the Examination of Water and Wastewater, most recent edition; unless a different source is agreed upon by Owner and the Vendor.

   b. The Owner shall furnish all materials, utilities, services and personnel as required to operate the plant during the process performance tests.

   c. The Owner will notify the Vendor in writing thirty (30) days in advance of beginning the process performance test.

4. The following are specific responsibilities of the Vendor and Owner with respect to the process performance test and guarantees:

   a. Owner will carry out the thirty (30) day process performance test at such conditions and at such time as the Vendor and Owner mutually agree for purposes of determining whether the process performance guarantees are met. The 30 day time frame within which the process performance test is to be carried out may be extended by the length of any period of down time required for correcting any failure or deficient performance.

   b. The Owner shall provide the labor required to obtain samples and measurements and shall pay for all laboratory analyses of the samples.

c. If during the process performance test it appears that the process guarantees are not being met, the Vendor shall have the right to have the plant operated at such reasonable conditions as it may deem necessary or advisable for the purpose of determining the nature or cause of the failure of the plant to meet such guarantee, provided such operating conditions are in accordance with good engineering practice and Owner's operating rules enforced at the plant site. Thereafter, the Vendor shall have the right to make or have made such adjustments in order to meet such guarantee and the right to make or have made such alterations or modifications to the plant necessary to correct deficiencies in the process design basis as it deems necessary or advisable. Such alterations or modifications shall be subject to review and approval by an appropriate State Agency and the Owner.

d. The following recordings and samples shall be taken and analyzed. The samples shall be taken at the Treatment Process influent and effluent, unless noted otherwise. The following are the minimum samples and recording points:

1) Plant Flow: Influent/Effluent (MGD)

2) BOD_5: Influent/Effluent (mg/L)

3) TSS: Influent/Effluent (mg/L)

4) TKN: Influent (mg/L as N)

5) Total Ammonia: Influent/Effluent (mg/L as N)

6) Nitrate: Influent/Effluent (mg/L as N)

7) Total Phosphorus: Influent

8) pH: Influent/Effluent (S.U.)

9) Temperature: Influent/Effluent (°C)

10) Alkalinity: Secondary Biological Tanks (mg/L) (one sample shall be taken during first week of testing only.)

e. The Vendor and Owner will jointly review performance of the process system to determine compliance with performance guarantees. Performance shall be based on 24-hour composite sample results. Review will include, but not be limited to, a comparison of influent and process design basis with the actual performance results. The effluent quality shall meet the requirements specified for 30 consecutive days based on 24-hour composite sample results.

f. The Owner will promptly notify the Vendor of the failure to meet any process guarantee and specify the respect in which such guarantee has not been met.

g. If the Vendor disputes any claimed failure, notice of such dispute shall be furnished promptly to Owner.

D. Performance Standards and Exclusive Remedy

1. In the event that the Treatment Process does not achieve the required level of process performance (as set forth in Section 2.2) during the test period, the Vendor shall be permitted to conduct a maximum of two (2) additional 30-day tests to meet the specified process guarantee criteria at Vendor's expense. Prior to either of these additional tests the Vendor may undertake modifications, (at Vendor's expense), to improve effluent quality.

2. Upon successful completion of the specified testing requirements, the Vendor's total liability, with the exception of equipment warranties, under this Agreement shall be discharged.

3. If the Treatment Process fails to achieve the required effluent quality during the process performance test period and fails the additional test(s), the Vendor shall have failed the process performance test.

1.7 WARRANTY AND GUARANTEE

A. A written Vendor warranty shall be provided. The warranty shall be for a minimum period of two (2) years from the date of Substantial Completion. Vendor shall repair or replace all defects of materials or workmanship in the equipment during the warranty period. Corrections shall be completed within five (5) days after notification.

B. Written Guarantee: The Vendor shall guarantee that the filter system shall meet the required effluent limits. If, during the two-year guarantee period, the filter system fails or does not meet any of the specified requirements or test criteria herein, the Vendor shall correct such deficiencies as may be necessary to meet these requirements and criteria, at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 APPROVED VENDORS

A. Parkson

B. Nexom

C. WesTech

D. Or approved equal

2.2 GENERAL

A. Equipment shall be furnished and installed in accordance with Divisions 26, 40, and 43.

B. All structural steel shall conform to "Standard Specifications for Structural Steel of the A.S.T.M."

C. An effluent weir shall be provided to control the water level over the media.

D. All equipment shall be designed for continuous, twenty-four hour operation, and all parts of the mechanism shall be amply proportioned for all stresses, which may occur during fabrication, erection, and operation.

E. All anchor bolts shall be Type 316 stainless steel and shall be sized by the Vendor. The Contractor shall provide and install the anchor bolts in accordance with the Vendor instructions.

F. All filter wetted parts shall be 304 or 316 stainless steel, FRP, or PVC. No carbon steel shall be allowed in the filters. All stainless steel shall be passivated.

2.3 UPFLOW MOVING BED FILTER

A. Materials of Construction

1.	Basin	Concrete, FRP, or 304 SS
2.	Filtrate trough (if applicable)	FRP or 304 SS
3.	Bottom hopper cones	FRP or 304 SS
4.	Feed distribution radials	FRP or 304 SS
5.	Reject compartment	FRP or Injection Molded Plastic
6.	Washer rings	PVC or Injection Molded Plastic
7.	Reject weirs	FRP or Injection Molded Plastic
8.	Distribution cones	FRP of 304 SS
9.	Airlift pipes	HDPE or PVC
10.	Airlift housing	FRP or 304 SS
11.	Airlift panel	304 SS
12.	Nuts, bolts, fasteners	304 SS
13.	Anchor bolts	304 SS

B. FILTER TANK

1. Each filter shall be self-contained in an open-top concrete tank sized by Vendor. Vendor shall produce dimensioned layout drawings of the filters with all sections needed to estimate concrete volumes, if applicable.

C. AIRLIFT

1. The sand cleaning system shall be capable of continuous and/or intermittent backwashing and internally redistributing the granular media to the top of the sand bed an average of 4-8 times per 24 hours. The airlift shall be supplied with an external air feed line to supply the pressurized air to the injection point. The feed line shall be protected from the abrasive movement of the media both inside the airlift and outside within the filter bed.

D. COUNTER-CURRENT WASHBOX

1. The filter system shall be furnished with a washbox assembly of fiberglass or injection molded plastic construction with an adjustable weir. The cross-sectional area of the counter-current washbox shall be sized to assure sufficient velocity of up-flowing water to transport separated solids into the wash chamber and over the reject weir and ultimately out through the reject line. The washbox geometry shall be optimized for separation of solids rejected from the filter media.

E. FILTER MEDIA

1. The filter media shall be furnished by the Filter Vendor and shall be of high quality silica sand in accordance with the American Water Works Association Standard for Filter Materials AWWA/ANSI B-100 (latest edition). The Filter Vendor shall deliver the sand to the Site and the Contractor shall install the filter media per the Filter Vendor's instructions.

F. FEED CHAMBER

1. Each filter shall be furnished with a central feed chamber designed to distribute the influent water directly into the media. The feed chamber shall have capacity to distribute the influent at least 80" below the top of the media. The feed chamber shall have a central protector tube to house, support and protect the airlift feed pump and compressed air feed line from damage due to abrasion. This central protector tube shall extend from the top of the filter bed down through the feed chamber to the recessed chamber in the lower cone. The feed chamber shall also incorporate support devices to the side wall, if applicable. The feed chamber shall be permanently attached and centered on the lower end to ensure that the system remains properly located at all times. The feed chamber shall be constructed of fiberglass or 304 SS.

G. HEAD LOSS INSTRUMENTATION

1. The Head Loss Indicator Sight Gauge shall be coupled directly to the influent feed channel of the filter and extend above the top of the filter cell. The Head Loss Indicator Sight Gauge shall be marked with an easily readable clear rule indicating the differential pressure (ΔP).

2. Head Loss shall also be monitored with a Pressure Transducer coupled directly to the influent feed of each filter. The Pressure Transducer shall be wired directly to the PLC mounted in the NEMA 4X Filter Control Panel.

H. AIR CONTROL PANEL WITH AIR BURST SYSTEM

1. Each filter shall be furnished with a NEMA 4X operators control panel equipped with Vendor's standard equipment, including air coalescing filtration and regulation, solenoids for airlift, airburst and influent butterfly functions, pressure measurement for process alarms, air flow measurement all other controls necessary for operation of the filter's airlift. A signal from the Filter Control Panel shall be received to operate the system. Upon receiving the signal, the system shall send a high volume of air to the airlift to initiate the pumping action of the airlift. The increased air flow shall continue until an adjustable timer shuts off the solenoid at the operators preset time delay.

2. If applicable, each airlift for each filter shall be equipped with a combination flow monitor/flow control valve that shall send a flow based analog signal to the PLC and receive a flow control analog signal from the PLC. Alternatively, each airlift for each filter shall be equipped with an on/off valve on the backwash waste line that shall be operated based on a signal from the PLC.

3. Where filter cells are intended to be operated in a lead/lag type configuration, the Vendor shall provide controls for this and integrate into overall plant SCADA architecture. Solenoid valves shall be included in the Vendor's scope, as well as sufficient instrument air in the air compressor system, to operate Installation Contractor-supplied pneumatic control valves to each filter cell.

I. AIR SYSTEM

1. The Filter Vendor shall furnish an air compressor unit to pressurize the pneumatic system. The duplex air compressor unit shall be provided with two each, two-stage compressor pumps. The air tank shall be an ASME Code receiver rated at a minimum of 200 psig. The system shall be complete with two (2), 460 volt/60 Hz / 3 phase power 2-stage compressor pumps, air cooled aftercooler, loadless starting, low oil shutdown switch, pressure gauge, safety valve, intake air filter, pressure switch, manual and automatic receiver blowdown and shut off valves, vibration pads for mounting, and complete startup kits. The Vendor shall size the air compressor.

2. A refrigerated-type air dryer shall be provided and sized by Vendor. Power shall be 115V/1P/60 Hz. The air dryer shall be provided with a pre-filter.

3. The Vendor shall provide a duplex alternating control panel. The panel shall include motor starter for the two compressor motors and thermal overloads. Circuit protection and disconnects shall be by others. Motor starter shall meet the requirements of Section 26 29 13.13 – Across the Line Motor Controllers.

J. SPARE PARTS

1. Filter Equipment: The Filter Vendor shall provide the following spare parts for the airlift pumps and control panel (one each):

a. Spare airlift

b. Regulator – air control panel.

c. Air flow indicator and control valve - air control panel.

d. Air filter element – air control panel.

e. One intake air filter and one oil change for the air compressor.

PART 3 - EXECUTION

3.1 DELIVERY AND HANDLING

A. The Vendor shall package and ship the filter equipment sufficiently to protect the equipment during shipment. Handling and storage requirements shall be provided to the Contractor and Engineer 6 weeks prior to shipping.

3.2 INSTALLATION

A. General: The Contractor shall install structures, filter equipment, filter media, piping and valves in conformance with the Vendor's recommendations.

3.3 TESTING AND CORRECTION OF DEFICIENCIES

A. General

1. All testing shall be performed under the supervision of the Filter Vendor's representative as specified. The Contractor shall conduct all specified tests and shall furnish all power, material, instrumentation, equipment, personnel, etc., for conducting tests as specified herein.

2. The Vendor shall submit three copies of full and complete test reports for all tests, describing the units tested; the type of test; test set-ups, and procedures and instrumentation; and test flow rates, pressures, levels and all other data and results as required to demonstrate that all items tested meet specified requirements.

B. Start-Up

1. Equipment Testing

a. The Filter Vendor's representative shall check and verify that installation of the filter modules is in accordance with Drawings, Specifications, and Filter Vendor's installation instructions.

b. The Filter Vendor's representative shall adjust all reject weir plates and air rates to each airlift.

c. The Filter Vendor's representative shall instruct plant personnel on operation and maintenance of the filter system.

d. The Filter Vendor shall include two (2) trips to the site, each one (1) day to advise the Contractor on the installation of the filter equipment and to inspect and approve the installation.

e. The Filter Vendor shall include two (2) trips to the site for four (4) days to start-up the filter system and to train the operators.

C. Testing

1. Process System Testing

a. The Contractor and Filter Vendor shall test the blower/air compressor system for correct operation and certify that the backwash system is operating in conformance with these Specifications.

2. 4-Day Test

a. The Owner shall collect inlet and outlet samples (either grab or composite) samples on seven consecutive days and analyze them for total suspended solids (TSS) and nitrate/nitrite (NO_x-N) at the Owner's expense. If the outlet concentration averages are less than or equal to the performance requirements, then the filter system shall have passed the initial four-day test. If the outlet concentrations are higher than the performance requirements the Contractor and Filter Vendor shall make the necessary adjustments to the filter system and conduct additional seven-day tests at no cost to the Owner until the system passes. Substantial completion is obtained after successful completion of the 4-day test.

3.4 OPERATOR TRAINING

A. A trained factory representative shall provide a minimum of 4 hours of operation and maintenance training to the Owner's personnel. The Contractor shall video the training session and provide a copy on DVD and/or digitally to the Owner.

END OF SECTION 46 61 27

Addendum No. 1

Mill City WPCF Improvements

Keller Project No.: 222194-202

May 22, 2024

The following information, clarifications, changes and modifications are by reference incorporated into the bid documents for the above referenced project. Any work item or contract provision not changed or modified will remain in full force and effect. The construction schedule remains the same.

CLARIFICATIONS AND ADDITIONAL INFORMATION

REVISIONS TO SPECIFICATIONS

Specification Revision No. 1: Section 46 53 53 – Sequencing Batch Reactors: **UPDATE** as follows:

B. Design Criteria

Parameter	Current	20-Year Design*	Units
Annual Average Daily Flow (AADF)	0.177	0.225	MGD
Max Month Wet Weather Flow ($MMWWF_5$)	0.207	0.266	MGD
Peak Day Average Flow ($PDAF_5$)	0.335	0.430	MGD
Peak Hour Flow (PHF)	0.541	0.696	MGD
Peak Instantaneous Flow (PIF)**	0.590	1.0	MGD
Assumed Influent pH	6.5-8.5		SU
Assumed Influent Alkalinity	280		mg/L as $CaCO_3$
Minimum Influent Temperature	8		°C
Maximum Influent Temperature	20		°C
Max Month BOD_5 Loading	280	515	ppd
Max Month TSS Loading	137	319	ppd
Max Month TKN Loading (as N)	100	194	ppd
Max Month Phosphorus Loading (as P)	20	30	ppd

*Includes expected recycle flows from headworks, dewatering, and tertiary treatment processes
** Peak instantaneous flowrate represents the maximum flowrate that can be delivered to the SBR basins based on the capacity of the influent pump station. This is expected to equalize to the peak hour flow rate over an hour period.

A. Oxygen Demand Parameters

Jobsite Elevation	860	Ft MSL
Alpha	0.65	
Beta	0.95	
Oxygen Requirements		
	1.25	lbs O_2/lb BOD_5 applied
	4.6*	lbs O_2/lb TKN applied
Actual Oxygen Requirement	1,328	lbs O_2/day
Minimum Blower Air Capacity per Blower	320	SCFM
Blower Discharge Pressure	10.7**	PSIG
Minimum Ambient Temperature	10	°F
Maximum Ambient Temperature	115	°F
Total # Blowers	Min. 3	1 Blower dedicated to each SBR basin with one shared standby blower (largest size) for redundancy

A. Post-Equalization Basin

Post-Equalization Basin Quantity	1	
Required Volume*	53,320	gal
Post-Equalization Basin Minimum Blower Air Capacity Per Blower	106	SCFM
Post-Equalization Basin Total # Blowers	1	
Post-Equalization Basin Blower Discharge Pressure	6	PSIG

*Equalization basin decantable storage volume

Specification Revision No. 2: Section 43 11 31 – Rotary Helical Screw Blowers: **UPDATE** as follows:

PART 2 - PRODUCTS

2.1 ENVIRONMENTAL CONDITIONS

A. Refer to Section 46 53 53 – Sequencing Batch Reactors.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

A. Each blower shall meet the performance requirements given in Section 46 53 53 – Sequencing Batch Reactors.

B. The blowers shall meet the minimum performance requirements specified below.

Design Point	Corresponding Influent Load	% RH	Inlet Temp
1	25% More Air than needed for Design Load	20	105°F
2	Design Load	20	105°F
3	75% of Design Load	0	30°F
4	40% of Design Load	0	30°F

C. The blower noise shall not exceed 85 dBA at 3 feet per ISO Standard 2151. The blower manufacturer shall perform open field noise test as specified in paragraph 1.3 of this Section meeting the above condition. A sound attenuating enclosure shall be provided to meet the noise limitations.

1. The sound attenuating enclosure shall completely enclose the blower and intake/discharge silencers.

2. The sound attenuating enclosure shall accommodate HVAC ductwork to separately vent the blower from the rest of the building.

D. All blowers to be same size and model. The blower shall be of the positive displacement type with a variable frequency drive (VFD) and rated for continuous duty.

E. Balance: Accurately machine rotating parts and place these parts in as perfect rotational balance as practicable.

Specification Revision No. 3: Section 43 11 33 – Rotary Lobe Blowers: **UPDATE** as follows:

PART 2 - PRODUCTS

2.1 ENVIRONMENTAL CONDITIONS

A. Refer to Section 46 53 53 – Sequencing Batch Reactors.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

A. The blowers shall meet the minimum performance requirements specified below.

Design Point	Corresponding Influent Load	% RH	Inlet Temp
1	25% More Air than needed for Design Load	20	105°F
2	Design Load	20	105°F
3	75% of Design Load	0	30°F
4	40% of Design Load	0	30°F

B. The blower noise shall not exceed 85 dBA at 3 feet per ISO Standard 2151. The blower manufacturer shall perform open field noise test as specified in paragraph 1.3 of this Section meeting the above condition. A sound attenuating enclosure shall be provided to meet the noise limitations.

1. The sound attenuating enclosure shall completely enclose the blower and intake/discharge silencers.

2. The sound attenuating enclosure shall accommodate HVAC ductwork to separately vent the blower from the rest of the building.

C. All blowers to be same size and model. The blower shall be of the positive displacement type with a variable frequency drive (VFD) and rated for continuous duty.

D. Balance: Accurately machine rotating parts and place these parts in as perfect rotational balance as practicable.

1. The mass of each unit shall be such that resonance at normal operating speeds is avoided.

2. Excessive vibration shall be sufficient cause for rejection of the equipment.

Prepared by Kevin Stewart

Keller Associates, Inc.

KELLER ASSOCIATES

ADDENDUM NO. 2

to the

CONTRACT DOCUMENTS

for

CITY OF Mill City
WPCF Design

This Addendum dated May 29, 2024, is for all persons preparing bids for the above referenced project and as such shall be made a part of the Contract Documents.

All changes, corrections, deletions and/or additions to the initial bidding documents enumerated herein shall be included in the Bidder's Proposal. In case of any conflict between the drawings, specifications, and this Addendum, this Addendum shall govern.

The Bidder shall acknowledge the receipt of this Addendum in the appropriate place in the Bidder's Proposal. Failure to acknowledge the receipt of this Addendum will cause a Bid to be considered non-responsive.

BIDDING DOCUMENTS

Item	Description
2-1	**SECTION 40 05 64 – BUTTERFLY VALVES** **REVISE** Part 2.3.D, as follows: Seat: The elastomer seat shall be in the body. It shall be field-replaceable without special tools. The seat material shall be ~~EPDM~~ **PTFE/Viton** to provide a tight shut-off at the temperatures ~~above~~ **listed in Part 2.3.A.**
2-2	**SECTION 40 67 00 – CONTROL PANELS** **REVISE** Part 2.2.B, as follows: 2.2 CONTROL PANELS B. Materials: Panels shall be made of Grade 304 stainless steel **if mounted outside. Section 2.2.B.4 lists control panels and required minimum NEMA ratings**. Panel section faces shall be No. 12 gauge minimum thickness for free standing panels and No. 14 gauge minimum thickness for wall mounted or pedestal mounted panels. Materials shall be selected for levelness and smoothness. 1. Relay rack high density type panels shall utilize standard relay racks with No. 14 gauge steel frame and supports. 2. Structural shapes and strap steel shall comply with ASTM A 283 - Low and Intermediate Tensile Strength Carbon Steel Plates, Grade C. 3. Bolting Material: Commercial quality carbon steel bolts, nuts, and washers shall be 1/2-inch diameter with UNC threads. Carriage bolts shall be used for attaching end

plates. All other bolts shall be hex end machine bolts. Nuts shall be hot pressed hex, American Standard, heavy. Standard wrought washers shall be used for foundation bolts and attachments to building structures. Other bolted joints shall have SAE standard lock washers.

4. **Control Panel Locations and minimum required NEMA ratings:**

   a. SBR Main Control Panel: Inside, NEMA 12

   b. Sand Filter Main Control Panel: Inside, NEMA 12

   c. Sand Filter Compressed Air Control Panel: Outside, NEMA 4

2-3

SECTION 43 25 00 – SUBMERSIBLE NON-CLOG PUMPS

REVISE Part 2.1.C, as follows:

C. Operating Conditions

Criteria	Unit	EQ Pumps	WAS Pumps	Influent Lift Station
Design Flow Capacity (per pump) Max. point	GPM	240	40	696
Design Flow Pump Head, TDH	Ft	~~23~~ **28**	10	36
Design Flow minimum efficiency (wire-to-water)	Percent	60	60	70
Driver				
Duty	Continuous			
Drive	Variable Speed			On/Off
Maximum Pump Speed	RPM	1800		2200
Maximum Motor Speed	RPM	1800		2200
Motor Size*	HP	**5**	**3**	**10**

*** Motor sizes may differ as long as all other pumping and process requirements are met.**

2-4

SECTION 46 53 53 – SEQUENCING BATCH REACTORS

REVISE Part 1.1.B.1, as follows:

1. Effluent decanters with an automated decant valve **where required**.

REVISE Part 1.1.B.8, as follows:

8. All the equipment and associated designs must comply with Oregon Administrative Rules (OAR) Chapter 340 ~~Division 45~~. **It will be the manufacturer's responsibility to independently verify compliance with applicable OAR stipulations for wastewater treatment in the state of Oregon with regards to SBR design (including, but not limited to; basin/treatment redundancy, energy efficiency, process sizing, aeration credits, etc.).**

REVISE Part 2.2.C, as follows:

C. Oxygen Demand Parameters

Jobsite Elevation	860	Ft MSL
Alpha*	0.65	
Beta	0.95	
Oxygen Requirements		
	1.25	lbs O_2/lb BOD_5 applied
	4.6**	lbs O_2/lb TKN applied
Actual Oxygen Requirement	1,328	lbs O_2/day
Minimum Blower Air Capacity per Blower	320	SCFM
Blower Discharge Pressure	10.7***	PSIG
Minimum Ambient Temperature	10	˚F
Maximum Ambient Temperature	115	˚F
Total # Blowers	Min. 3	1 Blower dedicated to each SBR basin with one shared standby blower (largest size) for redundancy

***The alpha value used in process calculations may differ from that listed here if adequate reasoning is provided. However, minimum blower air capacity per blower and minimum number of blowers may not differ from the parameters listed above.**

REVISE Part 2.2.B, as follows:

B. Design Criteria

Parameter	Current	20-Year Design*	Units
Annual Average Daily Flow (AADF)	~~0.177~~ **0.179**	0.225	MGD
Max Month Wet Weather Flow ($MMWWF_5$)	~~0.207~~**0.210**	0.266	MGD
Peak Day Average Flow ($PDAF_5$)	0.335	0.430	MGD
Peak Hour Flow (PHF)	0.541	0.696	MGD
Peak Instantaneous Flow (PIF)**	0.590	1.0	MGD
Assumed Influent pH	6.5-8.5		SU
Assumed Influent Alkalinity	280		mg/L as $CaCO_3$
Minimum Influent Temperature	8		˚C
Maximum Influent Temperature	20		˚C
Max Month BOD_5 Loading	~~280~~**294**	515	ppd
Max Month TSS Loading	~~137~~**158**	319	ppd
Max Month TKN Loading (as N)	~~100~~**125**	194	ppd
Max Month Phosphorus Loading (as P)	~~20~~**25**	30	ppd
Effluent BOD_5 Concentration	20		mg/L
Effluent TSS Concentration	20		mg/L
Effluent Ammonia Concentration (as N)	1		mg/L
Effluent Nitrate Concentration (as N)	5		mg/L
Effluent pH	6.5-8.5		SU
Minimum Process Basin DO	2		mg/L
Maximum MLSS at LWL	4,500		mg/L
Maximum Number of Cycles at Max. Daily Flow	4		Per day/Basin
Minimum Reactor Volume at Low Level	0.202		MG/Basin
Minimum Reactor Volume at High Level	0.254		MG/Basin
Minimum Settling Cycle Time	1		Hour/cycle at Max. Daily Flow
SBR Basin Quantity	2		

*Includes expected recycle flows from headworks, dewatering, and tertiary treatment

processes.

** Peak instantaneous flowrate represents the maximum flowrate that can be delivered to the SBR basins based on the capacity of the influent pump station. This is expected to equalize to the peak hour flow rate over an hour period.

Average Flows and Loadings for manufacturer evaluation of operating costs:

Parameter	Current	20-Year Design*	Units
Annual Average Daily Flow (AADF)	0.179	0.225	MGD
Average BOD_5 Loading	250	436	ppd
Average TSS Loading	135	270	ppd
Average TKN Loading (as N)	107	164	ppd
Average Phosphorus Loading (as P)	22	26	ppd

2-4

SECTION 46 61 27 – UPFLOW MOVING BED FILTERS

REVISE Part 1.3.A, as follows:

1.3 SUBMITTALS

A. The submittal shall be made in accordance with Section 01 33 00 – Submittal Procedures.

1. The Vendor shall submit a copy of the equipment specification section with all addenda and all referenced specification sections. Each paragraph shall be check-marked to indicate specification compliance or marked to indicate deviations from the specification requirements. Check marks shall indicate complete compliance with the paragraph requirements. Deviations from the specification shall be indicated by underlining the deviation and marking the paragraph or line with a number or letter. The remainder of the paragraph not marked as a deviation shall indicate compliance with the requirements of the paragraph. The Vendor shall prepare a detailed justification for each deviation. Failure to include the required specification sections and justification for deviations will indicate non-compliance and shall be rejected without further consideration.

2. Submit to the Engineer for review, filtration calculation, headloss calculations, air flow requirements, complete drawings showing installation details, materials of construction, arrangement details, loadings, elevations, and all items furnished under this Section.

3. **Submit to the Engineer for review: Seller shall submit all shop drawings and panel drawings to buyer for Engineer's review and approval.**

4. Complete instructions on installation of the equipment, air compressor, air lift system, controls, and filter media.

5. Design calculation for anchor bolts. Design calculations shall include dead, live, and dynamic loadings for normal and seismic conditions (see Drawings for seismic design standards). Design calculations shall be stamped by a professional engineer registered in the State of Oregon.

6. Start-up instructions.

REVISE Part 2.3.H, as follows:

H. AIR CONTROL PANEL WITH AIR BURST SYSTEM

1. ~~Each~~ **The filters** shall be furnished with a NEMA 4X operators control panel equipped with Vendor's standard equipment, including air coalescing filtration and regulation, solenoids for airlift, airburst and influent butterfly functions, pressure measurement for process alarms, air flow measurement all other controls necessary for operation of the filter's airlift. A signal from the Filter Control Panel shall be received to operate the system. Upon receiving the signal, the system shall send a high volume of air to the airlift to initiate the pumping action of the airlift. The increased air flow shall continue until an adjustable timer shuts off the solenoid at the operator's preset time delay.

2. If applicable, each airlift for each filter shall be equipped with a combination flow monitor/flow control valve that shall send a flow based analog signal to the PLC and receive a flow control analog signal from the PLC. Alternatively, each airlift for each filter shall be equipped with an on/off valve on the backwash waste line that shall be operated based on a signal from the PLC.

3. Where filter cells are intended to be operated in a lead/lag type configuration, the Vendor shall provide controls for this and integrate into overall plant SCADA architecture. Solenoid valves shall be included in the Vendor's scope, as well as sufficient instrument air in the air compressor system, to operate Installation Contractor-supplied pneumatic control valves to each filter cell.

4. **The PLC that shall be provided for complete operation and control of the filters shall be of the CompactLogix 5380 family. The Vendor shall provide the PLC programming to run the filters in a lead lag configuration based on flow provided via messaging on the network. The Vendor shall provide feedback to the SCADA system for each filter running, and all applicable alarms. All communications shall be over Ethernet/IP.**

5. **The Seller shall provide and program an HMI. The HMI shall have real-time feedback of filters' operation and alarms. It shall have provision for local operation by operator. Each instrument with feedback to PLC shall be viewable.**

KELLER ASSOCIATES, Inc.
245 Commercial St SE, Suite 210
Salem, OR 97301

ADDENDUM NO. 3

to the

CONTRACT DOCUMENTS

for

CITY OF Mill City
WPCF Design

This Addendum dated June 3, 2024, is for all persons preparing bids for the above referenced project and as such shall be made a part of the Contract Documents.

All changes, corrections, deletions and/or additions to the initial bidding documents enumerated herein shall be included in the Bidder's Proposal. In case of any conflict between the drawings, specifications, and this Addendum, this Addendum shall govern.

The Bidder shall acknowledge the receipt of this Addendum in the appropriate place in the Bidder's Proposal. Failure to acknowledge the receipt of this Addendum will cause a Bid to be considered non-responsive.

BIDDING DOCUMENTS

Item	Description
3-1	**SECTION 46 61 27 – UPFLOW MOVING BED FILTERS** **REVISE** Part 1.1.D, as follows: 1.1 SCOPE OF WORK A. The installation contractor shall provide the carbon chemical dosing system, to be controlled by others. The vendor shall identify all mixing and injection requirements necessary to meet the performance requirements listed herein. ~~Where filters are to be operated in a duty/standby configuration~~ Vendor shall provide a control strategy **as well as graphical representation of operator interface screens**, with controls to be provided by others. **REVISE** Part 1.5.A, as follows: 1.5 PROCESS GAURANTEE B. The Upflow Moving Bed Filter Equipment Vendor/Manufacturer shall provide a process guarantee that the SBR process will produce effluent quality listed in Part 1.2 of this specification. This guarantee shall remain in effect for a period of one year. The process guarantee shall include modifying equipment and controls **strategy** to achieve these discharge limits at no additional cost to Owner if the process is operated within the specified design guidelines.

REVISE Part 2.3.G.2, as follows:

2. Head Loss shall also be monitored with a Pressure Transducer coupled directly to the influent feed of each filter. The Pressure Transducer shall be wired ~~directly~~ to the **main** PLC ~~mounted in the NEMA 4X Filter Control Panel~~ **(provided by others).**

REVISE Part 2.3.H, as follows:

H. AIR CONTROL PANEL WITH AIR BURST SYSTEM

1. The filters shall be furnished with a NEMA 4X operator's control panel equipped with Vendor's standard equipment, including air coalescing filtration and regulation, solenoids for airlift, airburst and influent butterfly functions, pressure measurement for process alarms, air flow measurement all other controls necessary for operation of the filter's airlift. ~~A signal from the Filter Control Panel shall be received to operate the system. Upon receiving the signal, the system shall send a high volume of air to the airlift to initiate the pumping action of the airlift. The increased air flow shall continue until an adjustable timer shuts off the solenoid at the operators preset time delay.~~

2. ~~If applicable, each airlift for each filter shall be equipped with a combination flow monitor/flow control valve that shall send a flow based analog signal to the main PLC (provided by others) and receive a flow control analog signal from said PLC. Alternatively, e~~ **E**ach airlift for each filter shall be equipped with an on/off valve on the backwash waste line that shall be operated based on a signal from said PLC.

3. Where filter cells are intended to be operated in a lead/lag type configuration, the Vendor shall provide controls ~~for this and integrate into overall plant SCADA architect~~ **strategy for this to be accomplished**. Solenoid valves shall be included in the Vendor's scope, as well as sufficient instrument air in the air compressor system, to operate Installation Contractor-supplied pneumatic control valves to each filter cell.

4. ~~The PLC that shall be provided for complete operation and control of the filters shall be of the CompactLogix 5380 family. The Vendor shall provide the PLC programming to run the filters in a lead lag configuration based on flow provided via messaging on the network. The Vendor shall provide feedback to the SCADA system for each filter running, and all applicable alarms. All communications shall be over Ethernet/IP.~~

5. ~~The Seller shall provide and program an HMI. The HMI shall have real time feedback of filters' operation and alarms. It shall have provision for local operation by operator. Each instrument with feedback to PLC shall be viewable.~~

6. **Vendor shall provide complete and detailed control strategy to govern all filter operations with said instruments.**

KELLER ASSOCIATES, Inc.
245 Commercial St SE, Suite 210
Salem, OR 97301

Marion County OREGON FINANCE DEPARTMENT

Contract Review Sheet

PW5569-23 A#1 to EWA1

Public Improvement Agreements #: **PW-5569-23** Amendment #: **1toEWA**

Contact: **Alicia Jones** Department: **Public Works Department**

Phone #: **503-373-4320** Analyst: **Kathleen George**

Title: **ARPA - CMGC - North Santiam Canyon Sewer Project**

Contractor's Name: **Slayden Constructors, Inc.**

Term - Date From: **upon execution** Expires: **December 31, 2026**

Original Contract Amount: **$ 375,218.00** Previous Amendments Amount: **$ 103,259.00**

Current Amendment: **$ -** New Contract Total: **$ 478,477.00** Amd% **0%**

☑ Incoming Funds ☑ Federal Funds ☐ Reinstatement ☐ Retroactive ☐ Amendment greater than 25%

Source Selection Method: **20-0260 Request for Proposal** RFP# **PW1258-23**

Description of Services or Grant Award

Construction Manager General Contractor (CM/GC), to engage in the following services: Construction management, constructability review, Value Engineering, CPM scheduling and schedule analysis, construction and construction procurement, bidding and administration of subcontracted work, commissioning and all related CM/GC services related to the North Santiam Canyon Sewer Project.
Early Work Amendment No. 1 adds $103,259.00 to original contract for clearing for surveying and test pits, excavation and backfill test pits.

1st Amendment to Early Work Amendment No. 1, changes scope of work as stated in Early Work Amendment No. 1.

Desired BOC Session Date: _____ Files submitted in CMS for Approval: _____

Agenda Planning Date _____ Printed packets due in Finance: _____

Management Update _____ BOC upload / Board Session email: _____

BOC Session Presenter(s) _____

FOR FINANCE USE

Comments: **G**

REQUIRED APPROVALS

DocuSigned by: A3538E7AEC704E4... 4/26/2024
Finance - Contracts Date

DocuSigned by: Alicia Jones DA7EBDCC1E7B47D... 4/30/2024
Contract Specialist Date

DocuSigned by: Scott Norris 60C98A6E708240B... 4/26/2024
Legal Counsel Date

DocuSigned by: Jan Fritz 1E004034585E453... 4/26/2024
Chief Administrative Officer Date

EXHIBIT E.2~~1~~

MARION COUNTY
FIRST AMENDMENT TO EARLY WORK AMENDMENT NO. 1 TO CONTRACT

THIS FIRST AMENDMENT TO EARLY WORK AMENDMENT NO. 1 shall become effective upon execution by the Owner and CM/GC and receipt of any applicable approvals.

THIS AMENDMENT IS BETWEEN:

OWNER: Marion County, a political subdivision of the State of Oregon,

And

Slayden Constructors, Inc.
("CM/GC" and, in the Marion County
General Conditions for Public
Improvement Contracts,
September 1, 2014, Revised February 14, 2022 Edition, referred to as
"Contractor")

The Project is: North Santiam Canyon Sewer Project

The Engineer is:
Keller Associates, Inc.
245 Commercial St SE #210
Salem, OR 97301

Date of Original CM/GC Contract: September 13, 2023

Date of this Amendment: April 30, 2024 **, 2024**

Owner and the CM/GC hereby amend the Contract as set forth below (new language is indicated by underlining and deleted language is indicated by ~~strikethrough~~). Capitalized terms used but not defined herein shall have the meanings given in the Contract Documents.

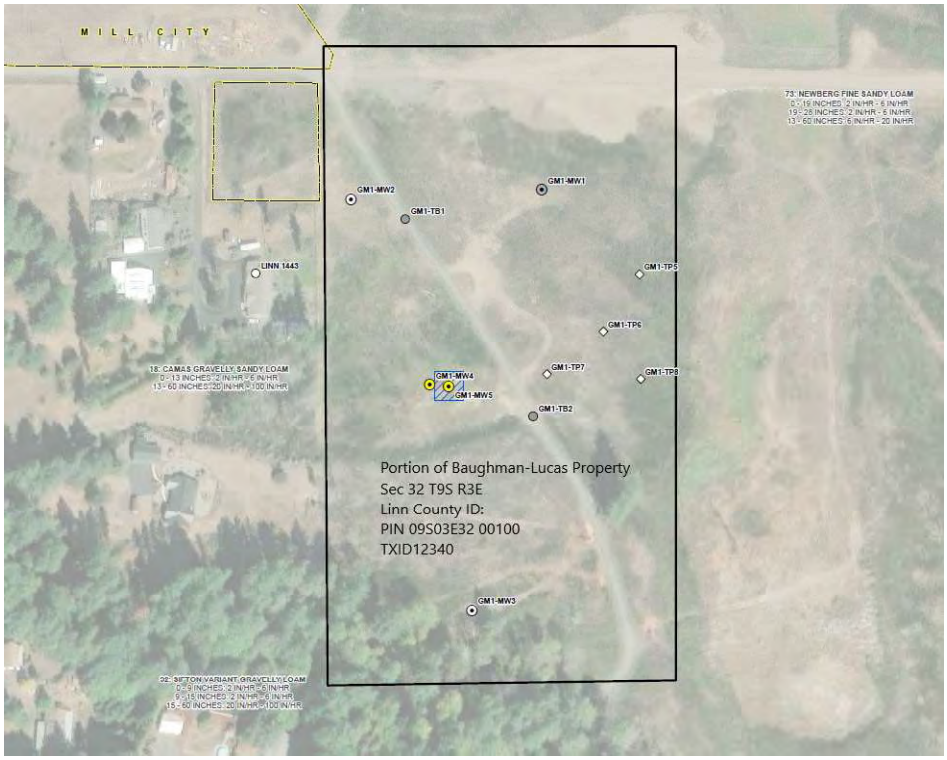
Except as amended hereby, the Contract remains in full force and effect.

~~1.~~ Early Work. In accordance with Article 3.2 of the CM/GC Contract, which authorizes the CM/GC to perform Construction Phase services if an Early Work Amendment is executed, Owner and the CM/GC hereby agree that the CM/GC shall perform the Early Work ~~generally~~ described below. ~~and more specifically described in the Attachment E.1.i., Documents for the Early Work, including any Early Work Plans and Specifications. Attachment E.1.i., is incorporated herein by this reference.~~

2. Statement of Early Work. The CM/GC will provide all labor, materials, supervision, coordination, and equipment necessary to complete the following Early Work:

~~a. Clearing for Surveying and Test Pits from Pump Station Near 920 West Central Street in Gates to East Mill City Limits. Clearing limits based on 8,360 LF approximately 15'-20' wide per alignment drawing in Attachment E.1.i.~~
~~b. Excavate & Backfill Test Pits Along Force Main & Gravity Sewer Alignment from Pump Station Near 920 West Central Street in Gates to Existing Pump Station in Mill City Near Park & Ride on NE Wall Street. Quantity of 45 test pits based on +/- Every 300' Along Alignment per alignment drawing in Attachment E.1.i.~~

a. Excavate Test Basin
   i. Excavate a 50' W x 50' L x 1' D basin. Stockpile dirt around the basin in a berm (to prevent surface water from running off into the basin during the test).
   ii. Rip-rap area where fire hose will discharge water to the basin, to diffuse energy of water entering basin. Rip-rap area must be sufficiently large to diffuse energy and prevent turbid water from being generated during discharge.
   iii. There will be a monitoring well in the center of the basin protected by three bollards. No digging shall occur within two feet of the monitoring well.
   iv. The basin shall be excavated such that the excavator is not driving across freshly excavated soil (i.e., dig out basin with excavator positioned at ground surface, backing out as digging proceeds).
b. Conduct Infiltration Test
   i. Install meters, hose ramps, hosing, as needed, to convey water from a fire hydrant located at the intersection of SE Fairview and Remine Road to the rip-rap area
   ii. At the location where water discharges into the basin, install totalizing flowmeter and shut off valve. Totalizing flowmeter shall be installed in accordance with manufacturer directions.
   iii. CM/CG is responsible for coordination with the city, permits, backflow prevention, meters, and other City requirements for using the hydrant.
   iv. Turn water on and let run for two to four weeks as directed by the Engineer. The CM/GC shall be responsible for payment for the cost of water included in this scope of work.
c. Return to Backfill Basin
   i. Backfill basin with native soil after testing concludes.
   ii. Restore premises and any improvements disturbed by the work to as good condition as they were prior to the work as directed by the Engineer.



d. Test Pit Excavation (To be conducted separately from infiltration basin pilot test)
   i. Mobilize to site
   ii. Three days excavating test pits and infiltration testing
   iii. Excavate test pits up to 15 feet bgs with 85G excavator.
   iv. Place 4-foot diameter x 3-foot-long metal pipe in the test pit (can be as long as 5 foot)
   v. Provide a minimum 500-gallon water tank, filled. Include a minimum 2-inch diameter hose and flow meter to convey water into the test pit.
   vi. CMGC is responsible for all costs for water, permitting, and other City requirements for hydrant use to fill the water tank.

~~c.~~ The final scope of work to be as directed by the Engineer on site but not to exceed quoted amendment value.

~~d. Work will take place on State of Oregon property managed by Oregon Department of Transportation and on public right-of-way within Mill City, Oregon, as indicated in the drawings noted in **Attachment E.1.i.**~~

3. Maximum Early Work Price. The parties agree that the cost of the Early Work described in this amendment shall not exceed $103,259 including the Estimated Cost of Work (ECOW) and the CM/GC fee as established in Article 6 of this Contract. CM/GC shall submit invoices for the following not to exceed amounts:

Estimated Cost of Work (Not to exceed):	$ 95,195
CM/GC Fee (7.0% of ECOW):	$ 6,664
Early Work Cost (Subtotal of Above):	$ 101,859
General Liability (0.8% of EWC):	$ 815

Oregon CATax (0.57% of ECOW):	$ 585
P&P Bond, Builder's Risk	$ Excluded
Maximum NTE (Total of above categories):	$ 103,259

4. Plans and Specifications. The specifications for the Early Work performed under this Amendment shall be Exhibit A of this Contract, Marion County General Conditions for Public Improvement Contracts, rev. February 14, 2022, and may be amended by the Engineer as required.

5. Substantial Completion Date. Unless directed by the Engineer to the contrary, the required date for Substantial Completion for this Early Work package is ~~June 30~~ August 31, 2024.

6. Tax Compliance Certification. The individual signing on behalf of the CM/GC hereby certifies and swears under penalty of perjury that s/he is authorized to act on behalf of the CM/GC, s/he has authority and knowledge regarding the CM/GC's payment of taxes, and to the best of her/his knowledge, the CM/GC is not in violation of any Oregon tax laws. For purposes of this certification, "Oregon tax laws" means a state tax imposed by ORS 401.792 to 401.816, ORS 320.005 to 320.150 and 403.200 to 403.250, and ORS chapters 118, 314, 316, 317, 318, 320, 321 and 323; the elderly rental assistance program under ORS 310.630 to 310.706, and local taxes administered by the Department of Revenue under ORS 305.620.

THIS AMENDMENT except as expressly amended above, all other terms and conditions of the original contract are still in full force and effect. CM/GC certifies that the representations, warranties and certifications contained in the original Contract are true and correct as of the effective date of this Amendment and with the same effect as though made at the time of this Amendment.

~~Attachment E.1.i Gates to Mill City Force Main Alignment by Keller Associates, pages B2 through B6~~

Contract #PW-5569-23

SLAYDEN CONSTRUCTORS, INC. (CM/GC)

Authorized Representative of CM/GC: DocuSigned by: Tom Paul 163792E4774E48F... 4/30/2024
Date

Title President

CCB Registration No.: 208848

MARION COUNTY (OWNER)

Authorized Signature: DocuSigned by: Jan Fritz 1E984034585E453... 4/26/2024
Chief Administrative Officer Date

Authorized Signature: DocuSigned by: Brian Nicholas 9703BA7ACD6D443... 4/26/2024
Department Director or designee Date

Reviewed by Signature: DocuSigned by: Scott Norris 60C98A6F708240D... 4/26/2024
Marion County Legal Counsel Date

Reviewed by Signature: DocuSigned by: A3538E7AEC784F4... 4/26/2024
Marion County Contracts & Procurement Date

Marion County
FINANCE DEPARTMENT

Contract Review Sheet

PW-5569-23 (1)

Public Improvement Agreements #: **PW-5569-23** Amendment #: **1**

Contact: **Alicia Henry** Department: **Public Works Department**

Phone #: **(503) 373-4320** Date Sent: **Wednesday, October 25, 2023**

Title: **ARPA - CMGC - North Santiam Canyon Sewer Project**

Contractor's Name: **Slayden Constructors, Inc.**

Term - Date From: **August 1, 2023** Expires: **December 31, 2026**

Original Contract Amount: **$ 375,218.00** Previous Amendments Amount: **$ -**

Current Amendment: **$ 103,259.00** New Contract Total: **$ 478,477.00** Amd% **28%**

☐ Incoming Funds ☑ Federal Funds ☐ Reinstatement ☐ Retroactive ☑ Amendment greater than 25%

Source Selection Method: **20-0260 Request for Proposal** RFP# **PW1258-23**

Description of Services or Grant Award

Construction Manager General Contractor (CM/GC), to engage in the following services: Construction management, constructability review, Value Engineering, CPM scheduling and schedule analysis, construction and construction procurement, bidding and administration of subcontracted work, commissioning and all related CM/GC services related to the North Santiam Canyon Sewer Project.

Early Work Amendment No. 1 adds $103,259.00 to original contract for clearing for surveying and test pits, excavation and backfill test pits.

Desired BOC Session Date:	**11/29/2023**	Files submitted in CMS for Approval:	**11/8/2023**
Agenda Planning Date	**11/16/2023**	Printed packets due in Finance:	**11/14/2023**
Management Update	**11/14/2023**	BOC upload / Board Session email:	**11/15/2023**

BOC Session Presenter(s) **Chris Einmo**

FOR FINANCE USE

Date Finance Received: **11/1/2023** Date Legal Received:

Comments: **Y**

REQUIRED APPROVALS

DocuSigned by: E4592AF86AA542C...	11/6/2023	DocuSigned by: Alicia Henry DA7E8DCC1E7B47D...	11/6/2023
Finance - Contracts	Date	Contract Specialist	Date
DocuSigned by: Jane E Vetto D0CFC5B04B9F483...	11/17/2023	DocuSigned by: Jan Fritz DC16351248D54EC...	11/17/2023
Legal Counsel	Date	Chief Administrative Officer	Date

MARION COUNTY BOARD OF COMMISSIONERS

Board Session Agenda Review Form

Meeting date: November 29, 2023

Department: Public Works

Title ARPA - North Santiam Canyon Sewer Project (NSCSP), Contract PW-5569-22, Early Work Amendment No. 1 (EWA1)

Agenda Planning Date: Nov. 16, 2023 **Management Update/Work Session Date:** Nov. 14, 2023 **Audio/Visual aids** ☐

Time Required 5 min **Contact:** Chris Einmo **Phone:** 503-566-4119

Requested Action: Consider approval of Early Work Amendment No. 1 to Contract PW-5569-23, , with Slayden Constructors, Inc. in the amount of $103,259.00 for field services associated with the North Santiam Canyon Sewer Project.

Issue, Description & Background: The Project team working under Marion County Contract PW-5069-22 has identified a preferred alignment for the pressurized sewer pipeline between Gates and Mill City as a former railroad alignment currently owned and maintained by the Oregon Department of Transportation. Design of the pipeline requires the clearing of vegetation along the proposed pressurized sewer pipeline alignment and the digging of test pits to enable the engineering team to complete topographic survey and geotechnical exploration of the proposed pipeline alignment. EWA1 will authorize Slayden to perform this work under Article 3 of the current CMGC Contract, PW-5569-23.

Financial Impacts: EWA1 increases the value of Contract PW-5569-23 by $103,259.00, from $375,218.00 to $478,477. This is a budgeted expense in the current fiscal year.

Impacts to Department & External Agencies: Approval of EWA1 will allow the work described above to proceed without delay, which is an essential component of establishing a Guaranteed Maximum Price for construction prior to the December 31, 2024 ARPA obligation deadline. EWA1 does not result in impacts to other county departments or external agencies.

List of attachments:
1. Early Work Amendment No. 1
2. Early Work Amendment Attachment (E.1.i)

Presenter: Chris Einmo, Marion County Public Works

Department Head Signature:

DocuSigned by:
Brian Nicholas
9793BA7ACD6D443...

REQUEST FOR AUTHORIZATION OF CONTRACT
PW-5569-23

Date: October 24, 2023
To: Chief Administrative Officer
Cc: Contract File
From: Alicia Henry

I. Subject: Amendment Exceeds 25%

DIPS CODE: 135-40-42-461-4603-Various
Budget Authority: ☒ Yes ☐ No
CIP: N/A

The Marion County Public Works Department is requesting approval to amend a contract as described in Section 20-0265, 20-0270, 30-0320, 40-0160, and 40-0910 of the Marion County Public Contracting Rules. The contract is with Slayden Constructors, Inc. for ARPA - CMGC - North Santiam Canyon Sewer Project having a pre-amended value of $375,218.00. Upon approval, the proposed amendment would add $103,259.00 to the contract for a new contract total of $478,477.00.

A. BACKGROUND

Marion County received $50,000,000 in American Rescue Plan Act (ARPA) funds from the State of Oregon for the design, permitting and construction of the North Santiam Sewer Project. Marion County has agreed to deliver the project on behalf of the North Santiam Sewer Authority (NSSA) and its member cities. On September 20, 2023, the county selected Slayden Constructors, Inc. to provide a comprehensive suite of construction management, constructability review, value engineering, CPM scheduling and schedule analysis, construction, and construction procurement, budding and administration of subcontracted work, commissioning, and all related Construction Management / General Contractor (CM/GC) services related to the project. This is a large, multi-phase project with aggressive expenditure deadlines driven by ARPA funding requirements. Therefore, for expediency, the full scope of services needed prior to the establishment of a Guaranteed Maximum Price (GMP) will be executed in a series of early work amendments to the original CM/GC contract, ensuring that early critical-path activities begin without delay.

B. CURRENT AMENDMENT PURPOSE

Early Work Amendment No. 1 adds $103,259.00 to the contract to provide clearing, test pit excavation and related support services for the proposed sewer pipeline alignment between Gates and Mill City. The CM/GC contract was written with the intent to include Early Work Amendments where fieldwork is necessary to support the Project goals prior to the execution of a Guaranteed Maximum Price (GMP) Amendment.

C. JUSTIFICATION

A pressurized sewer pipeline must be constructed between the cities of Gates and Mill City. The Wastewater Facility Planning Study developed under PW-5069-22 has identified an historic railroad alignment located adjacent to OR22 as the preferred pressurized sewer pipeline alignment. Oregon Department of Transportation owns and maintains this area as a linear parcel of real property.

The proposed Early Work Amendment includes the field work necessary to collect the field data required for design of the pressurized sewer pipeline, including vegetative clearing, topographic survey, environmental/cultural resource clearances, and geotechnical field investigation. Under this amendment, Slayden Constructors will clear a 20-foot pedestrian traversable width to support the Engineer with the necessary studies. Slayden will additionally provide the excavation for test pits at the Engineer's direction to study the soil parameters for the future pipeline.

D. BUDGET IMPACTS

1. Are the expected expenditures for the current fiscal year under the contract, including any additional funds being requested with this action, already included in the current year's adopted budget? ☒ Yes ☐ No

2. If yes, amount $103,259 Program / Account: 461/4603/534500

Submitted by:

DocuSigned by:
Alicia Henry
DA7EBDCC1E7B47D...

Alicia Henry
Public Works Department

Reviewed by:

DocuSigned by:
A3538E7AEC704F4...

Contracts & Procurement

Acknowledged by:

DocuSigned by:
Brian Nicholas
9793BA7ACD6D443...

Department Head

Acknowledged by:

DocuSigned by:
Jan Fritz
DC16351248DE4EC...

Jan Fritz, CAO

EXHIBIT E.1

MARION COUNTY
EARLY WORK AMENDMENT NO. 1 TO CONTRACT

THIS EARLY WORK AMENDMENT NO. 1 shall become effective upon execution by the Owner and CM/GC and receipt of any applicable approvals.

THIS AMENDMENT IS BETWEEN:

OWNER: Marion County, a political subdivision of the State of Oregon,

And

Slayden Constructors, Inc.
("CM/GC" and, in the Marion County
General Conditions for Public
Improvement Contracts,
September 1, 2014, Revised February 14, 2022 Edition, referred to as
"Contractor")

The Project is: North Santiam Canyon Sewer Project

The Engineer is:
Keller Associates, Inc.
245 Commercial St SE #210
Salem, OR 97301

Date of Original CM/GC Contract: September 13, 2023

Date of this Amendment: _____, 2023

Owner and the CM/GC hereby amend the Contract as set forth below. Capitalized terms used but not defined herein shall have the meanings given in the Contract Documents. Except as amended hereby, the Contract remains in full force and effect.

1. Early Work. In accordance with Article 3.2 of the CM/GC Contract, which authorizes the CM/GC to perform Construction Phase services if an Early Work Amendment is executed, Owner and the CM/GC hereby agree that the CM/GC shall perform the Early Work generally described below and more specifically described in the Attachment E.1.i., Documents for the Early Work, including any Early Work Plans and Specifications. Attachment E.1.i., is incorporated herein by this reference.

2. Statement of Early Work. The CM/GC will provide all labor, materials, supervision, coordination, and equipment necessary to complete the following Early Work:

    a. Clearing for Surveying and Test Pits from Pump Station Near 920 West Central Street in Gates to East Mill City Limits. Clearing limits based on 8,360 LF approximately 15'-20' wide per alignment drawing in Attachment E.1.i.
    b. Excavate & Backfill Test Pits Along Force Main & Gravity Sewer Alignment from Pump Station Near 920 West Central Street in Gates to Existing Pump Station in Mill City Near Park & Ride on NE Wall Street. Quantity of 45 test pits based on +/- Every 300' Along Alignment per alignment drawing in Attachment E.1.i.
    c. The final scope of work to be as directed by the Engineer on site but not to exceed quoted amendment value.
    d. Work will take place on State of Oregon property managed by Oregon Department of Transportation and on public right-of-way within Mill City, Oregon, as indicated in the drawings noted in **Attachment E.1.i.**

3. Maximum Early Work Price. The parties agree that the cost of the Early Work described in this amendment shall not exceed $103,259 including the Estimated Cost of Work (ECOW) and the CM/GC fee as established in Article 6 of this Contract. CM/GC shall submit invoices for the following not to exceed amounts:

Estimated Cost of Work (Not to exceed):	$ 95,195	
CM/GC Fee (7.0% of ECOW):	$ 6,664	
Early Work Cost (Subtotal of Above):	$ 101,859	
General Liability (0.8% of EWC):	$ 815	
Oregon CATax (0.57% of ECOW):	$ 585	
P&P Bond, Builder's Risk	$	Excluded
Maximum NTE (Total of above categories):	$ 103,259	

4. Plans and Specifications. The specifications for the Early Work performed under this Amendment shall be Exhibit A of this Contract, Marion County General Conditions for Public Improvement Contracts, rev. February 14, 2022, and may be amended by the Engineer as required.

5. Substantial Completion Date. Unless directed by the Engineer to the contrary, the required date for Substantial Completion for this Early Work package is June 30, 2024.

6. Tax Compliance Certification. The individual signing on behalf of the CM/GC hereby certifies and swears under penalty of perjury that s/he is authorized to act on behalf of the CM/GC, s/he has authority and knowledge regarding the CM/GC's payment of taxes, and to the best of her/his knowledge, the CM/GC is not in violation of any Oregon tax laws. For purposes of this certification, "Oregon tax laws" means a state tax imposed by ORS 401.792 to 401.816, ORS 320.005 to 320.150 and 403.200 to 403.250, and ORS chapters 118, 314, 316, 317, 318, 320, 321 and 323; the elderly rental assistance program under ORS 310.630 to 310.706, and local taxes administered by the Department of Revenue under ORS 305.620.

THIS AMENDMENT except as expressly amended above, all other terms and conditions of the original contract are still in full force and effect. CM/GC certifies that the representations, warranties and certifications contained in the original Contract are true and correct as of the effective date of this Amendment and with the same effect as though made at the time of this Amendment.

ATTACHMENTS

Attachment E.1.i	Gates to Mill City Force Main Alignment by Keller Associates, pages B2 through B6

Contract #PW-5569-23

SLAYDEN CONSTRUCTORS, INC. (CM/GC)

Authorized Representative of CM/GC: DocuSigned by: Tom Paul 163792E4774E48F... 12/4/2023
Date

Title President

CCB Registration No.: 208848

MARION COUNTY (OWNER)

BOARD OF COMMISSIONERS

Chair 11/29/2023
Date

Commissioner 11.29.2023
Date

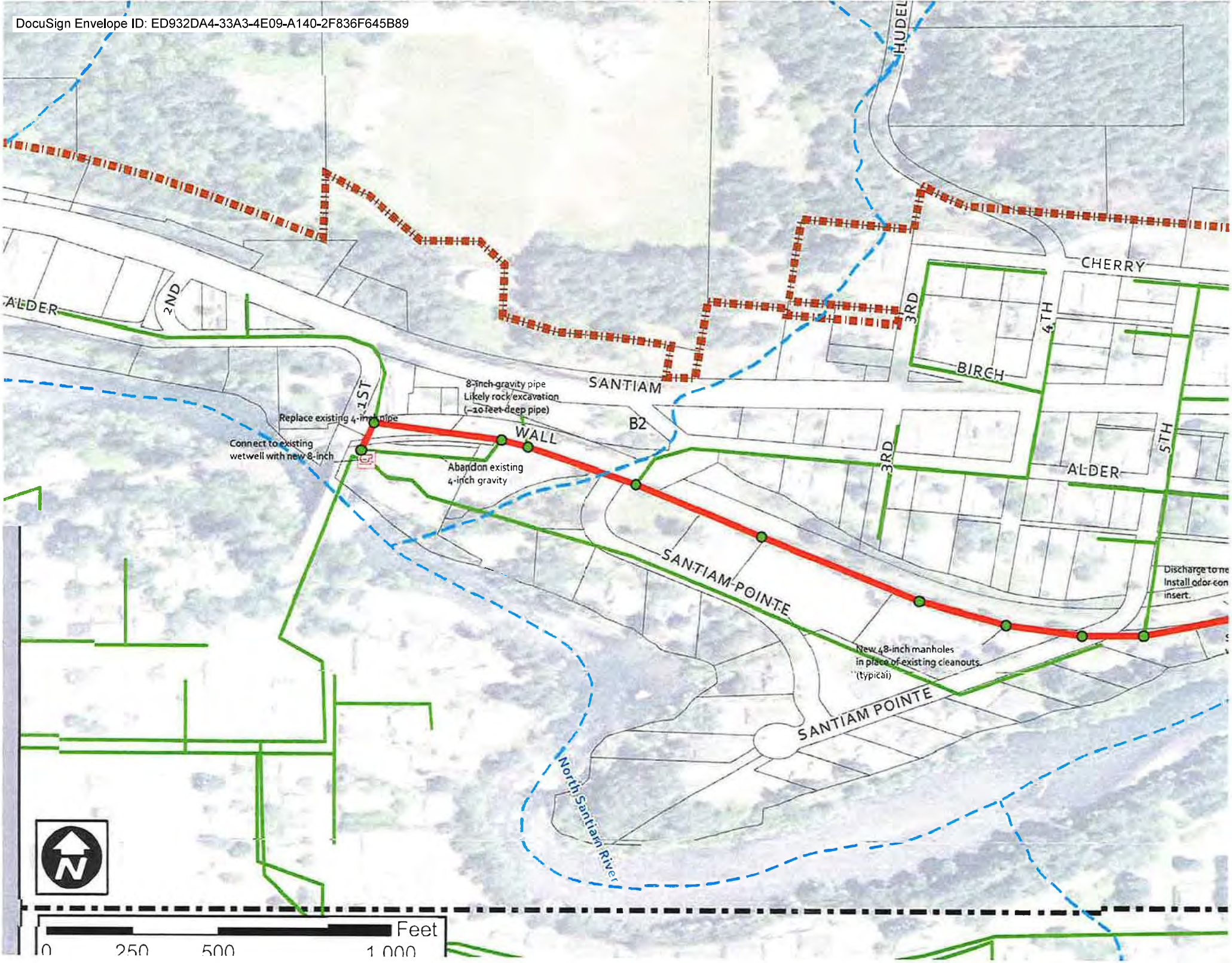
Commissioner 11/29/2023
Date

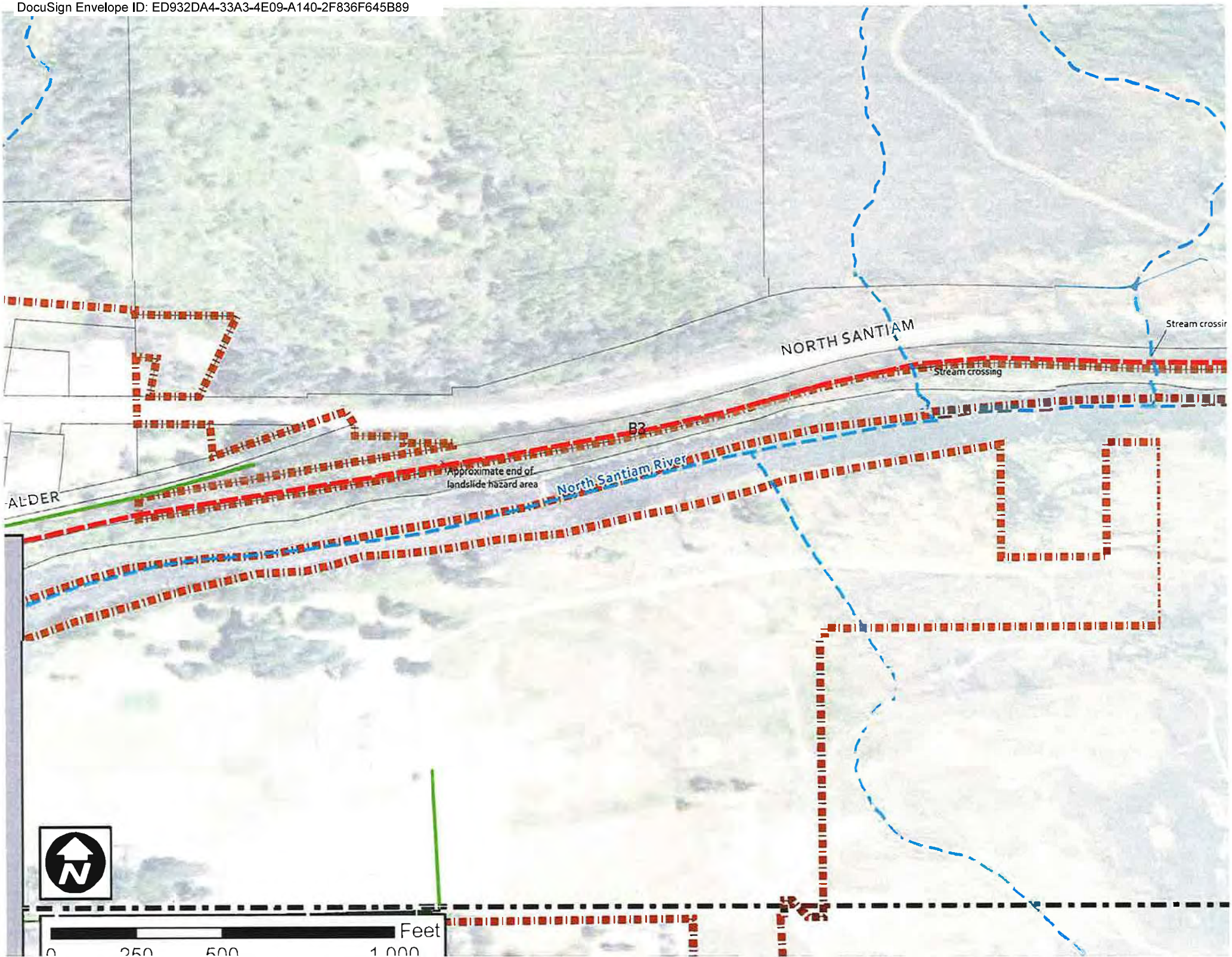
Authorized Signature: DocuSigned by: Brian Nicholas 9793BA7ACD6D443... 11/7/2023
Department Director or designee Date

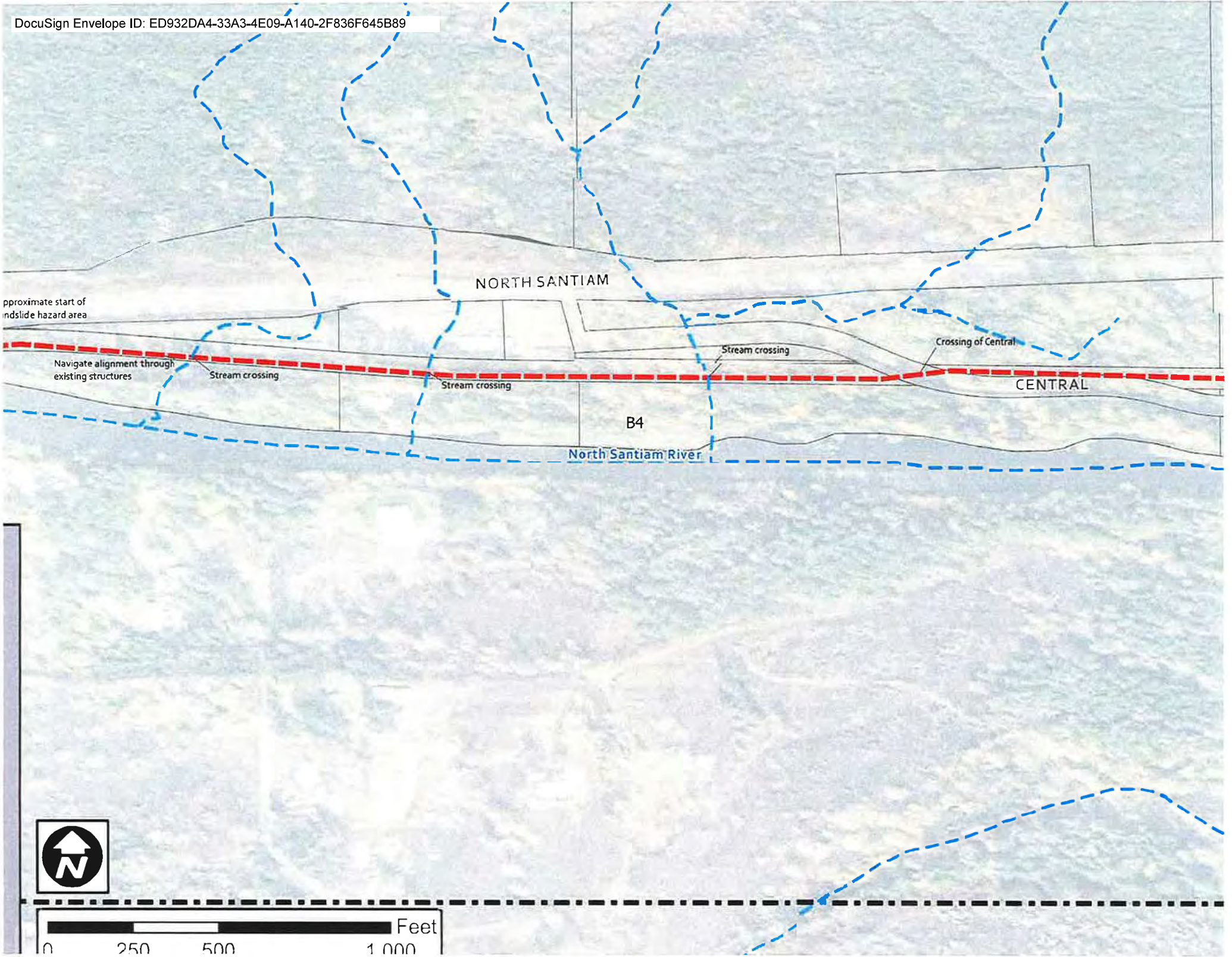
Authorized Signature: DocuSigned by: Jan Fritz DG16351248DE4EC... 11/17/2023
Chief Administrative Officer Date

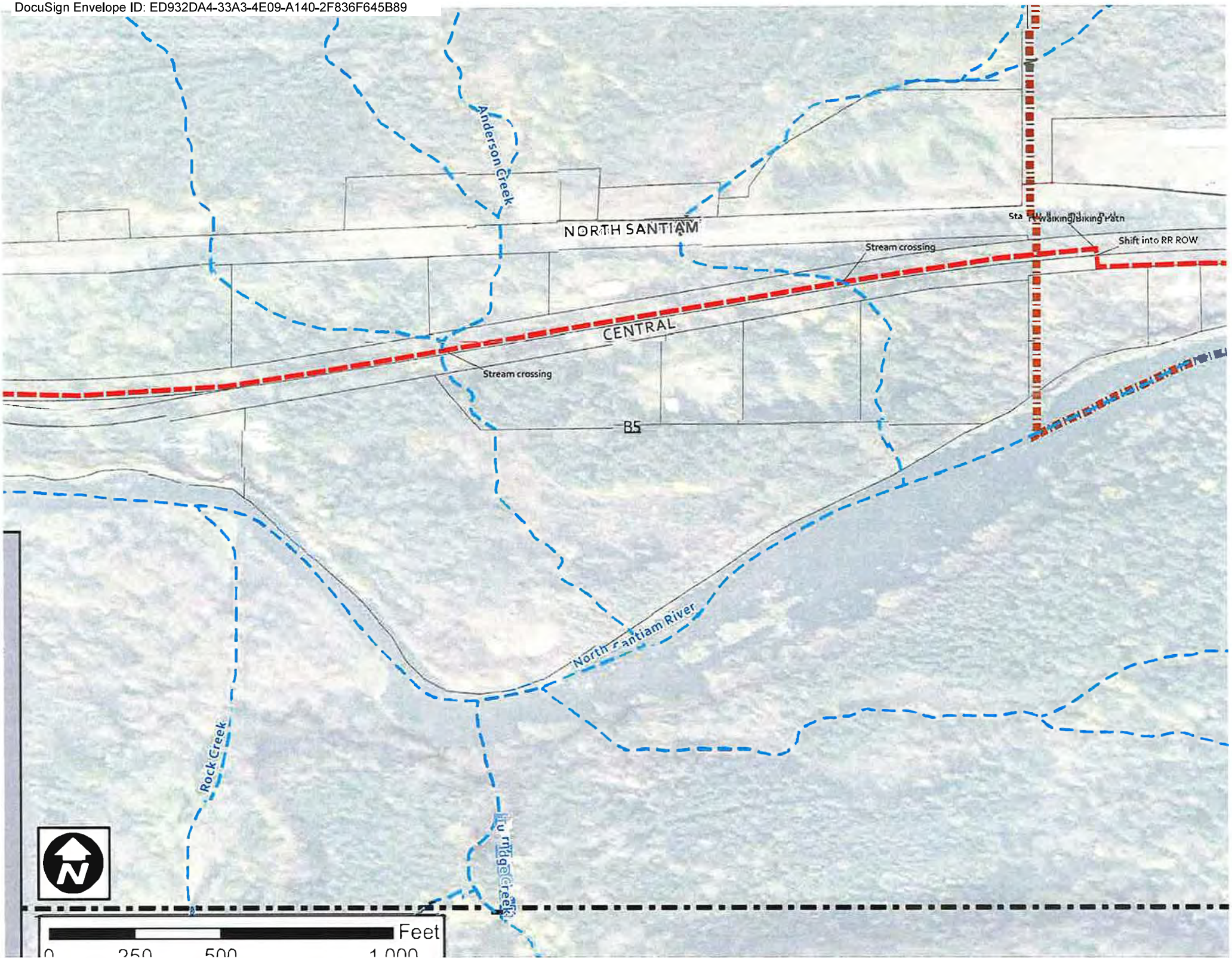
Reviewed by Signature: DocuSigned by: Jane E Vetto D0CFC6B04B9F483... 11/17/2023
Marion County Legal Counsel Date

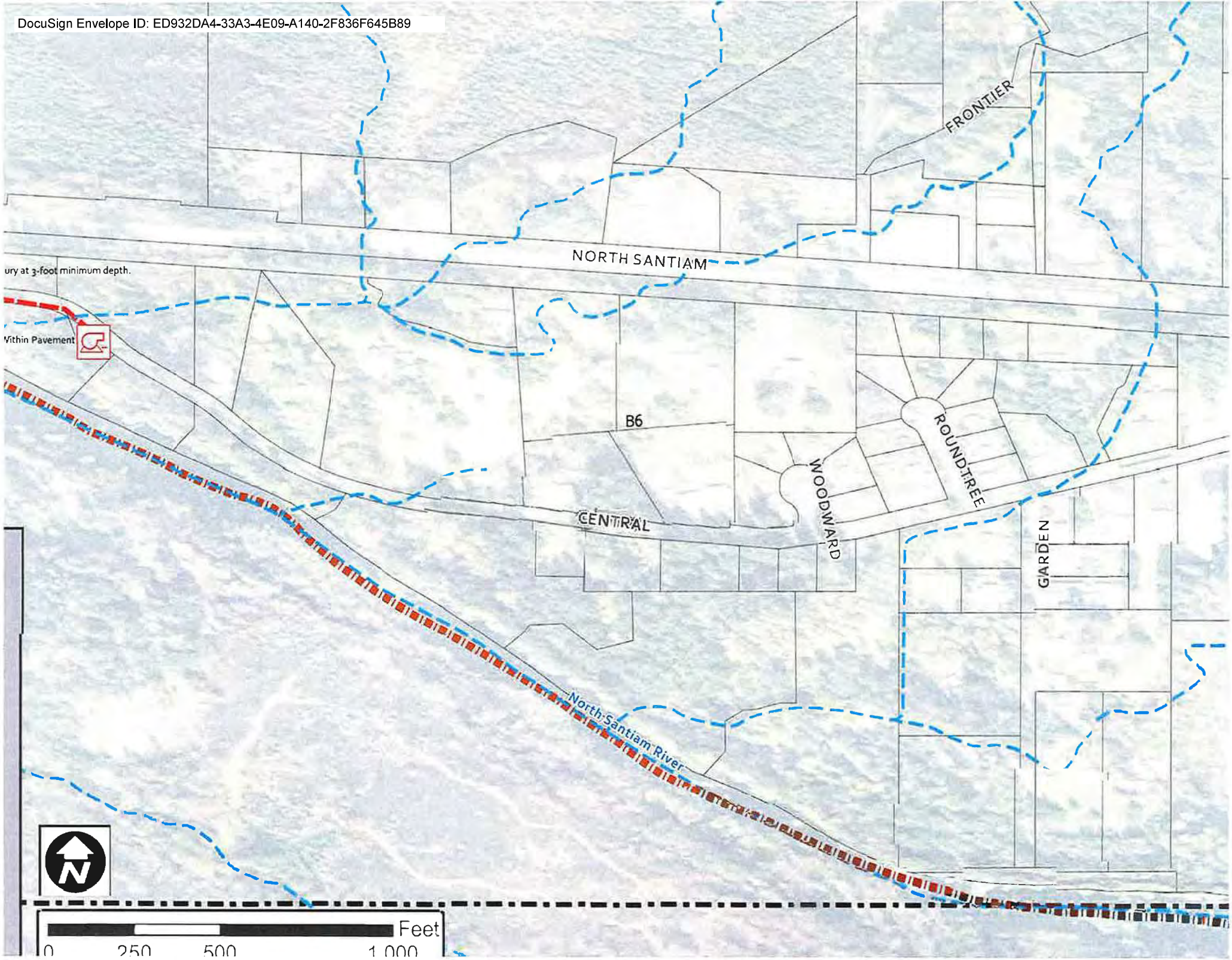
Reviewed by Signature: DocuSigned by: E4592AF8GAA642G... 11/6/2023
Marion County Contracts & Procurement Date











Contract Review Sheet

PW-5569-23

Public Improvement Agreements #: **PW-5569-23** Amendment #: ____

Contact: **Alicia Henry** Department: **Public Works Department**

Phone #: **503-373-4320** Date Sent: **Friday, August 25, 2023**

Title: **ARPA - CMGC - North Santiam Canyon Sewer Project**

Contractor's Name: **Slayden Constructors, Inc.**

Term - Date From: **Execution** Expires: **December 31, 2026**

Original Contract Amount: **$375,218.00** Previous Amendments Amount: **$0.00**

Current Amendment: **$0.00** New Contract Total: **$375,218.00** Amd% **0%**

☐ Incoming Funds ☑ Federal Funds ☐ Reinstatement ☐ Retroactive ☐ Amendment greater than 25%

Source Selection Method: **20-0260 Request for Proposal** RFP# **PW1258-23**

Description of Services or Grant Award

Construction Manager General Contractor (CM/GC), to engage in the following services: Construction management, constructability review, Value Engineering, CPM scheduling and schedule analysis, construction and construction procurement, bidding and administration of subcontracted work, commissioning and all related CM/GC services related to the North Santiam Canyon Sewer Project.

Desired BOC Session Date: **9/13/2023** BOC Planning Date: **8/31/2023**

Files submitted in CMS: **8/23/2023** Printed packet & copies due in Finance: **8/29/2023**

BOC Session Presenter(s) **Chris Einmo**

FOR FINANCE USE

Date Finance Received: **8/28/2023** Date Legal Received: ____

Comments: **Y**

REQUIRED APPROVALS

DocuSigned by: Jeff White 90EC84E244DF43D... 8/28/2023
Finance - Contracts — Date

DocuSigned by: Alicia Henry DA7EBDCC1E7B47D 9/4/2023
Contract Specialist — Date

DocuSigned by: Scott Norris 60C98A6E708240B 9/2/2023
Legal Counsel — Date

DocuSigned by: Jan Fritz DC16351248DE4EC 9/3/2023
Chief Administrative Officer — Date

MARION COUNTY BOARD OF COMMISSIONERS

Board Session Agenda Review Form

Meeting date:	Wednesday, September 13, 2023 at 9:00 am				
Department:	Public Works	Agenda Planning Date:	8/31/2023	Time required:	10 Min.
☐ Audio/Visual aids					
Contact:	Chris Einmo	Phone:	x4119		

Department Head Signature:
DocuSigned by:
Brian Nicholas
9793BA7ACD6D443...

TITLE	Consider approval of Contract PW-5569-23 for Construction Manager/General Contractor services with Slayden Constructors, Inc., for the North Santiam Canyon Sewer Project.
Issue, Description & Background	Marion County received $50,000,000 in American Rescue Plan Act (ARPA) funds from the State of Oregon for the design, permitting and construction of the North Santiam Canyon Sewer Project. Marion County has agreed to deliver the project on behalf of the North Santiam Sewer Authority (NSSA) and its member cities. On March 15, 2023, the Board authorized the use of alternative competitive procurement procedures in accordance with Marion County Public Contracting Rules (MCPCR), Sections 40-0600 to 40-0690, and ORS 279C.335, allowing the use of Construction Manager/General Contractor (CMGC) project delivery for construction of the Project. Marion County Public Works (MCPW) issued RFP PW1258-23 to solicit proposals from qualified firms to provide CMGC services. The RFP selection committee scored Slayden Constructors, Inc., of Stayton, Oregon as the highest ranked proposer. Contract PW-5569-23 includes the anticipated suite of pre-construction activities needed from the CMGC for Project design, permitting and early procurement of long lead-time equipment. Tasks include constructibility review, Value Engineering, cost estimating, construction scheduling, Guaranteed Maximum Price (GMP) proposals and other key deliverables. Future amendments to this contract are anticipated for various Early Work Packages (EWP) and the establishment of a global GMP for construction of the Project.
Financial Impacts:	The initial value of Contract PW-5569-23 is $375,218.00, which is a budgeted expense in the current fiscal year. Total available funding for this project is $50,000,000.00, of which 100% will be paid with federal funds. No matching funds are required from Marion County.
Impacts to Department & External Agencies	NSSA and NSSA member cities will benefit from construction of a new wastewater treatment plant, sewer collection systems and commercial on-site wastewater facilities resulting from this Project.
Options for Consideration:	1. Approve Contract PW-5569-23 with Slayden Constructors, Inc. 2. Take no action at this time.
Recommendation:	Staff recommend the Board approve Contract PW-5569-23 with Slayden Constructors, Inc., allowing the selected CMGC to provide pre-construction services critical to the successful delivery of this large, complex Project.
List of attachments:	Contract PW-5569-23 between Marion County and Slayden Constructors, Inc.

MARION COUNTY BOARD OF COMMISSIONERS

Board Session Agenda Review Form

Presenter:	Chris Einmo, Public Works

Copies of completed paperwork sent to the following: (Include names and e-mail addresses.)

Copies to:	Alicia Henry, Public Works, ahenry@co.marion.or.us Brian Nicholas, Public Works, bnicholas@co.marion.or.us Jeff White, Finance, jdwhite@co.marion.or.us

MARION COUNTY
CM/GC CONTRACT

(CONSTRUCTION MANAGER/GENERAL CONTRACTOR)

THE CONTRACT IS BETWEEN:

OWNER: Marion County, a political subdivision of the State of Oregon,

And

Slayden Constructors, Inc.
("CM/GC" and, in the Marion County
General Conditions for Public
Improvement Contracts,
September 1, 2014, Revised February 14, 2022 Edition, referred to as
"Contractor")

The Project is: North Santiam Canyon Sewer Project

The Engineer is:
Keller Associates, Inc.
245 Commercial St SE #210
Salem, OR 97301

The Owner's Target GMP Range is: $ 45,000,000.00

Contract #PW-5569-23

MARION COUNTY
CM/GC CONTRACT
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RECITALS

A. On August 3, 2022, Owner entered into Coronavirus State Fiscal Recovery Fund Grant Agreement SR2240 with the Oregon Business Development Department for development of a project entitled by the state the North Santiam Septic to Sewer Project. The North Santiam Canyon Sewer Project and the North Santiam Septic to Sewer Project are one and the same project.

B. On April 19, 2023, Owner issued Request for Proposals RFP PW1258-23 for North Santiam Canyon Sewer Project (the "Project").

C. Project will construct new sanitary sewer conveyance and treatment infrastructure serving the Oregon cities of Mill City and Gates, with commercial septic components in the cities of Detroit and Idanha.

D. The work of the Project (the "Work") will be performed in two phases:

(i) During the Preconstruction Phase, the CM/GC will perform the pre-construction services (the "Pre-Construction Services") described in Article 3.1. During the Preconstruction Phase, the CM/GC will comply with all terms of the Contract, except those requirements of the Marion County General Conditions applicable only to Construction Phase Services.

(ii) During the Construction Phase, the CM/GC will perform all portions of the Work (the "Construction Phase Services"), other than the Pre-Construction Services described in Article 3.1. During the Construction Phase, the CM/GC will comply with all terms of the Contract, without exception. Until Owner and the CM/GC successfully negotiate and execute an Early Work Amendment or the GMP Amendment described in Article 6, the CM/GC has not been awarded the Construction Phase portion of the Work.

It is understood that time is of the essence and all parties shall work to construct and commission the full Project as soon as possible. It is anticipated that construction, commissioning, and invoicing shall be completed no later than November 1, 2026, unless otherwise amended.

AGREEMENT

Owner and the CM/GC agree to give effect to the recitals above by mutually establishing the terms and conditions below, and the promises so exchanged constitute adequate consideration for this Contract.

ARTICLE 1
DEFINITIONS

Except as expressly defined or modified below or elsewhere in this agreement (the "Contract" or this "CM/GC Contract"), all capitalized terms shall have the meanings set forth in Section A of the Marion County General Conditions for Public Improvement Contracts, September 1, 2014, Revised February 14, 2022 Edition, attached as Exhibit A (the "Marion County General Conditions"). The terms below are expressly defined as follows:

1.1 Affiliate

Affiliate means any subsidiary of the CM/GC, and any other entity in which the CM/GC has a financial interest or which has a financial interest in the CM/GC (including, without limitation, parent companies, related businesses under the same holding company, or any other business controlled by, under common control with, or that controls the CM/GC).

1.2 Allowances
Allowances means the allowance amounts shown in the GMP Supporting Documents, together with any further allowances the parties may develop as the Project progresses.

1.3 Amendment
Amendment means a written modification of the Contract (including, without limitation, any change in the GMP to which the parties agree), that is identified as an Amendment, is executed by the CM/GC and Owner's Authorized Representative (as identified on the cover page of this CM/GC Contract), and, if required, approved in writing on behalf of Owner by the County Legal Counsel.

1.4 Business Days
Business Days means every day except Saturday, Sunday, and legal holidays recognized for employees of Owner.

1.5 Change Order
Change Order means a written modification of the Contract under Section D.1 of the Marion County General Conditions, (including, without limitation, any change in the GMP to which the parties agree), that is identified as a Change Order, is executed by Owner's Authorized Representative and CM/GC, if applicable, and, if required, approved in writing by the County Legal Counsel.

1.6 CM/GC Field Work
CM/GC Field Work means work the Owner and CM/GC determine to be in the best interest of the Project, provided, however, that (i) the CM/GC has reasonably determined that the CM/GC doing such portion of the Work using staff and direct resources of the CM/GC is in the best interests of Owner, (ii) the Work is identified as CM/GC Field Work in monthly billings and (iii) the CM/GC receives prior approval of Owner's Authorized Representative as to the scope of the CM/GC Field Work.

1.7 CM Services
CM Services has the meaning given in Article 3.3 below.

1.8 Construction Documents
Construction Documents has the meaning given in the Marion County Standard Professional Services Contract for Architectural, Engineering & Related Services (the "A/E Contract") for this Project.

1.9 Construction Phase
Construction Phase means the period that begins when Owner executes a GMP Amendment or Early Work Amendment, together with the earlier of (i) issuance by Owner of a Notice to Proceed with any on-site construction or (ii) execution of a subcontract or issuance of a purchase order for materials or equipment required for the Work.

1.10 Construction Phase Services
Construction Phase Services means all of the Work other than the Preconstruction Phase Services, including Early Work.

1.11 Contract Documents
Contract Documents has the meaning given in Section A of the Marion County General Conditions, and as supplemented by Article 2.1 below.

1.12 Costs for General Conditions Work
Costs for General Conditions Work means the sums paid on a cost reimbursable maximum, not-to-exceed price basis as described in Article 8.8.

1.13 Design Development Documents
Design Development Documents has the meaning given in the A/E Contract for the Project.

1.14 Development Plan and Operations Manual
Development Plan and Operations Manual means the document described in Article 2.4.

1.15 Early Work
Early Work means Construction Phase Services authorized by Amendment that the parties agree should be performed before establishing the GMP. Permissible Early Work is limited to: early procurement of materials and supplies; early release of bid or proposal packages for site development and related activities; and any other advance work related to critical components of the project for which performance before establishing the GMP will materially affect the critical path schedule of the Project.

1.16 Early Work Amendment
Early Work Amendment means an Amendment to the Contract executed by and between the parties to authorize Early Work.

1.17 RESERVED.

1.18 General Conditions Work
General Conditions Work ("GC Work") means (i) the portion of the Work required to support construction operations that is not included within overhead or general expense (ii) any other specific categories of Work approved in writing by Owner's Authorized Representative as forming a part of GC Work.

1.19 Guaranteed Maximum Price (the "GMP")
The GMP means the Guaranteed Maximum Price of this Contract, as stated in dollars in the GMP Amendment, as determined in accordance with Article 6, and as the price may be adjusted from time to time pursuant to the provisions of the Contract.

1.20 GMP Amendment
The GMP Amendment means an Amendment to the Contract, issued in the form of Exhibit D and executed by and between the parties, to establish the GMP and identify the GMP Supporting Documents for Construction Phase Services.

1.21 GMP Supporting Documents
The GMP Supporting Documents means the documents referenced in the GMP Amendment as the basis for establishing the GMP and that expressly identify the plans and specifications, assumptions, qualifications, exclusions, conditions, allowances, unit prices, and alternatives that form the basis for the GMP.

1.22 Preconstruction Phase
Preconstruction Phase means the period that begins on the date of this CM/GC Contract and ends upon commencement of the Construction Phase; provided that if Owner and the CM/GC agree, the Construction Phase may commence before the Preconstruction Phase is completed, in which case

both phases shall proceed concurrently, subject to the terms and conditions of the Contract Documents.

1.23 Preconstruction Phase Services
Preconstruction Phase Services means all services described in Article 3.1, and any similar services described in the RFP, including such similar services as are described in the CM/GC's response to Owner's RFP to the extent that Owner agrees to the services, but excluding any Early Work.

1.24 Schematic Design Documents
Schematic Design Documents has the meaning given in the A/E Contract for the Project.

1.25 Scope Change
Scope Change means (i) changed site conditions not reasonably inferable from information available to the CM/GC at the time of execution of the GMP Amendment, and (ii) significant Work modifications (including additions, substitutions and deletions), application of Allowances, and selection of alternatives, all as approved by Owner under the Contract, beyond that identified or inferable from the GMP Supporting Documents (but in the case of Allowances items, the GMP will increase only if the cost to Owner of the Allowances items exceeds the total amount of the Allowances).

ARTICLE 2
CONTRACT DOCUMENTS

2.1 Contract Documents
For purposes of the Project, the document identified as "Marion County Public Improvement Agreement Form" in the Marion County General Conditions means this CM/GC Contract. This CM/GC Contract includes all exhibits attached, which by this reference are incorporated.

2.2 Effective Date
The Contract becomes effective on the first date on which every party has signed the Contract and Owner has received all necessary approvals, including approval for legal sufficiency by the County Legal Counsel.

2.3 The Contract; Order of Precedence
This CM/GC Contract, together with the other Contract Documents, forms the entire agreement between the parties. Except as otherwise expressly provided herein, the order of precedence of the Contract Documents is as established in Section A.3.1 of the Marion County General Conditions. The parties shall look to this order of precedence to resolve inconsistent or conflicting terms among the Contract Documents.

ARTICLE 3
WORK OF THE CONTRACT

3.1 Preconstruction Phase Services
The CM/GC agrees to provide all of the Preconstruction Phase Services described below on an ongoing basis in support of, and in conformance with, the time frames described in the RFP. Commencement of the Construction Phase does not excuse the CM/GC from completion of the Preconstruction Phase Services, if such services have not been fully performed at commencement of the Construction Phase.

3.1.1 Project Schedule:

Within one week of contract execution, the CM/GC shall establish a Pre-Construction Schedule according to the project scope elements in coordination with the Design Team. The CM/GC shall incorporate the preconstruction roles and responsibilities of the various team members. The Preconstruction Schedule will be used to establish the initial schedule for the Project and shall include/consider a proposed construction schedule as well. The CM/GC shall provide continuous schedule validation for construction schedules and the overall schedule for the duration of the CM/GC preconstruction phase.

The CM/GC will incorporate or perform the following items while developing the Preconstruction Schedule and maintaining it for the duration of the CM/GC preconstruction phase:

a. Incorporate all pre-construction activities for both the Design Team and the CM/GC.

b. Impacts to the traveling public must be minimized and will be a consideration in the determination of daily working time schedules allowed. The CM/GC must work and communicate with Project stakeholders and citizens before and during construction. Seasonal, weekly, and daily traffic patterns must be considered when planning and scheduling work.

c. Notable Project schedule constraints to be considered:

   i. Environmental Requirements

      - All work is anticipated to conform to the environmental clearance and/or permit documents.

      - Any early packages shall have the appropriate environmental clearances, approvals, and permits before GMP negotiation, and bid package construction.

   ii. Lane Closures

   iii. Utility Relocation

   iv. Resource availability

   v. Long-lead procurement items.

d. Develop a preliminary construction schedule and construction packaging strategy within Owner's construction budget. Collaborate with the Design Team to determine if early construction packages are viable, cost effective and provide an overall benefit to the Project.

e. Assist in determining the scope for any potential early construction packages.

f. Prepare construction schedules and phasing alternatives at each pre-construction milestone to support development of Opinion of Probable Construction Costs (OPCC's), validate deadlines, and help develop Project delivery strategies.

g. Develop a resource-loaded, critical path method, construction schedule at 30%, 60% and 90% OPCC milestones, as well as for all GMP proposals.

h. Ensure each GMP package will be severable; will have specific beginning and end points; and will have independent overhead, mobilization, traffic control, and Project costs. Each GMP package will include provisions for liquidated damages and incentive/disincentive as determined by Owner in its sole discretion. The awarded CM/GC and Owner are responsible for ensuring the severability of each package. If Liquidated Damages are agreed upon, the following shall be incorporated into any GMP proposal of the CM/GC:

i. CM/GC and Owner recognize that all time limits for Substantial Completion, and completion as stated in the Contract Documents are of the essence of the Contract and that Owner will suffer financial and other losses if the Work is not completed and Milestones not achieved within the Contract Times, as duly modified. The parties also recognize the delays, expense, and difficulties involved in proving, in a legal or arbitration proceeding, the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and CM/GC agree that as liquidated damages for delay, but not as a penalty:

- Substantial Completion–CM/GC shall pay Owner **$1,000** for each day that expires after the time, as duly adjusted pursuant to the Contract, specified above for Substantial Completion, until the Work is substantially complete.
- If Owner recovers liquidated damages for a delay in completion of the Project or a specified Milestone by CM/GC, then such liquidated damages are Owner's sole and exclusive remedy for such delay, and Owner is precluded from recovering any other damages, whether actual, direct, excess, or consequential, for such delay, except for special damages, if any, specified in this Agreement.

h. Compare and verify construction schedules and all assumptions with the ICE.

3.1.2 Meetings:

a. The Kick-Off meeting will emphasize the importance of partnering within the CM/GC delivery method by focusing on team building and partnering. This meeting is mandatory for all key team members including key subcontractors. This workshop will be facilitated by the Owner and will cover at a minimum the following items:

i. Introduction to the Project, CM/GC, partnering, Project stakeholder engagement, identification of roles and responsibilities. Subcontractors performing major and high-risk work items should be in attendance.

ii. The Team will review Project status, vision, goals, objectives, funding, preliminary preconstruction schedule, what success would look like, current design, etc.

iii. Initial discussion of preliminary innovations, phasing, and risk mitigations being proposed by the CM/GC, Design Consultant, and Independent Cost Estimator (ICE).

iv. Coordinate Project Schedule review meetings.

v. Coordinate progress meeting frequencies and initiate working groups for various elements of the Project. Progress meetings may include project management meetings, design meetings, discipline/specialty meetings, stakeholder meetings, and public meetings.

vi. Strategy, timing, and approach for the Project Value Engineering Workshop.

b. The Project Value Engineering Workshop will be co-facilitated by the Owner, the CM/GC, ICE, and the Design Consultant. Attendance and duration will be outlined at the Kick-Off Meeting. It is also anticipated that Project stakeholders' input will also be incorporated into this workshop. The approach, agenda, format, and duration for the workshop will be developed in collaboration with the Owner, the CM/GC, ICE, and the Design Consultant. The CM/GC shall provide input into how to achieve the desired results for the Project. This workshop could require several sessions. The purpose of this workshop is to evaluate the Preferred Alternative, consider any of the CM/GC innovations or design refinements for the Project, incorporate value engineering principles to the Project, incorporate stakeholder input and get support for endorsement of any potential changes to the Preferred Alternative.

c. The CM/GC shall at a minimum attend the following meetings. Other meetings may be deemed useful and necessary. Attendance to any additional meetings by the CM/GC shall be coordinated with Owner.

i. Kick-Off meeting

ii. Risk management and assessment workshop

iii. Regular partnering meetings

iv. Project Value Engineering Workshop

v. Field Inspection Review (FIR) for each construction scope package – 30%

vi. Design Office Review (DOR) for each construction scope package – 60%

vii. Final Office Review (FOR) for each construction scope package – 90%

viii. Quantity reconciliation meetings

ix. Regular risk management meetings

x. Innovation meetings

xi. Cost estimate review meetings

xii. GMP review meetings

xiii. GMP negotiations and assumption resolution meetings (if applicable)

xiv. Ongoing lessons learned

xv. Assist with and attend public meetings and/or open houses

xvi. Other Project meetings as may become necessary

3.1.3 The CM/GC shall provide the following services relating to design and preconstruction tasks:

a. Conduct a thorough review of all plans, specifications, reports, diagrams, shop drawings, as-built plans, site conditions, specifications, and all other necessary Project documentation to provide design validation from a construction expertise perspective.

b. Conduct and analyze preliminary field work (coring, sampling, test holes, etc.) to assist with the design phase.

c. Independently calculate quantities for verification purposes of construction packages, independent from both the Design Consultant and the Independent Contract Estimator.

d. Provide constructability input on all facets of the Project including, but not limited to:

i. Construction methods and elements

ii. Structures

iii. Geotechnical findings

iv. Geohazards

v. Environmental commitments

vi. Minimizing impacts of construction to the traveling public

vii. Material availability

viii. Staging

ix. Stormwater Management

x. Shoring and phasing techniques

xi. Accelerated construction techniques

xii. Existing subsurface utilities

xiii. Quality assurance of design deliverables specific to mitigation of error and omission prior to negotiation

e. Provide written reviews or reports and details/redlines of the Project plans and specification packages at Project milestones. Comments should be related to constructability, construction phasing, clarifications, design errors or omission mitigation and tracking, impacts to schedule, impacts to cost, risk identification, and recommendations to increase efficiencies of the Project.

f. Coordinate with the design team to make determinations whether early procurement packages for materials (long lead-time procurement) will benefit the Project.

g. Actively participate in discussions to study the feasibility of design options and provide input on constructability, pricing, innovation, value, risk mitigation, and quality.

h. Provide additional milestone reviews depending on package complexity.

i. Provide timely feedback from design reviews to assist in decision making.

3.1.4 Cost Estimating:

The CM/GC shall provide cost estimating along with schedule impact estimates as design concepts/alternatives are being developed and evaluated throughout the preconstruction phase to help inform decisions. This may include:

a. Evaluating means and methods of various construction techniques that may influence design solutions with considerations of cost and schedule impacts.

b. Evaluating industry standard operating and maintenance costs to determine life-cycle costs.

c. Proposing design alternatives to reduce cost.

d. Providing construction cost estimates at milestones that shall include the following activities:

i. Item identification that is compatible with the Owner's cost estimating, standards, and specifications.

ii. Submission of Opinion of Probable Construction Costs ("OPCCs") at 30%, 60% and 90% milestones for each construction package. Analysis should include availability of labor, equipment, and materials. Additional OPCCs may be required at the request of the Owner if: the package complexity indicates an added benefit, analysis of proposed alternatives is necessary, analysis of means and methods is necessary, or work is added to the Project.

iii. Additional OPCCs may be required before determining the GMP proposal if the Owner agrees on their necessity. To facilitate comparisons with ICE estimates, both CM/GC and subcontractor cost estimates will be included in an open book review.

iv. Submit a GMP proposal when both the CM/GC and Owner agree the design has progressed to the appropriate level, typically at 90%.

- Quantity and schedule reconciliation will be required between the Design Team and Owner. This may include verification of assumptions, and means of methods between Owner, the Design Consultant and the ICE.

- Owner may require the CM/GC submit a GMP proposal on early construction packages, or for the procurement of long-lead items.

- During GMP proposal reviews, the CM/GC GC shall provide Owner all production rates, material assumptions, indirect costs, and any other information as requested by Owner to aid in reaching an agreement on a GMP proposal.

3.1.5 Risk:

The CM/GC delivery method provides a forum to communicate and discuss risk in the design phase and to collaboratively address and reduce risk with the Owner, CM/GC and the Design Consultant. A primary benefit of CM/GC is the ability to contractually allocate risks to the party best able to manage the risk. Risk assessment will be a continual process throughout the pre-construction and construction stage with risk sharing between public and private parties that holds both accountable for performance and expenditure of public resources.

Risk management will be a topic at both the 1-day Kickoff meeting and an initial Risk Management and Assessment Workshop which shall be scheduled by the CM/GC early in the preconstruction phase. Regular risk meetings, facilitated by the CM/GC, will be held to monitor progress. Risk responsibilities include:

a. Facilitate quantitative and qualitative risk management discussions to identify risks, quantify probabilities, quantify impacts, develop mitigation strategies, and assign risk responsibility.

b. Set risk meeting frequencies and prepare and update the Project Risk Matrix throughout the Project lifecycle.

c. Collaborate with the Project Team to develop a Risk Management Plan, perform risk assessments, and prepare and update the Risk Matrix.

3.1.6 The CM/GC shall perform the following services relating to Subcontractors and suppliers:

a. The CM/GC shall seek to develop Subcontractor and supplier interest in the Project, consistent with applicable legal requirements, and shall furnish to Owner and the engineer a list of possible Subcontractors and suppliers, including suppliers who may furnish materials or equipment fabricated to a special design, from whom competitive bids, quotes, or proposals (collectively, "Offers") will be requested for each principal portion of the Work. The parties acknowledge and agree that the CM/GC's submission of the list of possible Subcontractors and suppliers is for information and discussion purposes only and not for prequalification. The receipt of such list does not require Owner or the engineer to investigate the qualifications of proposed Subcontractors and suppliers. Owner or the engineer does not, as a consequence of receiving the list, waive any rights to object later to or reject any proposed Subcontractor, supplier, or method of procurement.

b. The CM/GC shall provide input to Owner and the design team regarding the current construction market bidding climate, the status of key subcontract markets, and other local economic conditions. The CM/GC shall determine the division of work to facilitate bidding for and awarding of trade contracts, considering such factors as the bidding climate, improving or accelerating construction completion, minimizing trade jurisdictional disputes, and related issues.

c. The CM/GC shall advise Owner on subcontracting opportunities for State of Oregon-certified minority-owned, women-owned and emerging small business firms ("MWESBs").

3.1.7 The CM/GC shall recommend to Owner and the engineer a schedule for procuring long-lead time items that will constitute part of the Work required to meet the Project schedule, which shall be procured by the CM/GC upon execution of either a GMP Amendment or Early Work Amendment covering the procurement and approval of the schedule by Owner. The CM/GC shall expedite the delivery of long-lead time items.

3.1.8 The CM/GC shall work with Owner in identifying critical elements of the Work that may require special procurement processes, such as prequalifying offerors or alternative contracting methods.

3.1.9 Deliverables:

In addition to the Work described above, the CM/GC shall develop and produce the following reports and deliverables:

a. Subsurface Exploration Plan

b. Subcontractor Selection Plan

c. Material and Equipment Sourcing Plan

d. Worker and Public Safety Plan

e. Risk Management Plan

f. Comments, input, and support that will be incorporated into the Value Engineering Report (the CM will not be creating the actual document)

3.2 Construction Phase Services.

3.2.1 Upon execution of an Early Work Amendment or GMP Amendment, the CM/GC shall provide Construction Phase Services as provided in the Contract Documents, including, without limitation, providing and paying for all materials, tools, equipment, labor and professional and non-professional services, and performing all other acts and supplying all other things necessary to fully and properly perform and complete the Work, as required by the Contract Documents; and to furnish to Owner a complete, fully functional Project, capable of being legally occupied and fully used for its intended purposes upon completion of the Contract (or, with respect to an Early Work Amendment, to furnish such Work as is described in the Early Work Amendment). Construction Phase Services include CM Services performed during the Construction Phase.

3.2.2 Notwithstanding any other references to Construction Phase Services in this Contract, the Contract includes Preconstruction Phase Services only unless (i) the parties execute a GMP Amendment or (ii) the parties execute an Early Work Amendment of the character described below.

3.2.3 The parties may execute one or more Early Work Amendments that identify specific Construction Phase Services that must be performed before establishing the GMP, without exceeding a not-to-exceed budget, a maximum not-to-exceed price, or a fixed price ("Early Work Price") that is stated in the Early Work Amendment. The Early Work Amendment must include all necessary governmental approvals required for the Early Work. If the Early Work Price is a not-to-exceed budget, then the CM/GC shall perform the Early Work only to the extent that the Cost of the Work, together with the CM/GC Fee, does not exceed the Early Work Price. If the CM/GC performs Early Work in accordance with a maximum not-to-exceed price or a fixed price and the CM/GC incurs a cost in excess of the maximum not-to-exceed price or fixed price, respectively, the CM/GC shall complete the Early Work and pay the excess cost without reimbursement. If one or more Early Work Amendments are executed, the CM/GC shall diligently continue to work toward developing a GMP Amendment that is acceptable to Owner and incorporates the Early Work Amendments. If Owner thereafter terminates the Contract before executing a GMP Amendment, the provisions of Section J. of the Marion County General Conditions apply.

3.2.4 Before the Construction Phase begins, and in any event not later than the parties execute the GMP Amendment, the CM/GC shall provide to Owner a full performance bond and a payment security bond as required by Section G of the Marion County General Conditions that together are equivalent to the amount of the GMP. If an Early Work Amendment is executed, CM/GC shall provide a bond in the amount of the Early Work Price under the Early Work Amendment. The CM/GC shall provide to Owner additional or replacement bonds at the time the parties execute

any subsequent Early Work Amendment or GMP Amendment, in each case before executing the Amendment and before any labor or materials are supplied to perform the Work covered by the Amendment, and in each case in an amount that equals or exceeds the total Early Work Price or the GMP, as the case may be. In the event of a Scope Change (as defined in Section 1.25 of this CM/GC Contract) that increases the GMP, the CM/GC shall provide to Owner an additional or supplemental bond in the amount of the increase before performing the additional Work.

3.2.5 As provided in Section C of the Marion County General Conditions, the CM/GC and all subcontractors shall comply with ORS 279C.800 through 279C.870. The Oregon Bureau of Labor and Industries (BOLI) prevailing wage rates that will apply to the Contract shall be the prevailing wage rates that are in effect at the time the first Early Work Amendment is executed or, if there is no Early Work Amendment, then the prevailing wage rates that are in effect at the time the GMP Amendment is executed. Once established, the prevailing wage rates are in effect for the remainder of the Contract. The prevailing wage rates that will apply will be those set forth in the then current version of the following BOLI booklet, together with any amendments to that booklet: "PREVAILING WAGE RATES for Public Works Contracts in Oregon". For purposes of calculating the prevailing wage rates for the Project, the Construction Phase Services take place in Marion County, Oregon.

3.3 Construction Management (CM) Services

Throughout the Preconstruction Phase and Construction Phase of the Project, the CM/GC shall provide CM Services, generally consisting of coordinating and managing the building process as an independent contractor, in cooperation with Owner, the engineer and other designated Project consultants. CM Services include, but are not limited to:

3.3.1 Providing all Preconstruction Phase Services described above and as outlined in the RFP documents.

3.3.2 Implementing the CM/GC Safety Plan, including ensuring that all Subcontractors, suppliers, and other participants in the Project comply with the plan and reporting any incidents promptly to Owner.

3.3.3 Allowing access to the Project site for tours by representatives of Owner, the architect, the engineer, and other personnel as approved by Owner and providing personal protective equipment for tour participants.

3.3.4 Developing and delivering schedules, preparing construction estimates, performing constructability review, analyzing alternative designs, studying labor conditions, coordinating and communicating the activities of each of the construction principals (including Owner, Owner's Authorized Representative, the A/E Service Provider [as defined in the A/E Contract], Subcontractors, suppliers and governmental agency representatives assigned to the Project (the "Construction Principals") throughout the Construction Phase to other Construction Principals.

3.3.5 Continuously monitoring the Project schedule and recommending adjustments to ensure completion of the Project in the most expeditious manner possible.

3.3.6 Working with Owner and the engineer to analyze the design, participate in decisions regarding construction materials, methods, systems, phasing, and costs, and suggest modifications to achieve the goals of providing Owner with the highest quality Project within the budget, GMP and schedule.

3.3.7 Providing VE services ongoing throughout the Project. The CM/GC shall develop cost proposals, in the form of additions to or deductions from the GMP, including detailed documentation to support such adjustments, and shall submit such proposals to Owner and the Construction Principals for approval. The CM/GC acknowledges that VE services are intended to improve the value received by Owner with respect to the first cost and life cycle cost of the Project. The CM/GC shall hold and conduct periodic meetings with Owner and the engineer to coordinate, update and ensure progress of the Work.

3.3.8 Submitting monthly written report(s) to Owner. Each report must include, but not be limited to, Project updates including (i) actual costs and progress for the reporting period as compared to the estimate of costs; (ii) explanations of significant variations; (iii) work completed; (iv) a monthly Project schedule update, with a narrative explaining any line item changes in the Project schedule and a recovery plan for recuperating schedule delays; (v) work in progress; (vi) changes in the Work; (vii) material and equipment delivery status; (viii) man-loading information; and (ix) other information as Owner determines is appropriate. The CM/GC shall provide oral or written updates to Owner as the CM/GC deems appropriate or as Owner requests.

3.3.9 Maintaining a daily log containing a record of weather, Subcontractors working on the site, the number of workers, Work accomplished, problems encountered, safety violations and incidents of personal injury and property damage, and other similar relevant data as Owner may reasonably require. The daily log shall be available to Owner and the engineer on request.

3.3.10 Developing and implementing a system of cost control for the Work that is acceptable to Owner, including regular monitoring of actual costs for activities in progress and estimates for uncompleted tasks and proposed changes. The CM/GC shall identify variances between actual and estimated costs and report the variances to Owner, the engineer and the engineer at regular intervals; maintaining an accurate system to propose and account for contingency utilization throughout the Project; maintaining an accurate system to account for usage of Allowances included in the GMP; providing detailed cost information, contingency utilization and Allowances usage to Owner on a minimum of a monthly basis.

3.3.11 Cooperating with any and all consultants hired by Owner.

3.3.12 Cooperating with inspection authorities and obtaining necessary permits for construction; ensuring close-out of all permits; obtaining temporary permits as needed for placing equipment in operations and commissioning; and supporting the engineer and Owner as needed to secure final permits.

3.3.13 Preparing and submitting monthly payment applications for the engineer and Owner to review in accordance with Owner's accounting standards and Project procedures and participating in reviews and reconciliations of monthly payment applications with Owner's staff.

3.3.14 Preparing, implementing, and documenting Owner's training program for all building systems and features.

3.3.15 Facilitating and participating in Owner's move-in to the Project as required by the Contract Documents.

3.3.16 At Owner's request, cooperating and performing warranty and inspection Work for the Project through the expiration date of the applicable warranty period(s).

3.3.17 Incorporating commissioning and inspection agents' activities into the Project schedule and coordinating Subcontractors required to participate in the commissioning and inspection process. Cooperating with and supporting the activities of Owner's commissioning agent. Identifying a commissioning team that consists of a CM/GC test engineer and representatives of the major Subcontractors to plan, execute, and document commissioning activities in accordance with the Contract Documents.

3.3.18 Implementing all other testing activities required by the Contract Documents.

3.3.19 Performing all other obligations and providing all other services set forth in the Contract Documents; and performing all other acts and supplying all other things necessary to fully and properly perform and complete the Work as required by the Contract.

ARTICLE 4
RELATIONSHIP AND ROLES OF THE PARTIES

4.1 Independent Contractor
The CM/GC is an independent contractor and not an officer, employee, or agent of Owner as those terms are used in ORS 30.265.

4.2 Performance of Work
The CM/GC covenants with Owner to cooperate with the engineer and Owner and to utilize the CM/GC's professional skill, efforts and judgment in furthering the interests of Owner; to furnish efficient business administration and supervision; to furnish, at all times, an adequate supply of workers and materials; and to perform the Work in conformance with the terms and conditions of the Contract Documents and in an expeditious and economical manner consistent with the interests of Owner.

4.3 Design Consultants
Owner has a separate contract with the engineer related to the Project. Both the CM/GC and the engineer shall be given direction by Owner through Owner. The CM/GC agrees to support Owner's efforts to create a collaborative and cooperative relationship among the CM/GC, the engineer, other Project consultants, and Owner.

4.4 Forms and Procedures
Owner has developed or may develop procedures and forms for the administration and tracking of the Contract. The CM/GC agrees to abide by those procedures and use those forms.

4.5 CM/GC's Project Staff
The CM/GC's Project staff shall consist of the following personnel:

4.5.1 Project Director and Project Manager: **Tom Paul** shall be the CM/GC's Project Director, and **Jeff Wall** shall be the CM/GC's Project Manager. One or both will supervise and coordinate all Construction Phase and Preconstruction Phase Services of the CM/GC and participate in all meetings throughout the Project term, unless otherwise directed by Owner. The CM/GC represents that each of the Project Director and Project Manager has authority to execute Change Orders and Contract Amendments on behalf of the CM/GC.

4.5.2 Job Superintendent: If Construction Phase Services are requested and accepted by Owner, CM/GC's on-site job superintendent shall be specified in the associated GMP Amendment.

4.6 Key Persons

The CM/GC's personnel identified in Article 4.5 shall be considered Key Persons and shall not be replaced during the Project without the written permission of Owner, which shall not be unreasonably withheld. If the CM/GC intends to substitute personnel, a request must be given to Owner at least 30 days (or such shorter period as permitted by Owner) prior to the intended time of substitution. When replacements have been approved by Owner, the CM/GC shall provide a transition period of at least 10 Business Days, during which the original and replacement personnel shall be working on the Project concurrently. Once a replacement for any of these staff members is authorized, further replacement shall not occur without the written permission of Owner. The Owner, at its sole discretion, may deduct $25,000 from the CM/GC's invoice for each occurrence of replacement of key staff to account for the learning curve to bring new staff up to speed on the project.

ARTICLE 5
DATE OF COMMENCEMENT; SUBSTANTIAL AND FINAL COMPLETION

5.1 Notice to Proceed

If Construction Phase Services are added to the Contract as set forth in Article 3.2, then a notice to proceed will be issued by Owner to begin the designated or full Construction Phase Services ("Notice to Proceed"). It is anticipated that the Notice to Proceed will be issued in or about September 2024. A separate Notice to Proceed shall be issued for any and every Early Work Amendment.

5.2 Completion of Project

The Expiration Date of this agreement is December 31, 2026, unless extended by GMP amendment. The target date for achieving Substantial Completion of the entire Work is November 1, 2026, unless an extension of the expenditure deadline associated with the American Rescue Plan Act (ARPA) is granted by the United States Congress. The exact date for final completion will be determined during pre-construction and established in the GMP amendment.

5.3 Time is of the Essence

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

5.4 Time Extensions

Notwithstanding provisions for Contract time extensions in Section D.2 of the Marion County General Conditions, Owner and the CM/GC agree that timely completion of the Work is essential to the success of the Project, and that approval for a time extension shall be granted only as a last resort. The CM/GC agrees to make every effort to recover "lost" time.

ARTICLE 6
FEES, CONTRACT SUM AND GMP

6.1 Fees; Contract Sum; GMP

Owner shall pay the CM/GC the Preconstruction Fee described in Article 6.2. In addition, for each Early Work Amendment executed by the CM/GC and Owner, Owner shall pay the CM/GC, as payment for the Early Work, an amount equal to the sum of the CM/GC Fee attributable to the Early Work, and the actual cost of all Early Work completed and accepted by Owner, but not exceeding the Early Work Price.

If a GMP Amendment is executed, Owner shall pay the CM/GC, as payment for the Work, the "Contract Sum", which shall equal the sum of the Preconstruction Fee, the CM/GC Fee, the actual Cost of the Work including any Early Work, but not exceeding the GMP.

The GMP shall be determined in accordance with the formula set forth below and as described in Article 6.4. The "Cost of the Work" is defined in Article 8. Costs in excess of the GMP shall be incurred by the CM/GC without reimbursement by Owner. Changes to the GMP shall only be authorized by Amendment or Change Order that includes any necessary governmental approvals, including any approvals by Owner's Legal Counsel.

Preconstruction Fee +	**CM/GC Fee +**	**Estimated Cost of the Work ("ECOW")**	**= GMP**
Pre-Construction Cost Reimbursement Not-to-Exceed $375,218	7.00% of ECOW (paid as Lump Sum)	Includes Cost for GC Work, CM/GC's Contingency, and Owner's allowance	

(Note: Bonds, Insurance, & Builder's Risk are not considered part of the ECOW when Calculating the CM/GC Fee)

6.2 Preconstruction Fee

The Preconstruction Fee shall be payable to the CM/GC on a cost reimbursement or lump sum basis up to a maximum sum of $375,218, which shall cover constructability review, VE, cost estimating, development of the GMP, and all other Preconstruction Phase Services, as described in Article 3 (the "Preconstruction Fee") and Exhibit C, Fee for Preconstruction Services. If the CM/GC's costs for provision of Preconstruction Phase Services exceed the maximum Preconstruction Fee, the CM/GC shall pay such additional cost without reimbursement unless a change order is executed due to change in scope. The CM/GC shall not be entitled to any CM/GC Fee upon the Preconstruction Fee. Owner shall pay the Preconstruction Fee on a cost-reimbursement or lump sum basis with each application for payment during the Preconstruction Phase. If the total actual Preconstruction Fee is less than the maximum Preconstruction Fee used for initial calculation of the GMP as provided above, the GMP shall be reduced by the difference; provided that Owner may direct, instead, that any unapplied portion of the maximum Preconstruction Fee be applied to Construction Phase Services, in which case the GMP shall not be reduced by the portion so applied.

6.3 Establishment of CM/GC Fee; Adjustments to CM/GC Fee.

6.3.1 The "CM/GC Fee" shall be a fixed dollar lump sum to be identified in the GMP Amendment, and shall be calculated as 7.00% of the ECOW at the time of establishment of the GMP. In making such calculation, the ECOW shall exclude the Preconstruction Fee, Performance and Payment Bonds, Commercial General Liability "CCIP", and Professional Liability Insurance, Builder's Risk Insurance, the CM/GC Fee itself, and any other cost or charge that this CM/GC Contract states is not to be included in calculating the CM/GC Fee, but shall include Allowances, selected alternates, Maximum Cost for GC Work, and reasonable CM/GC contingencies as designated in the GMP Supporting Documents. The CM/GC Fee is inclusive of profit, overhead, and all other indirect or non-reimbursable costs. No additional markup will be paid to the CM/GC for change order or force account work or for subcontracted labor or materials, notwithstanding anything to the contrary in the Marion County General Conditions. Owner shall pay the CM/GC Fee ratably with each application for payment during the Construction Phase. In the case of Early Work, the CM/GC Fee shall be the above percentage multiplied by the actual Cost of the Early Work, until such time as a GMP Amendment is executed, at which time such CM/GC Fee payments shall be credited against the CM/GC Fee fixed therein.

6.3.2 Notwithstanding any provision of Section D.1.3 of the Marion County General Conditions to the contrary, and unless the parties agree in writing to the contrary, any Amendment or Change Order that increases or decreases the GMP shall adjust the CM/GC Fee then in effect by multiplying the percentage shown in Article 6.3.1 by the change in the Estimated Cost of Work (ECOW) reflected in such approved Amendment or Change Order. In addition, if the Contract is terminated for any reason prior to full completion of the Work (including, without limitation, termination during or following performance of Early Work), the CM/GC Fee shall be limited to the total CM/GC Fee multiplied by the percentage of Work completed and accepted at the time of termination. The CM/GC Fee shall not be subject to adjustment for any other reason, including, without limitation, schedule extensions or adjustments, Project delays, unanticipated costs, or unforeseen conditions.

6.4 Determination of GMP.

6.4.1 The CM/GC shall deliver to Owner a proposed GMP and GMP Supporting Documents at a time designated by Owner during the Preconstruction Phase. If any actual subcontract Offers (as defined in Article 3.1.6[a]) are available at the time the GMP is being established, CM/GC shall use those subcontract Offers in establishing the GMP.

6.4.2 As the Plans and Specifications (as defined in Section A.1 of the Marion County General Conditions) may not be developed to the stage of biddable design documents at the time the GMP proposal is prepared, the CM/GC shall provide in the GMP for further development of the Plans and Specifications by the engineer that is consistent with the Contract Documents and reasonably inferable therefrom. Such further development does not include such things as changes in scope, systems, kinds and quality of materials, finishes or equipment, all of which, if required, shall be incorporated by Change Order or Amendment with a corresponding GMP adjustment.

6.4.3 The CM/GC shall include with the GMP proposal a written statement of its basis (the "GMP Supporting Documents"), which shall include:

a. A list of the Plans and Specifications, including all addenda thereto and the conditions of the Contract, which were used in preparation of the GMP proposal.

b. A list of Allowances and a statement of their basis.

c. A list of the clarifications and assumptions made by the CM/GC in the preparation of the GMP proposal to supplement the information contained in the Plans and Specifications.

d. The proposed GMP, including a statement of the estimated cost organized by trade categories, allowances, contingency, and the other items and associated fees that comprise the GMP.

e. The Date of Substantial Completion upon which the proposed GMP is based and a schedule of the Construction Documents issuance dates upon which the date of Substantial Completion is based.

6.4.4 The CM/GC shall meet with Owner and the engineer to review the GMP proposal and the written statement of its basis. If Owner or the engineer discovers any inconsistencies or inaccuracies in the information presented, they shall promptly notify the CM/GC, which shall make appropriate adjustments to the GMP proposal, its basis or both.

6.4.5 Prior to Owner's acceptance of the CM/GC's GMP proposal and issuance of a Notice to Proceed, the CM/GC shall not incur any cost to be reimbursed as part of the Cost of the Work, except as specifically provided in an Early Work Amendment.

6.4.6 Owner shall authorize and cause the engineer to revise the Plans and Specifications to the extent necessary to reflect the agreed-upon assumptions and clarifications contained in the GMP Amendment. Such revised Plans and Specifications shall be furnished to the CM/GC in accordance with schedules agreed to by Owner, the engineer and the CM/GC. The CM/GC shall promptly notify the engineer and Owner if such revised Plans and Specifications are inconsistent with the agreed-upon assumptions and clarifications.

6.4.7 The GMP shall include in the ECOW only those taxes that are enacted at the time the GMP is established.

6.4.8 The ECOW shall include the CM/GC's contingency, a sum established by the CM/GC for the CM/GC's exclusive use to cover additional development of Plans and Specifications and unanticipated costs and unforeseen conditions which are properly reimbursable as a Cost of the Work but which are not the basis for a Change Order. For purposes of the CM/GC's contingency, unanticipated costs and unforeseen conditions include Work within the scope of the Project and any conditions that the CM/GC reasonably should have anticipated might be encountered in a project of this size and complexity. The CM/GC shall provide advance, written notice to Owner each time the CM/GC proposes to use its contingency and shall include in the notice the proposed purpose for such use and those approved for use in advance by Owner.

6.4.9 The CM/GC shall work with the engineer and Owner to identify and confirm components and systems not specifically shown but required for a complete, fully functional Project. Owner will direct the engineer to complete the final Construction Documents in accordance with the Project scope agreed upon by all parties at the time the GMP is established.

6.4.10 Notwithstanding the level of detail represented in the GMP Supporting Documents, the CM/GC shall represent and warrant, at the time that it submits the GMP, that the GMP includes the entire cost of all components and systems required for a complete, fully functional Project.

6.4.11 In developing the GMP, the CM/GC shall include and identify such contingencies and allowances within the GMP as may be necessary to pay for unanticipated costs and unforeseen conditions that are required for a complete, fully functional Project.

6.5 Failure to Furnish an Acceptable GMP

If the CM/GC does not furnish a GMP acceptable to Owner within Owner's Target GMP Range (stated on the cover page of this CM/GC Contract), or if Owner determines at any time in its sole discretion that the parties may fail to reach a timely agreement on a GMP acceptable to Owner, Owner may terminate the Contract without liability, and the CM/GC shall not receive additional compensation beyond the Preconstruction Fee under the Contract and sums due under any Early Work Amendment. Termination under this provision shall proceed under Section J.5 of the Marion County General Conditions as a termination for Owner's convenience. The CM/GC further agrees that Owner shall not be liable for any damages whether actual, consequential or otherwise for termination of the Contract under this provision.

6.6 Acceptance of GMP

Upon acceptance of the GMP by Owner, the parties shall execute a GMP Amendment.

6.7 Owner Savings

If the sum of the Preconstruction Fee, plus the CM/GC Fee, plus the actual and final Cost of the Work (the Contract Sum as defined in Article 6.1), is less than the GMP, the savings shall accrue to Owner.

6.8 Allowance Work.

6.8.1 The CM/GC shall not perform any Allowance Work without prior approval by Owner or execution of a Change Order approving the Allowance Work and the price thereof.

6.8.2 Owner shall be entitled to apply any Allowance line items that have not been fully expended to other line-item Allowances that have been fully expended, without any resulting increase in the GMP.

6.8.3 If the total Cost of the Allowance Work exceeds the total Allowances within the GMP, the CM/GC shall not perform any Allowance Work in excess of such amount until either (i) the parties agree that the additional Allowance work will be performed within the then-current GMP or (ii) a GMP Amendment is executed to increase the GMP by the excess cost of the Allowance work.

6.8.4 If, at the Final Completion of the Project, any portion of the Allowance funds remains unexpended, the GMP shall be reduced by a corresponding amount via a Change Order or Amendment.

6.9 Reallocating Projected Cost Underruns after Bid (Offer) Buyout

As soon as possible after the awarding of the Work to the primary Subcontractors, the CM/GC shall review projected costs and provide Owner with a buy-out status report showing any projected cost underruns, reconciling accepted Offers and other reasonably anticipated costs, to the cost estimate used by the CM/GC to establish the GMP. The CM/GC shall include with its report any underlying documentation requested by Owner and used to develop or support such report. The CM/GC shall also consider the reduced risk associated with known subcontracting costs, and the impact that reduced risk has on the amount of the CM/GC's Contingency. The parties shall negotiate in good faith to execute a Change Order transferring an appropriate portion of any projected cost underruns to an Owner-controlled contingency fund to be held within the GMP to pay for additional costs arising from (a) any Owner-directed or approved change to the Work, (b) schedule changes that would otherwise entitle the CM/GC to an increase in the GMP, (c) Allowance items after exhaustion of all Allowances, (d) selection by Owner of more expensive alternates than those used for calculation of the GMP, (e) Owner selection of substitutions that increase the Cost of the Work, or (f) any other costs which otherwise would entitle the CM/GC to an increase in the GMP. Any transfer of projected cost underruns from the CM/GC's contingency to the Owner-controlled contingency fund will not affect the CM/GC's obligation to furnish Owner with a complete, fully functional Project ready for its intended use within the GMP, without use of the funds transferred to the Owner-controlled contingency fund, unless such funds are released by Owner for the purposes set forth in (a) through (f) of this Article 6.9. Any transfer of funds to the Owner-controlled contingency fund will not reduce the CM/GC Fee, nor will any subsequent release and use of funds from the Owner-controlled contingency fund for the purposes set forth in (a) through (f) of this Article 6.9 increase the CM/GC Fee.

ARTICLE 7

CHANGES IN THE WORK

7.1 Price Adjustments

Adjustments to the Estimated Cost of the Work required by changes in the Work shall be determined by any of the methods listed in Section D of the Marion County General Conditions, except that, unless the adjustment is based upon fixed pricing or unit pricing:

7.1.1 The overhead and profit markup for the CM/GC shall be limited to the CM/GC Fee adjustment, if any, permitted under Article 6.3.2 of this CM/GC Contract;

7.1.2 The increase or decrease in the Estimated Cost of the Work, other than for subcontract work, shall be calculated pursuant to Articles 8 and 9 of this CM/GC Contract, instead of being based on the CM/GC's Direct Costs as defined in the Marion County General Conditions; and

7.1.3 In calculating adjustments to subcontracts, unless the parties agree otherwise, the change shall be limited to the Subcontractor's Direct Costs plus the supplemental mark-up provided in Section D of the Marion County General Conditions, and shall not be modified by Articles 8 and 9 of this CM/GC Contract.

7.2 Adjustments to GMP

Adjustments to the GMP after execution of the GMP Amendment may be made only (i) in the event of Scope Changes or (ii) as otherwise expressly provided in this CM/GC Contract, and then only in accordance with the following procedure:

7.2.1 The CM/GC shall review subsequent iterations of the Plans and Specifications as they are prepared to determine whether, in the opinion of the CM/GC, they result in a Scope Change so that it can be determined if an adjustment to the GMP is warranted.

7.2.2 Changes to the GMP shall be initiated by written notice by one party to the other ("GMP Change Request"). The CM/GC shall deliver any such GMP Change Request to the engineer and Owner promptly after becoming aware of any Scope Change if, in the CM/GC's opinion, it constitutes grounds for adjustment of the GMP. Any GMP Change Request shall include a proposal as to the appropriate GMP adjustment with respect to the Scope Change at issue.

7.2.3 The CM/GC shall submit its GMP Change Requests as soon as possible, and the CM/GC shall not be entitled to claim a GMP increase unless the CM/GC submitted a GMP Change Request to Owner and to engineer within the earlier of (a) 14 days after the CM/GC has received the information constituting the basis for the claim, or (b) as to Work not yet bid or proposed, prior to submission of solicitations for such Work and as to Work already solicited, prior to commencement of the portion of the Work for which the CM/GC intends to claim a Scope Change; and (c) in any event, prior to the CM/GC's signing of a Change Order for the Scope Change.

7.2.4 Owner may, at any time, submit a GMP Change Request requesting a reduction of the GMP, which shall include Owner's basis for such request, which may include, for example, reduction of the CM/GC's Contingency after further development of the Plans and Specifications that form the basis for the original GMP Amendment, and/or unused Allowances.

7.2.5 The CM/GC shall work with engineer to reconcile all differences in its GMP Change Request with the engineer within seven days from the date of submission of the GMP Change Request. "Reconciled" means that the CM/GC and the engineer have verified that their assumptions about

the various categories are the same, and that they have identified the reason for differences in the GMP Change Request and the engineer's position. The CM/GC shall submit the Reconciled GMP Change Request to Owner, which submission shall be a condition to any CM/GC claim for a GMP increase.

7.2.6 If the Reconciled GMP Change Request is not acceptable to Owner, the CM/GC agrees to work with Owner and the engineer to provide a GMP Change Request that is acceptable to Owner.

7.2.7 The CM/GC agrees to make all records, calculations, drawings and similar items relating to GMP Change Request available to Owner and to allow the engineer and Owner access and opportunity to view such documents at the CM/GC's offices. Upon Owner's reasonable notice, the CM/GC shall deliver two copies of such documents to Owner and the engineer at any regular meeting or at the Site.

7.2.8 GMP increases, if any, shall not exceed the increased Cost of the Work arising from the Scope Change (whether based on agreed fixed pricing, or the estimated Cost of the Work increase based on cost-reimbursable pricing), reconciled in accordance with the above provisions, as arising from the incident justifying the GMP increase, plus or minus the CM/GC Fee applicable to such change in the Cost of the Work.

7.2.9 Except as provided in this Article 7.2, adjustments to the GMP shall be reconciled in accordance with Section D of the Marion County General Conditions.

7.3 Execution by Owner

The engineer has no authority to execute Change Orders or Amendments on behalf of Owner, and only duly authorized personnel of Owner may do so.

ARTICLE 8
COST OF THE WORK
(To Be Reimbursed)

8.1 Cost of the Work

The term "Cost of the Work" means, and the costs properly reimbursable as a Cost of the Work are, those costs that are directly related to the Project, necessarily and reasonably incurred by the CM/GC in the proper performance of the Work, and specifically and expressly described in this Article 8. Cost of the Work does not include the Costs Excluded from Cost of the Work as set forth in Article 9.

8.2 Labor Costs

The Cost of the Work includes the following Labor Costs:

8.2.1 Wages of construction workers directly employed by the CM/GC to perform the construction of the Work at the site.

8.2.2 Wages and salaries of the CM/GC's supervisory and administrative personnel (i) stationed at the site, or (ii) engaged at factories, workshops or on the road, in expediting the production or transportation of materials or equipment required for the Work with Owner, or otherwise engaged and off the site when specifically related to the Project, and (iii) under either clause (i) or (ii), only with Owner's prior written approval and only for that portion of their time directly required for the Work.

8.2.3 Fringe benefit costs paid or incurred by the CM/GC for taxes, insurance, contributions, assessments and benefits required by law or collective bargaining contracts and, for personnel not covered by such contracts, customary benefits such as sick leave, medical and health benefits, holidays, vacations and pensions, provided such costs are based on wages and salaries included in the Cost of the Work under Articles 8.2.1 and 8.2.2.

8.3 Subcontract Costs

The Cost of the Work includes the following Subcontract Costs:

The CM/GC's actual payment to Subcontractors pursuant to the CM/GC's contract with such Subcontractor for the Work on the Project. No amount paid by or payable to any such Subcontractor other than the fixed or cost reimbursement price of its subcontract shall be included in the Cost of the Work, unless otherwise approved in writing by Owner.

8.4 Costs of Materials and Equipment Incorporated in the Work or Stored On Site

The Cost of the Work includes the following Incorporated Materials and Equipment Costs:

8.4.1 Costs, including transportation, of materials and equipment incorporated or to be incorporated in the completed Work.

8.4.2 Costs of materials in excess of those actually installed, but required to provide reasonable allowance for waste and for spoilage. Unused excess materials, if any, shall be delivered to Owner at the completion of the Work or, at Owner's option, shall be sold or otherwise disposed of by the CM/GC. Any sale shall be commercially reasonable, and the CM/GC shall provide accounting for such a sale within 15 days of the transaction. Net amounts realized, if any, from such sales shall be credited to Owner as a deduction from the Cost of the Work.

8.5 Costs of Miscellaneous Equipment and Other Items; Equipment Rental Charges

The Cost of the Work includes the following Miscellaneous Equipment Costs and Equipment Rental Charges:

8.5.1 Costs, including transportation, installation, maintenance, dismantling and removal, of materials, supplies, temporary facilities, machinery, equipment, and hand tools not customarily owned by the construction workers, which are provided by the CM/GC at the site and fully consumed in the performance of the Work; and cost less salvage value on such items if not fully consumed, whether sold to others or retained by the CM/GC; provided that Owner at Owner's option may require that the CM/GC deliver to Owner (at no charge) at the end of the Project any of such items procured for this Project. Cost for items previously used by the CM/GC shall mean fair market value. The CM/GC shall charge no additional administrative or other mark-up for purchased items. The CM/GC shall document all small tools purchased for the Project via invoices in monthly billing, and shall document the disposition of small tools which have an individual price that exceeds $100. A copy of such disposition log shall accompany the payment application whenever these items are included in the application.

8.5.2 Rental charges for temporary facilities, machinery, equipment and hand tools not customarily owned by the construction workers, which are provided by the CM/GC at the site, whether rented from the CM/GC or others, and costs of transportation, installation, minor repairs and replacements, dismantling and removal thereof. Rates and quantities of equipment rented shall be according to industry standards, shall not exceed 100% of the rental rates published from time to time in the Rental Rate Blue Book for Construction Equipment, prepared by Machinery Information Division of Primedia Information, Incorporated in effect at the time of rental, shall

not exceed acquisition costs, and for individual items exceeding $500.00, will be subject to Owner's prior approval. The CM/GC shall deliver to Owner a list of published rates from time to time at Owner's request. For all items rented or leased, the CM/GC shall charge Owner only the rental charge incurred by the CM/GC with no additional administrative or other mark-up. The CM/GC shall make efforts and use its best skills and judgment to procure equipment in the most expeditious and economical manner consistent with the interest of Owner. Efforts shall include, but not be limited to, providing Owner with a rent/buy analysis so that Owner may elect for the CM/GC to procure the item in lieu of rental if the facility, machinery or equipment at issue is expected to be rented for six months or longer. Such rent/buy analysis shall include, where available, a leasing rate commensurate with the expected term of rental of the facility, machinery or equipment at issue.

8.5.3 Costs of removal of debris from the site.

8.5.4 Cost of long-distance telephone calls, communication devices, postage and parcel delivery charges, telephone service at the site and reasonable petty cash expenses of the site office, which are solely for the benefit of the Work.

8.5.5 That portion of the travel and subsistence expenses of the CM/GC's personnel determined by Owner to be reasonable and necessary as approved by Owner, at Owner approved rates, incurred while traveling in discharge of duties connected with the Work. Main office staff travel shall not be reimbursed unless approved in advance by Owner. These travel costs shall be reimbursed only to the extent allowed under the State of Oregon travel reimbursement guidelines ("State Travel Rules") applicable to Owner and only at approved State travel rates. The CM/GC personnel who are scheduled to work at the Project site for less than six months may receive a subsistence per diem, if approved by Owner, in accordance with State Travel Rules, if their place of residence is greater than 60 miles from the Project site; provided no such personnel shall be entitled to such per diem reimbursement beyond such six-month period. The CM/GC personnel who live within a 60-mile radius from the Project site shall not be eligible for travel and subsistence expenses.

8.6 Other Costs

The Cost of the Work includes the following Other Costs:

8.6.1 The cost of that portion of premiums for insurance directly attributable to the Contract, including the deductible for builder's all risk insurance, and payment and performance bonds as required by Section G of the Marion County General Conditions.

8.6.2 Sales, Corporate Activity Tax, use or similar excise taxes imposed by a governmental authority which are directly related to the Work and for which the CM/GC is liable.

8.6.3 Fees and assessments for the building permit and for other permits, licenses and inspections for which the CM/GC is required by the Contract Documents to pay.

8.6.4 CM/GC deposits lost for causes other than the CM/GC's fault or negligence.

8.6.5 RESERVED

8.6.6 Costs of drawings, Specifications and other documents required to complete the Work, except as provided by Owner or the engineer.

8.6.7 Other costs incurred in the performance of the Work if and to the extent approved in advance in writing by Owner.

8.7 Costs to Prevent Damage or Injury in Emergencies

The Cost of the Work includes costs which are incurred by the CM/GC in taking action to prevent threatened damage, injury or loss in case of an emergency affecting the safety of persons and property.

8.8 Costs For General Conditions Work

The Cost of the Work includes the Costs for GC Work as defined in Article 1.12. The CM/GC shall be paid on a cost reimbursable maximum not-to-exceed price basis as payment for the GC Work, including all labor, materials, and direct and indirect costs thereof. The maximum not-to-exceed amount for GC Work shall be established in each Early Work Amendment or the GMP Amendment, as applicable. The Cost for GC Work, less 5% retainage thereon, shall be paid monthly on a reimbursable basis over the number of months of the scheduled Construction Phase, including any period of Early Work, commencing with the first progress billing after commencement of the scheduled Construction Phase or Early Work Period. However, no adjustment in the maximum amount payable for GC Work will be made if the actual construction period or Early Work period is shorter or longer than the number of months scheduled for the Construction Phase or Early Work period, unless such period is extended because of an Owner-requested delay or change order.

ARTICLE 9
COSTS EXCLUDED FROM COST OF WORK
(Not To Be Reimbursed)

9.1 Costs Excluded from Cost of Work

The Cost of the Work does not include the costs set forth in this Article 9, and Owner shall not reimburse the CM/GC for the costs herein:

9.1.1 Salaries and other compensation of the CM/GC's personnel stationed at the CM/GC's principal office or offices other than the site office except as allowed under Articles 8.2.2 and 8.2.3.

9.1.2 Expenses of the CM/GC's principal office and offices other than the site office.

9.1.3 Any overhead and general expenses, except as specifically and expressly described in Article 8.

9.1.4 The CM/GC's capital expenses, including interest on the CM/GC's capital employed for the Work.

9.1.5 RESERVED

9.1.6 Costs due to the fault or negligence of the CM/GC, Subcontractors, suppliers, anyone directly or indirectly employed by any of them, or for whose acts any of them may be liable.

9.1.7 The cost of correction of any repair work, nonconforming or defective work, or warranty work.

9.1.8 Merit, safety, or other incentive payments, bonuses or awards, or any expenses in connection therewith, except as otherwise provided in Article 8.

9.1.9 Fines and penalties.

9.1.10 Except for Early Work, the cost of Preconstruction Phase Services.

9.1.11 Any costs in excess of the GMP.

9.1.12 Any costs associated with travel expenses within a 60-mile radius of the Project.

ARTICLE 10
DISCOUNTS, REBATES AND REFUNDS

10.1 Discounts, Rebates and Refunds
Trade discounts, rebates, refunds and net amounts received from sales of surplus materials and equipment shall accrue to Owner, and the CM/GC shall make provisions so that they can be secured.

10.2 Amounts Credited to Owner
Amounts which accrue to Owner in accordance with the provisions of Article 10.1 shall be credited to Owner as a deduction from the Cost of the Work.

ARTICLE 11
SUBCONTRACTS AND OTHER CONTRACTS

11.1 General Subcontracting Requirements.

11.1.1 Other than Work performed pursuant to Articles 11.4 or 11.5 of this CM/GC Contract, the CM/GC shall subcontract the Work to Subcontractors other than the CM/GC and its Affiliates. If the CM/GC elects to bid on any Work, the CM/GC shall inform Owner of its intention to do so prior to the bid date for that Work.

11.1.2 The CM/GC shall take the actions specified in ORS 200.045(2) and (3) to make good faith efforts to subcontract with Minority, Women and Emerging Small Business Enterprises.

11.1.3 The CM/GC shall report to Owner on the results of the good faith efforts of compliance required in Article 11.1.2 following award of all subcontracts. The CM/GC shall also submit monthly reports to Owner listing Work contracted to date with Minority, Women and Emerging Small Business Enterprises.

11.2 CM/GC's Obligations under Subcontracts.

11.2.1 No use of a Subcontractor or supplier shall relieve the CM/GC of any of its obligations or liabilities under the Contract. Except as may expressly otherwise be provided in the Contract, the CM/GC shall be fully responsible and liable for the acts or omissions of all Subcontractors and suppliers including persons directly or indirectly employed by them. The CM/GC shall have sole responsibility for managing and coordinating the operations of its Subcontractors and suppliers, including the settlement of disputes with or between the CM/GC and any such Subcontractor or supplier.

11.2.2 The CM/GC shall include in each subcontract and require each Subcontractor to include in any lower tier subcontract, all provisions necessary to make all of the provisions of the Contract Documents, including Appendix II To Part 200—Contract Provisions For Non-Federal Entity Contracts Under Federal Awards Exhibit B, fully effective as applied to Subcontractors. The CM/GC shall indemnify Owner for any additional cost based on a subcontractor claim which results from the failure of the CM/GC to incorporate the provisions of this CM/GC Contract into

each subcontract. The CM/GC shall provide all necessary Plans, Specifications, and instructions to its suppliers and Subcontractors to enable them to properly perform their work.

11.2.3 Retainage from Subcontractors. Except with Owner's prior approval, payments to Subcontractors shall be subject to retainage of five percent (5%). Owner and the CM/GC shall agree upon a mutually acceptable procedure for review and approval of payments and retainage for Subcontractors.

11.3 Subcontractor Selection.

11.3.1 Unless otherwise provided under this Article 11, the selection of all Subcontractors and suppliers shall be selected through procurement standards set forth in the Uniform Guidance at 2 CFR 200.317 through 2 CFR 200.327, as applicable and. the competitive procurement requirements of ORS Chapter 279C. The process shall conform to the following procedures, in general compliance with the open and competitive nature of public procurement, taking into account industry subcontracting practices.

11.3.2 The CM/GC shall submit to Owner its proposed procurement documents for review and comment before they are issued for solicitation. The CM/GC shall consider and respond to all Owner comments regarding any proposed Offer packages. As Offers are received, the CM/GC shall submit to Owner an Offer comparison in a mutually agreeable form, together with any specific back-up documentation requested by Owner. The competitive process used to award subcontracts by the CM/GC may be monitored by Owner, provided that such monitoring shall not excuse the CM/GC from compliance with the subcontracting requirements of this CM/GC Contract. The CM/GC shall cooperate in all respects with Owner's monitoring. Owner shall be advised in advance of and be given the opportunity to be present at Offer openings, and the CM/GC shall provide him or her with a summary or abstract of all Offers in form acceptable to Owner's Authorized Representative, and copies of particular Offers if requested, prior to the CM/GC's selection of offerors. Prior to opening Offers, the CM/GC agrees to disclose in writing to Owner any financial interest it has in any such Subcontractor, supplier or other contracting party whenever such Subcontractor, supplier or contracting party intends to compete on any Project work, directly or indirectly, including whether such party is an Affiliate of the CM/GC.

11.3.3 The following minimum requirements apply to the Subcontract solicitation process:

a. Solicitations will be advertised at least 10 days prior to opening in the Daily Journal of Commerce and at least one other newspaper specifically targeted to reach the Minority, Women and Emerging Small Business audience. The CM/GC also agrees to advertise in a local community newspaper in the area in which the Project is located, in order to allow for local participation in the solicitation process.

b. Unless specific other prior arrangement has been made with Owner, all Offers will be written, and submitted to a specific location at a specific time. The CM/GC shall timestamp all Offers as received. Subcontractors must be qualified to perform the Work for this Project by being appropriately registered with the State of Oregon Construction Contractors Board.

c. If fewer than three (3) Offers are submitted in response to any solicitation (inclusive of any Offer submitted by the CM/GC), prior written approval by Owner shall be required to accept an Offer.

d. The CM/GC must develop and implement a prequalification process for particular solicitations; followed by selection of successful Offers among those offerors that the CM/GC determines meet the prequalification standards, with Owner's prior written approval of such prequalification process.

e. The CM/GC shall comply, and require Subcontractor compliance with, State of Oregon Bureau of Labor & Industries prevailing wage rates as specified in the RFP.

f. Owner may at its sole discretion, require the CM/GC to re-solicit for Offers based on the same or modified documents.

g. The CM/GC shall review all Offers and shall work with offerors to clarify Offers, reduce exclusions, verify scope and quantities, and seek to minimize work subsequently awarded via the Change Order process.

h. The CM/GC will document any and all discussions, questions and answers, modifications and responses to/from any offeror and ensure that the same are distributed to all offerors, and Owner shall be entitled to inspect such documentation on request.

i. The CM/GC shall determine the lowest Offer for each solicitation that meets the CM/GC's reasonable performance standards for the components of the Work at issue; provided that if the CM/GC determines it is unable to execute a suitable subcontract with such offeror, the CM/GC may, with Owner's prior approval, execute a subcontract with the second-lowest offeror pursuant to Article 11.3.4 below.

11.3.4 Under special circumstances and only with prior written authorization by Owner, Work may be subcontracted on other than a low-price basis, including without limitation, through competitive negotiation. As a condition to its authorization, Owner may require the CM/GC's agreement to establish and implement qualification and performance criteria for offerors, including a scoring system within requests for proposals. Special circumstances include, without limitation, the following: instances where only a single fabricator of materials exists; special packaging requirements for Subcontractor work; design-build work; and instances in which an alternative contracting method can be demonstrated to clearly benefit Owner.

11.3.5 The CM/GC shall notify Owner in writing in advance before award of any proposed Subcontract, which notice shall include summaries in a form acceptable to Owner of all Offers received for the Subcontract at issue. Owner reserves the right to disapprove any proposed Subcontractors, suppliers and Subcontract or supply contract awards, based on legal standards of responsibility.

11.3.6 The CM/GC's subcontracting records shall not be considered public records; provided, however, that Owner, and agencies of the State of Oregon shall retain the right to audit and monitor the subcontracting process in order to protect Owner's interests.

11.4 CM/GC Field Work.

11.4.1 The CM/GC or its Affiliate may provide the CM/GC Field Work required to complete the Project with its own forces, without the necessity of subcontracting such work.

11.4.2 Except as provided in Article 11.4.1, any other portion of the Work proposed to be performed by the CM/GC or any Affiliate, including without limitation provision of any materials, equipment, or supplies, shall be subject to the provisions of Article 11.5.

11.5 Subcontracting by the CM/GC.

11.5.1 Except to the extent otherwise approved in advance in writing by Owner, the CM/GC or its Affiliates may submit an Offer in accordance with Article 11.3 to do Work with its own forces, provided at least 50% of the labor by such work unit is performed by employees of the CM/GC or such Affiliate.

11.5.2 For those items for which the CM/GC or any of its subsidiaries intends to submit an Offer, such intent must be publicly announced with the solicitation for Offers required by Article 11.3.1, and Owner notified in writing. All Offers for this work shall be delivered to Owner and publicly opened by Owner at an announced time, date, and place.

11.6 Protests

The CM/GC, acting as an independent contractor, shall include in the competitive process to award all subcontracts, a protest process for Subcontractors and suppliers that are competing offerors, which process shall be subject to approval by Owner. The CM/GC shall be solely responsible for resolving the procurement protests of Subcontractors and suppliers. The CM/GC shall indemnify, defend, protect and hold harmless Owner from and against any such procurement protests and resulting claims or litigation. The CM/GC shall act as an independent contractor, and not an agent of Owner, in connection with any procurement protest. The provisions of this Article 11 are solely for the benefit of Owner and do not grant any rights or remedies (including third party beneficiary rights) to any offeror or other protester, in connection with any procurement protest or claim.

11.7 Prevailing Wage

If this project meets the requirements under U.S. Treasury's FAQ dated April 27, 2022, section 6.15, the Davis-Bacon Act requirements (prevailing wage rates) do not apply to projects funded solely with ARPA awarded funds. CM/GC and Subcontractor(s) may be otherwise subject to the requirements of Davis-Bacon Act, when APRA funds are used on a construction project in conjunction with funds from another federal program that requires enforcement of the Davis-Bacon Act. State of Oregon Prevailing Wage Laws will apply to these funds.

a. The prevailing wage rate requirements that may apply to the Project are set forth in ORS 279C.800 through 279C.870, the administrative rules promulgated thereunder (OAR Chapter 839, Division 25) and Oregon Laws 2021, chapter 678, section 17 (collectively, state "PWR"), or, if applicable, 40 U.S.C. 3141 et seq. (federal "Davis-Bacon Act"). If applicable, Recipient shall:

i. comply with PWR, require CM/GC and subcontractors to pay the applicable PWR or Davis-Bacon Act rates, as applicable, and to comply with all other Oregon Bureau of Labor and Industries ("BOLI") requirements pursuant to the PWR, including on all contracts and subcontracts and in filing separate public works bonds with the Construction Contractors Board;

ii. pay to BOLI, within the required timeframe and in the appropriate amount, the project fee required by OAR 839-025-0200 to 839-025-0230, including any additional fee that may be owed upon completion of the Project; and

iii. unless exempt under Section 17(2) of Oregon Laws 2021, chapter 678, if Recipient is a "public body" and the Project is a "qualified project," as those terms are defined in Section 17(3) of Oregon Laws 2021, chapter 678, Recipient shall require each contactor in a contract with an estimated cost of $200,000 or greater to:

1) Enter into a project labor agreement that, at a minimum, provides for payment of wages at or above the prevailing rate of wage;

2) Employ apprentices to perform 15 percent of the work hours that workers in apprenticeable occupations perform under the contract, in a manner consistent with the apprentices' respective apprenticeship training programs;

3) Establish and execute a plan for outreach, recruitment and retention of women, minority individuals and veterans to perform work under the contract, with the aspirational target of having at least 15 percent of total work hours performed by individuals in one or more of those groups; and

4) Require any subcontractor engaged by the contractor to abide by the requirements set forth in subparagraphs (i), (ii) and (iii) above, if the work to be performed under the subcontract has an estimated cost of $200,000 or greater.

b. Recipient represents and warrants that it is not on the BOLI current List of Contractors Ineligible to Receive Public Works Contracts and that it will not contract with any contractor on this list.

c. Pursuant to ORS 279C.817, Recipient may request that the Commissioner of BOLI make a determination about whether the Project is a public works on which payment of the prevailing rate of wage is required under ORS 279C.840.

ARTICLE 12
ACCOUNTING RECORDS

12.1 Accounting; Audit Access

The CM/GC shall keep full and detailed accounts and exercise such controls as may be necessary for proper financial management under the Contract; the accounting and control systems shall be satisfactory to Owner. Owner, including accountants and auditors employed by or under contract with OJD and DAS, shall be afforded reasonable and regular access to the CM/GC's records, books, correspondence, instructions, drawings, receipts, subcontracts, purchase orders, vouchers, memoranda and other data relating to the Contract, and the CM/GC shall preserve these for a period of six (6) years after final payment, or for such longer period as may be required by law.

12.2 Periodic and Final Audits

Owner may, at its discretion, perform periodic audits of the Cost of the Work and any other reimbursable costs associated with the Project. Owner intends to conduct a final audit of reimbursable costs prior to the Contract closeout. The CM/GC shall cooperate fully with Owner in the performance of such audits. Disputes over audit findings or conclusions shall be subject to the process set forth in Article 14.4.

ARTICLE 13
PROGRESS PAYMENTS

13.1 Integration with Marion County General Conditions

The requirements of this Article 13 and Article 14 are in addition to, and not in lieu of, the requirements of Section E of the Marion County General Conditions. In the event of conflict between the provisions of Articles 13 and 14 and Section E, as amended, the provision more favorable to Owner shall control in the sole discretion of Owner. Without limitation, the provisions of Articles

13.3 and 13.4 shall control over the corresponding provisions of Section E.2.5 of the Marion County General Conditions.

13.2 Progress Payments

Based upon applications for payment submitted pursuant to Section E of the Marion County General Conditions (as amended by the Supplemental General Conditions), Owner shall make progress payments on account of the Preconstruction Fee, the Cost of the Work, and associated CM/GC Fee, less 5% retainage, to the CM/GC as provided below and elsewhere in the Contract Documents. A progress payment shall not be considered acceptance or approval of any Work or waiver of any defects therein.

13.3 Percentage of Completion

All applications for payment shall show the percentage of completion of each portion of the Work as of the end of the period covered by the application for payment. The percentage of completion shall be the lesser of (i) the percentage of that portion of the Work which has actually been completed; or (ii) the percentage obtained by dividing (a) the expense that has actually been incurred by the CM/GC on account of that portion of the Work for which the CM/GC has made or intends to make actual payment prior to the next application for payment by (b) the share of the GMP allocated to that portion of the Work in the Schedule of Values.

13.4 Calculation of Payment

Subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

13.4.1 Pre-Construction Phase

a. The Preconstruction Fee will be billed on an agreed cost reimbursable or lump sum basis submitted monthly. Provide backup for each payment application that includes breakdowns of labor hours, materials, and all other items of expense to justify reimbursement being requested.

b. These billings will not be subject to retainage described in the Marion County General Conditions.

c. If upon execution of an Early Work Amendment, the Preconstruction Services are not complete, the CM/GC is to submit separate payment applications for Preconstruction Phase Services and Construction Phase Services.

d. The Preconstruction Fee for Preconstruction Phase Services shall not be included in the Construction Phase invoicing until the final application for payment. Include within the final application, a single line item for the final cost reimbursed value determined at the end of the Preconstruction Phase. In no event may the Preconstruction Fee and the cost of Construction Phase Services and all other costs and fees authorized under the Contract exceed the GMP.

13.4.2 Construction Phase

a. Take that portion of the GMP properly allocable to completed Work as determined by multiplying the percentage of completion of each portion of the Work under the Schedule of Values by the share of the GMP allocated to that portion of the Work in the Schedule of Values. Pending final determination of cost to Owner of changes in the Work, any amounts in dispute shall not be included;

b. Add that portion of the GMP properly allocable to materials and equipment delivered and suitably stored and otherwise in compliance with Section E.2.3 of the Marion County General Conditions;

c. Add the CM/GC's Fee. The portion of the CM/GC's Fee payable shall be an amount that bears the same ratio to the CM/GC Fee as the sum of the amounts in Article 13.4.1 and 13.4.2 bears to the estimated probable Cost of the Work described in Article 6.1.2, but in no event causing total CM/GC Fee payments to exceed the total CM/GC Fee;

d. Subtract the aggregate of previous payments made by and retained by Owner;

e. Subtract the shortfall, if any, detailed by the documentation required to substantiate prior applications for payment, or resulting from errors subsequently discovered by Owner in such documentation;

f. Subtract any amounts for which Owner has withheld or denied payment as provided in the Contract Documents; and

g. Subtract 5% retainage on the entire progress payment.

ARTICLE 14
FINAL PAYMENT

14.1 Final Payment Accounting

The CM/GC shall submit to Owner a final detailed accounting of the Cost of the Work together with the CM/GC's final application for payment.

14.2 Calculation of Final Payment

The amount of the final payment shall be calculated as follows:

14.2.1 Take the sum of the CM/GC Fee, plus the Preconstruction Fee, plus the actual Cost of the Work substantiated by the CM/GC's final accounting. Said sum shall not exceed the GMP.

14.2.2 Subtract amounts, if any, for which Owner withholds, in whole or in part, approval of payment.

14.2.3 Subtract the aggregate of previous payments made by Owner to the CM/GC. If the aggregate of previous payments made by Owner exceeds the amount due the CM/GC, the CM/GC shall reimburse the difference to Owner within 30 days, with interest at the rate applicable to Owner payments under Section E.5.1.3 of the Marion County General Conditions.

14.3 Final Payment Review

Owner or its accountants will review and report in writing on the CM/GC's final accounting within 30 days after it is submitted to Owner by the CM/GC. Contingent upon the other conditions of the Contract having been met, Owner will, within 10 Business Days after receipt of the written report of Owner's accountants, either issue to Owner an approval of the CM/GC's final application for payment with a copy to the CM/GC, or notify the CM/GC and Owner in writing of Owner's reasons for withholding approval of any part of the application for payment, which disapproval shall include Owner's estimate of the amount that is due the CM/GC under the application for payment.

14.4 Payment Disputes

If Owner's accountants report the Cost of the Work as substantiated by the CM/GC's final accounting to be less than claimed by the CM/GC or if Owner declines to approve any duly submitted payment request by the CM/GC, or any portion thereof, the CM/GC shall be entitled to demand a review by Owner's Director of Public Works of the disputed amount. Such demand shall be made by the CM/GC within 30 days after the CM/GC's receipt of a copy of the rejection of the application for payment or any portion thereof. Failure to demand review within this 30-day period shall result in a waiver of the CM/GC's right to demand review under this Article, and the substantiated amount as reported by Owner's accountants becoming binding on the CM/GC. In addition, if Owner or any other governmental agency performs a subsequent audit of the Cost of the Work and determines any item therein to have been unsubstantiated or that the CM/GC was otherwise overpaid, Owner may submit a request for reimbursement to the CM/GC for the amount of overpayment. The CM/GC shall have 30 days after delivery of the request for reimbursement by Owner to demand additional review by Owner's Director of Public Works. Failure to make such demand within this 30-day period shall result in waiver of the right to demand review under this Article, and the requested reimbursement becoming unconditionally due and payable by the CM/GC. If the CM/GC timely submits a demand for review to Owner's Director of Public Works, the CM/GC's claim shall be subject to the claims review process in Section D.3 of the Marion County General Conditions. Pending a final resolution, Owner shall pay the CM/GC any outstanding amounts of the application for payment approved by Owner.

14.5 Effect of Payment

Neither approval of an application for payment, a progress payment, release of retainage, final payment, or partial or entire use or occupancy of the Project by Owner shall constitute acceptance of Work not conforming to the Contract Documents, or waiver of the right to assert overpayment.

ARTICLE 15
TERMINATION OR SUSPENSION

15.1 Owner's Right to Terminate Prior to Execution of GMP Amendment

Prior to execution of the GMP Amendment by both parties, Owner may terminate the Contract at any time without cause. Upon such termination, the amount to be paid to the CM/GC shall not exceed the Preconstruction Fee payable to the date of termination, together with amounts payable for Early Work if an Early Work Amendment has been executed. If Owner terminates for convenience during the Preconstruction Phase, Owner shall be entitled to copies of, and shall have the right to use, all work product of the CM/GC and its Subcontractors and suppliers performed to the date of termination, and the CM/GC shall deliver copies of the same to Owner on request.

15.2 Owner's Termination for Convenience after GMP Amendment

After the GMP Amendment is executed by both parties, the Contract may be terminated by Owner without penalty for convenience pursuant to Section J.5 of the Marion County General Conditions, in which case the CM/GC shall be entitled to payment of the amount stated in Article 15.1, together with the actual Cost of the Work completed, plus the CM/GC's Fee prorated based on the actual Cost of the Work completed prior to the date of termination, but in any event not in excess of the GMP.

15.3 Owner's Termination for Cause

In the event of termination of this Agreement by Owner for cause pursuant to Section J.4 of the Marion County General Conditions, the amount, if any, to be paid to the CM/GC, after application of the Marion County General Conditions as adjusted in the Supplemental General Conditions and of Owner's rights and remedies under the Contract, shall not exceed the amount the CM/GC would be entitled to receive under Article 15.2.

15.4 CM/GC Termination for Cause

The CM/GC acknowledges that disputes regarding payments and Change Orders may occur as part of the CM/GC process, and that Owner's declining to pay disputed amounts shall not be grounds for suspension of the Work or termination for cause by the CM/GC. If the CM/GC terminates the Contract for Owner's material breach, the amount to be paid to CM/GC shall not exceed the amount the CM/GC would have been entitled to receive under Article 13 above through termination and demobilization from the Project, with the CM/GC Fee prorated based on the actual Cost of the Work through the date of termination.

15.5 Assignment of Subcontracts

In the event that Owner terminates the Contract with the CM/GC, each subcontract and supply contract for any portion of the Work is hereby irrevocably assigned by the CM/GC to Owner, effective from the date of termination. This assignment is effective only for those subcontracts and supply contracts that Owner accepts by notifying the Subcontractor/supplier and the CM/GC in writing. For those subcontracts and supply contracts accepted by Owner, if the Work has been suspended for more than 30 days, the Subcontractor's/supplier's compensation shall be equitably adjusted for increases in cost resulting from the suspension. Such adjustments shall be subtracted from the amounts owed by Owner to the CM/GC. The CM/GC shall include a provision in each subcontract and supply agreement whereby the Subcontractor/supplier acknowledges Owner's rights under this Article 15.5. With respect to any subcontracts/supply contracts that are not accepted by Owner, the provisions of Section J.6.1 of the Marion County General Conditions shall apply, as adjusted in the Supplemental General Conditions.

ARTICLE 16
REPRESENTATIONS, WARRANTIES AND CERTIFICATIONS

16.1 Representations and Warranties

The CM/GC represents and warrants to Owner as of the effective date of the Contract:

16.1.1 The CM/GC is qualified to do business as a licensed general contractor under the laws of the State of Oregon, and has all requisite corporate power and corporate authority to carry on its business as now being conducted;

16.1.2 The CM/GC has full corporate power and corporate authority to enter into and perform the Contract and to consummate the transactions contemplated hereby; the CM/GC has duly and validly executed and delivered this CM/GC Contract to Owner and the Contract constitutes the legal, valid and binding obligation of the CM/GC, enforceable against the CM/GC in accordance with its terms, except as enforceability may be limited or affected by applicable bankruptcy, insolvency, reorganization, moratorium or other similar laws affecting creditors' rights generally and by general principles of equity (regardless of whether enforceability is considered in a proceeding in equity or at law);

16.1.3 The CM/GC's execution and delivery of this CM/GC Contract and the consummation of the transactions contemplated hereby will not conflict with or result in a material breach of any terms or provisions of, or constitute a material default under, (i) the CM/GC's Articles of Incorporation or Bylaws; (ii) any note, bond, mortgage, indenture, license, lease, contract, commitment, agreement or other instrument or obligation to which the CM/GC is a party or by which the CM/GC may be bound; or (iii) any statute, order, writ, injunction, decree, rule or regulation applicable to the CM/GC;

16.1.4 No material consent, approval, authorization, declaration or other order of, or registration or filing with, any court or regulatory authority or any third person is required for the valid execution, delivery and performance of the Contract by the CM/GC or its consummation of the transactions contemplated hereby;

16.1.5 There is no action, proceeding, suit, investigation or inquiry pending that questions the validity of the Contract or that would prevent or hinder the consummation of the transactions contemplated hereby; and

16.1.6 The CM/GC's Project Director and Project Manager identified in Article 4 are duly appointed representatives, and each has the authority to bind the CM/GC to any and all duties, obligations and liabilities under the Contract Documents and any Amendments thereto.

16.2 Tax Compliance Certification

The individual signing on behalf of the CM/GC hereby certifies and swears under penalty of perjury that s/he is authorized to act on behalf of the CM/GC, s/he has authority and knowledge regarding the CM/GC's payment of taxes, and to the best of her/his knowledge, the CM/GC is not in violation of any Oregon tax laws. For purposes of this certification, "Oregon tax laws" means a state tax imposed by ORS 401.792 to 401.816, ORS 320.005 to 320.150 and 403.200 to 403.250, and ORS chapters 118, 314, 316, 317, 318, 320, 321 and 323; the elderly rental assistance program under ORS 310.630 to 310.706, and local taxes administered by the Department of Revenue under ORS 305.620.

16.3 Federal and State Program Eligibility

The CM/GC represents and warrants that it is not excluded from participation, and is not otherwise ineligible to participate, in a "Federal health care program" as defined in 42 U.S.C. Section 1320a-7b(f) or in any other government payment program. In the event the CM/GC is excluded from participation, or becomes otherwise ineligible to participate in any such program during the term of the Contract, the CM/GC will notify Owner in writing within three (3) days after such event. Upon the occurrence of such event, whether or not such notice is given to Owner, Owner may immediately terminate this Contract for cause pursuant to Article 15.3 upon written notice to the CM/GC. Owner will not make any payments under this Contract during any period of the CM/GC's debarment, ineligibility or exclusion from participation.

ARTICLE 17
MISCELLANEOUS

17.1 Headings

The headings used in this CM/GC Contract are solely for convenience of reference, are not part of the Contract and are not to be considered in construing or interpreting the Contract.

17.2 Merger

The Contract Documents constitute the entire contract between the parties. No waiver, consent, modification or change of terms of the Contract shall bind either party unless made in writing and signed by both parties. Such waiver, consent, modification or change, if made, shall be effective only in the specific instance and for the specific purpose given. There are no understandings, agreements, or representations, oral or written, not specified herein, regarding the Contract. The CM/GC, by signature of its representative, hereby acknowledges that it has read the Contract, understands it and agrees to be bound by its terms and conditions.

17.3 Exemption from Competitive Bidding

The parties acknowledge that the Contract has been awarded under an exemption from competitive bidding requirements pursuant to ORS 279C.335, as authorized by the Legislative Assembly, acting by and through the Legislative Administrator under ORS 173.720, and by County's Board of Commissioners.

CERTIFICATIONS AND SIGNATURE. THIS CONTRACT MUST BE SIGNED BY AN AUTHORIZED REPRESENTATIVE OF CM/GC

The undersigned certifies under penalty of perjury both individually and on behalf of CM/GC is a duly authorized representative of CM/GC, has been authorized by CM/GC to make all representations, attestations, and certifications contained in this Contract and to execute this Contract on behalf of CM/GC.

SLAYDEN CONSTRUCTORS, INC. (CM/GC)

DocuSigned by:
Authorized Representative of CM/GC: Tom Paul 163792E4774E48F... 9/20/2023
Date

Title President

CCB Registration No.: 208848

MARION COUNTY (OWNER)

BOARD OF COMMISSIONERS

Chair 9/13/2023
Date

Commissioner 9.13.2023
Date

Commissioner 9-13-2023
Date

DocuSigned by:
Authorized Signature: Brian Nicholas 9793BA7ACD6D443... 8/28/2023
Department Director or designee Date

DocuSigned by:
Authorized Signature: Jan Fritz DC16351248DE4EC... 9/3/2023
Chief Administrative Officer Date

DocuSigned by:
Reviewed by Signature: Scott Norris 60C98A6F708240B... 9/2/2023
Marion County Legal Counsel Date

DocuSigned by:
Reviewed by Signature: Jeff D White 90EC84E244DF43D... 8/28/2023
Marion County Contracts & Procurement Date

EXHIBIT A

MARION COUNTY
GENERAL CONDITIONS FOR PUBLIC IMPROVEMENT CONTRACTS
September 1, 2014 Edition, Revised February 14, 2022

MARION COUNTY
GENERAL CONDITIONS FOR
PUBLIC IMPROVEMENT CONTRACTS

September 1. 2014 Edition, Revised February 14, 2022

Changes to the General Conditions (including any additions, deletions, or substitutions) should only be made by Supplemental General Conditions, unless the General Conditions are specifically modified in the Public Improvement Agreement (which has a higher order of precedence under Section A.3 of the General Conditions). The text of these General Conditions should not otherwise be altered.

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MARION COUNTY
GENERAL CONDITIONS FOR PUBLIC IMPROVEMENT CONTRACTS
("General Conditions")

SECTION A GENERAL PROVISIONS

A.1 DEFINITION OF TERMS

In the Contract Documents the following terms shall be as defined below:

ARCHITECT/ENGINEER means the Person appointed by the Owner to make drawings and specifications and, to provide contract administration of the Work contemplated by the Contract to the extent provided herein or by supplemental instruction of Owner (under which Owner may delegate responsibilities of the Owner's Authorized Representative to the Architect/Engineer), in accordance with ORS Chapter 671 (Architects) or ORS Chapter 672 (Engineers) and administrative rules adopted thereunder.

CHANGE ORDER means a written order issued by the Owner's Authorized Representative to the Contractor requiring a change in the Work within the general scope of the Contract Documents, issued under the changes provisions of Section D.1 including Owner's written change directives as well as changes reflected in a writing executed by the parties to this Contract and, if applicable, establishing a Contract Price or Contract Time adjustment for the changed Work.

CLAIM means a demand by Contractor pursuant to Section D.3 for review of the denial of Contractor's initial request for an adjustment of Contract terms, payment of money, extension of Contract Time or other relief, submitted in accordance with the requirements and within the time limits established for review of Claims in these General Conditions.

CONTRACT means the written agreement between the Owner and the Contractor comprised of the Contract Documents which describe the Work to be done and the obligations between the parties.

CONTRACT DOCUMENTS means the Solicitation Document and addenda thereto, the Marion County Public Improvement Agreement Form, General Conditions, Supplemental General Conditions, if any, the accepted Offer, Plans, Specifications, amendments, and Change Orders.

CONTRACT PERIOD as set forth in the Contract Documents, means the total period of time beginning with the issuance of the Notice to Proceed and concluding upon Final Completion.

CONTRACT PRICE means the total of the awarded Offer amount, as increased or decreased by the price of approved alternates and Change Orders.

CONTRACT TIME means any incremental period of time allowed under the Contract to complete any portion of the Work as reflected in the project schedule.

CONTRACTOR means the Person awarded the Contract for the Work contemplated.

DAYS are calendar days, including weekdays, weekends, and holidays, unless otherwise specified.

DIRECT COSTS means, unless otherwise provided in the Contract Documents, the cost of materials, including sales tax, cost of delivery; cost of labor, including social security, old age and unemployment insurance, and fringe benefits required by agreement or custom; worker's compensation insurance; project specific insurance (including, without limitation, Builder's Risk Insurance and Builder's Risk Installation Floater); bond premiums, rental cost of equipment, and machinery required for execution of the work; and the additional costs of field personnel directly attributable to the Work.

FINAL COMPLETION means the final completion of all requirements under the Contract, including Contract Closeout as described in Section K but excluding Warranty Work as described in Section I.2, and the final payment and release of all retainage, if any, released.

FORCE MAJEURE means an act, event or occurrence caused by fire, riot, war, acts of God, nature, sovereign, or public enemy, strikes, freight embargoes, pandemics or any other act, event or occurrence that is beyond the control of the party to this Contract who is asserting Force Majeure.

NOTICE TO PROCEED means the official written notice from the Owner stating that the Contractor is to proceed with the Work defined in the Contract Documents. Notwithstanding the Notice to Proceed, Contractor shall not be authorized to proceed with the Work until all initial Contract requirements, including the Contract, performance bond and payment bond, and certificates of insurance, have been fully executed and submitted to Owner in a suitable form.

OFFER means a bid in connection with an invitation to bid and a proposal in connection with a request for proposals.

OFFEROR means a bidder in connection with an invitation to bid and a proposer in connection with a request for proposals.

OVERHEAD means those items which may be included in the Contractor's markup (general and administrative expense and profit) and that shall not be charged as Direct Cost of the Work, including without limitation such Overhead expenses as wages or salary of personnel above the level of foreman (i.e., superintendents and project managers), expenses of Contractor's offices at the job site (e.g. job trailer) including expenses of personnel staffing the job site office, and Commercial General Liability Insurance and Automobile Liability Insurance.

OWNER means Marion County acting by and through the governmental entity identified in the Solicitation Document.

OWNER'S AUTHORIZED REPRESENTATIVE means those individuals identified in writing by the Owner to act on behalf of the Owner for this project. Owner may elect, by written notice to Contractor, to delegate certain duties of the Owner's Authorized Representative to more than one party, including without limitation, to an Architect/Engineer. However, nothing in these General Conditions is intended to abrogate the separate design professional responsibilities of Architects under ORS Chapter 671 or of Engineers under ORS Chapter 672.

PERSON means an entity doing business as a sole proprietorship, a partnership, a joint venture, a corporation, a limited liability company or partnership, or any other entity possessing the legal capacity to contract.

PLANS means the drawings which show the location, type, dimensions, and details of the Work to be done under the Contract.

PUNCHLIST means the list of Work yet to be completed or deficiencies which need to be corrected to achieve Final Completion of the Contract.

RECORD DOCUMENT means the as-built Plans, Specifications, testing and inspection records, product data, samples, manufacturer, and distributor/supplier warranties evidencing transfer to Owner, operational and maintenance manuals, shop drawings, Change Orders, correspondence, certificate(s) of occupancy, and other documents listed in Subsection B.9.1 of these General Conditions, recording all Services performed.

SOLICITATION DOCUMENT means an invitation to bid or request for proposal or request for quotes.

SPECIFICATION means any description of the physical or functional characteristics of the Work, or of the nature of a supply, service, or construction item. Specifications may include a description of any requirement for inspecting, testing, or preparing a supply, service or construction item for delivery and the quantities or qualities of materials to be furnished under the Contract. Specifications generally will state the results or products to be obtained and may, on occasion, describe the method and manner of doing the work to be performed. Specifications may be incorporated by reference and/or may be attached to the Contract.

SUBCONTRACTOR means a Person having a direct contract with the Contractor, or another Subcontractor, to perform one or more items of the Work.

SUBSTANTIAL COMPLETION means the date when the Owner accepts in writing the construction, alteration, or repair of the improvement to real property or any designated portion thereof as having reached that state of completion when it may be used or occupied for its intended purpose.

SUBSTITUTIONS means items that in function, performance, reliability, quality, and general configuration are the same or better than the product(s) specified. Approval of any substitute item shall be solely determined by the Owner's Authorized Representative. The decision of the Owner's Authorized Representative is final.

SUPPLEMENTAL GENERAL CONDITIONS means those conditions that remove from, add to, or modify these General Conditions. Supplemental General Conditions may be included in the Solicitation Document or may be a separate attachment to the Contract.

WORK means the furnishing of all materials, equipment, labor, transportation, services, and incidentals necessary to successfully complete any individual item or the entire Contract and the carrying out of duties and obligations imposed by the Contract Documents.

A.2 SCOPE OF WORK

The Work contemplated under this Contract includes all labor, materials, transportation, equipment, and services for, and incidental to, the completion of all construction work in connection with the project described in the Contract Documents. The Contractor shall perform all Work necessary so that the project can be legally occupied and fully used for the intended use as set forth in the Contract Documents.

A.3 INTERPRETATION OF CONTRACT DOCUMENTS

A.3.1 Unless otherwise specifically defined in the Contract Documents, words which have well-known technical meanings or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings. Contract Documents are intended to be complementary. Whatever is called for in one, is interpreted to be called for in all. However, in the event of conflicts or discrepancies among the Contract Documents, interpretations will be based on the following descending order of precedence:

A.3.1.1 Contract amendments and Change Orders, with those of later date having precedence over those of an earlier date;

A.3.1.2 The Supplemental General Conditions;

A.3.1.3 The Marion County Public Improvement Agreement Form;

A.3.1.4 The General Conditions

A.3.1.5 The Plans and Specifications

A.3.1.6 The Solicitation Document and any addenda thereto;

A.3.1.7 The accepted Offer.

A.3.2 In the case of an inconsistency between Plans and Specifications or within either document not clarified by addendum, the better quality or greater quantity of Work shall be provided in accordance with the Owner or Owner's Authorized Representative's interpretation in writing.

A.3.3 If the Contractor finds discrepancies in, or omissions from the Contract Documents, or if the Contractor is in doubt as to their meaning, the Contractor shall at once notify the Owner or Owner's Authorized Representative. Matters concerning performance under, and interpretation of requirements of, the Contract Documents will be decided by the Owner's Authorized Representative, who may delegate that duty in some instances to the Architect/Engineer. Responses to Contractor's requests for interpretation of Contract Documents will be made in writing by Owner's Authorized Representative (or the Architect/Engineer) within any time limits agreed upon or otherwise with reasonable promptness. Interpretations and decisions of the Owner's Authorized Representative (or Architect/Engineer) will be consistent with the intent of and reasonably inferable from the Contract Documents. Contractor shall not proceed without direction in writing from the Owner's Authorized Representative (or Architect/Engineer).

A.3.4 References to standard specifications, manuals, codes of any technical society, organization or association, to the laws or regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard specification, manual, code, laws or regulations in effect in the jurisdiction where the project is occurring on the first published date of the Solicitation Document, except as may be otherwise specifically stated.

A.4 EXAMINATION OF PLANS, SPECIFICATIONS, AND SITE

A.4.1 It is understood that the Contractor, before submitting an Offer, has made a careful examination of the Contract Documents; has become fully informed as to the quality and quantity of materials and the

character of the Work required; and has made a careful examination of the location and conditions of the Work and the sources of supply for materials. The Owner will in no case be responsible for any loss or for any unanticipated costs that may be suffered by the Contractor resulting from the Contractor's failure to acquire full information in advance regarding all conditions pertaining to the Work. No oral agreement or conversation with any officer, agent, or personnel of the Owner, or with the Architect/Engineer either before or after the execution of this Contract, shall affect or modify any of the terms or obligations herein contained.

A.4.2 Should the Plans or Specifications fail to particularly describe the materials, kind of goods, or details of construction of any aspect of the Work, Contractor shall have the duty to make inquiry of the Owner and Architect/Engineer as to what is required prior to performance of the Work. Absent Specifications to the contrary, the materials or processes that would normally be used to produce first quality finished Work shall be considered a part of the Contract requirements.

A.4.3 Any design errors or omissions noted by the Contractor shall be reported promptly to the Owner's Authorized Representative, including without limitation, any nonconformity with applicable laws, statutes, ordinances, building codes, rules, and regulations.

A.4.4 If the Contractor believes that additional cost or Contract Time is involved because of clarifications or instructions issued by the Owner's Authorized Representative (or Architect/Engineer) in response to the Contractor's notices or requests for information, the Contractor must submit a written request to the Owner's Authorized Representative, setting forth the nature and specific extent of the request, including all time and cost impacts against the Contract as soon as possible, but no later than thirty (30) Days after receipt by Contractor of the clarifications or instructions issued. If the Owner's Authorized Representative denies Contractor's request for additional compensation, additional Contract Time, or other relief that Contractor believes results from the clarifications or instructions, the Contractor may proceed to file a Claim under Section D.3, Claims Review Process. If the Contractor fails to perform the obligations of Sections A.4.1 to A.4.3, the Contractor shall pay such costs and damages to the Owner as would have been avoided if the Contractor had performed such obligations.

A.5 INDEPENDENT CONTRACTOR STATUS

The service or services to be performed under this Contract are those of an independent contractor as defined in ORS 670.600. Contractor represents and warrants that it is not an officer, employee, or agent of the Owner.

A.6 RETIREMENT SYSTEM STATUS AND TAXES

Contractor represents and warrants that it is not a contributing member of the Public Employees' Retirement System and will be responsible for any federal or state taxes applicable to payment received under this Contract. Contractor will not be eligible for any benefits from these Contract payments of federal Social Security, employment insurance, workers' compensation, or the Public Employees' Retirement System, except as a self-employed individual. Unless the Contractor is subject to backup withholding, Owner will not withhold from such payments any amount(s) to cover Contractor's federal or state tax obligations.

A.7 GOVERNMENT EMPLOYMENT STATUS

A.7.1 If this payment is to be charged against federal funds, Contractor represents and warrants that it is not currently employed by the Federal Government. This does not preclude the Contractor from holding another contract with the Federal Government.

A.7.2 Contractor represents and warrants that Contractor is not an employee of the Marion County for purposes of performing Work under this Contract.

SECTION B ADMINISTRATION OF THE CONTRACT

B.1 OWNER'S ADMINISTRATION OF THE CONTRACT

B.1.1 The Owner's Authorized Representative will provide administration of the Contract as described in the Contract Documents (1) during construction (2) until final payment is due and (3) during the one-year period for correction of Work. The Owner's Authorized Representative will act on behalf of the Owner to the extent provided in the Contract Documents, unless modified in writing in accordance with other provisions of the Contract. In performing these tasks, the Owner's Authorized Representative may rely on the Architect/Engineer or other consultants to perform some or all of these tasks.

B.1.2 The Owner's Authorized Representative will visit the site at intervals appropriate to the stage of the Contractor's operations (1) to become generally familiar with and to keep the Owner informed about the progress and quality of the portion of the Work completed, (2) to endeavor to guard the Owner against defects and deficiencies in the Work, and (3) to determine in general if Work is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. The Owner's Authorized Representative will not make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Owner's Authorized Representative will neither have control over or charge of, nor be responsible for the construction means, methods, techniques, sequences, or procedures, or for the safety precautions and programs in connection with the Work.

B.1.3 Except as otherwise provided in the Contract Documents or when direct communications have been specifically authorized, the Owner and Contractor shall endeavor to communicate with each other through the Owner's Authorized Representative or designee about matters arising out of or relating to the Contract. Communications by and with the Architect/Engineer's consultants shall be through the Architect/Engineer. Communications by and with Subcontractors and material suppliers shall be through the Contractor. Communications by and with separate contractors shall be through the Owner's Authorized Representative.

B.1.4 Based upon the Architect/Engineer's evaluations of the Contractor's Application for Payment, or unless otherwise stipulated by the Owner's Authorized Representative, the Architect/Engineer will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

B.2 CONTRACTOR'S MEANS AND METHODS; MITIGATION OF IMPACTS

B.2.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences, and procedures and for coordinating all portions of the Work under the

Contract, unless the Contract Documents give other specific instructions concerning these matters. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences or procedures, the Contractor shall evaluate the jobsite safety thereof and, except as stated below, shall be fully and solely responsible for the jobsite safety of such means, methods, techniques, sequences, or procedures.

B.2.2 The Contractor is responsible to protect and maintain the Work during construction and to mitigate any adverse impacts to the project, including those caused by authorized changes, which may affect cost, schedule, or quality.

B.2.3 The Contractor is responsible for the actions of all its personnel, laborers, suppliers, and Subcontractors on the project. The Contractor shall enforce strict discipline and good order among Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of persons who are unfit or unskilled for the tasks assigned to them.

B.2.4 Contractor agrees that it will commence performance of the Work in a timely manner and will achieve the Contract Times in the Contract Documents.

B.3 MATERIALS AND WORKMANSHIP

B.3.1 The intent of the Contract Documents is to provide for the construction and completion in every detail of the Work described. All Work shall be performed in a professional manner and unless the means or methods of performing a task are specified elsewhere in the Contract Documents, Contractor shall employ methods that are generally accepted and used by the industry, in accordance with industry standards.

B.3.2 The Contractor is responsible to perform the Work as required by the Contract Documents. Defective Work shall be corrected at the Contractor's expense.

B.3.3 Work done and materials furnished shall be subject to inspection and/or observation and testing by the Owner's Authorized Representative to determine if they conform to the Contract Documents. Inspection of the Work by the Owner's Authorized Representative does not relieve the Contractor of responsibility for the Work in accordance with the Contract Documents.

B.3.4 Contractor shall furnish adequate facilities, as required, for the Owner's Authorized Representative to have safe access to the Work including without limitation walkways, railings, ladders, tunnels, and platforms. Producers, suppliers, and fabricators shall also provide proper facilities and access to their facilities.

B.3.5 When required by the specifications the Contractor shall furnish Samples of materials for testing by the Owner's Authorized Representative and include the cost of the Samples in the Contract Price.

B.4 PERMITS

Contractor shall obtain and pay for all necessary permits and licenses, except for those specifically excluded in the Supplemental General Conditions, for the construction of the Work, for temporary obstructions, enclosures, opening of streets for pipes, walls, utilities, environmental Work, etc., as required for the project. Contractor shall be responsible for all violations of the law, in connection with the construction or caused by obstructing streets, sidewalks or otherwise. Contractor shall give all requisite notices to public authorities. The Contractor shall pay all royalties and license fees. The

Contractor shall defend all suits or claims for infringement of any patent or other proprietary rights and save harmless and blameless from loss, on account thereof, Marion County, and its departments, divisions, members, and employees.

B.5 COMPLIANCE WITH GOVERNMENT LAWS AND REGULATIONS

B.5.1 Contractor shall comply with all federal, state, and local laws, codes, regulations and ordinances applicable to the Work and the Contract. Failure to comply with such requirements shall constitute a breach of Contract and shall be grounds for Contract termination. Without limiting the generality of the foregoing, Contractor expressly agrees to comply with the following as applicable: i) Title VI and VII of Civil Rights Act of 1964, as amended; (ii) Section 503 and 504 of the Rehabilitation Act of 1973, as amended; (iii) the Health Insurance Portability and Accountability Act of 1996; (iv) the Americans with Disabilities Act of 1990, as amended; (v) ORS Chapter 659A; as amended (vi) all regulations and administrative rules established pursuant to the foregoing laws; and (vii) all other applicable requirements of federal and state civil rights and rehabilitation statutes, rules and regulations. Owner's performance under the Contract is conditioned upon Contractor's compliance with the provisions of ORS 279C.505, 279C.510, 279C.515, 279C.520, and 279C.530, which are incorporated by reference herein.

B.5.2 Contractor shall comply with all applicable requirements of federal and state civil rights and rehabilitation statutes, rules, and regulations; and

B.5.2.1 Contractor shall not discriminate against Disadvantaged, Minority, Women or Emerging Small Business enterprises, as those terms are defined in ORS 200.005, or a business enterprise that is owned or controlled by or that employs a disabled veteran, as that term is defined in ORS 408.225, in the awarding of subcontracts.

B.5.2.2 Contractor shall maintain, in current and valid form, all licenses and certificates required by law, regulation, or this Contract when performing the Work.

B.5.3 Unless contrary to federal law, Contractor shall certify that it shall not accept a bid from Subcontractors to perform Work as described in ORS 701.005 under this Contract unless such Subcontractors are registered with the Construction Contractors Board in accordance with ORS 701.035 to 701.055 at the time they submit their bids to the Contractor.

B.5.4 Unless contrary to federal law, Contractor shall certify that each landscape contractor, as defined in ORS 671.520(2), performing Work under this Contract holds a valid landscape contractor's license issued pursuant to ORS 671.560.

B.5.5 The following notice is applicable to Contractors who perform excavation Work. ATTENTION: Oregon law requires you to follow rules adopted by the Oregon Utility Notification Center. Those rules are set forth in OAR 952-001-0010 through OAR 952-001-0090. You may obtain copies of the rules by calling the center at (503)232-1987.

B.5.6 Failure to comply with any or all of the requirements of B.5.1 through B.5.5 shall be a breach of Contract and constitute grounds for Contract termination. Damages or costs resulting from such noncompliance shall be the responsibility of Contractor.

B.6 SUPERINTENDENCE

Contractor shall keep on the site, during the progress of the Work, a competent superintendent and any necessary assistants who shall be satisfactory to the Owner and who shall represent the Contractor on the site. Directions given to the superintendent by the Owner's Authorized Representative shall be confirmed in writing to the Contractor.

B.7 INSPECTION

B.7.1 Owner's Authorized Representative shall have access to the Work at all times.

B.7.2 Inspection of the Work will be made by the Owner's Authorized Representative at its discretion. The Owner's Authorized Representative will have authority to reject Work that does not conform to the Contract Documents. Any Work found to be not in conformance with the Contract Documents, in the discretion of the Owner's Authorized Representative, shall be removed and replaced at the Contractor's expense.

B.7.3 Contractor shall make or obtain at the appropriate time all tests, inspections, and approvals of portions of the Work required by the Contract Documents or by laws, ordinances, rules, regulations, or orders of public authorities having jurisdiction. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections and approvals. Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work. The Contractor shall give the Owner's Authorized Representative timely notice of when and where tests and inspections are to be made so that the Owner's Authorized Representative may be present for such procedures. Required certificates of testing, inspection or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor, and promptly delivered to the Owner's Authorized Representative.

B.7.4 As required by the Contract Documents, Work done, or material used without inspection or testing by the Owner's Authorized Representative may be ordered removed at the Contractor's expense.

B.7.5 If directed to do so any time before the Work is accepted, the Contractor shall uncover portions of the completed Work for inspection. After inspection, the Contractor shall restore such portions of Work to the standard required by the Contract. If the Work uncovered is unacceptable or was done without sufficient notice to the Owner's Authorized Representative, the uncovering and restoration shall be done at the Contractor's expense. If the Work uncovered is acceptable and was done with sufficient notice to the Owner's Authorized Representative, the uncovering and restoration will be paid for as a Change Order.

B.7.6 If any testing or inspection reveals failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure, including those of repeated procedures and compensation for the Owner's Authorized Representative's and Architect/Engineer's services and expenses, shall be at the Contractor's expense.

B.7.7 When the United States government participates in the cost of the Work, or the Owner has an agreement with other public or private organizations, or if any portion of the Work is being performed for a third party or near third party facilities, representatives of these organizations have the right to inspect the Work affecting their interests or property. Their right to inspect shall not make them a

party to the Contract and shall not interfere with the rights of the parties of the Contract. Instructions or orders of such parties shall be transmitted to the Contractor, through the Owner's Authorized Representative.

B.8 SEVERABILITY

If any provision of this Contract is declared by a court to be illegal or in conflict with any law, the validity of the remaining terms and provisions shall not be affected, and the rights and obligations of the parties shall be construed and enforced as if the Contract did not contain the particular provision held to be invalid.

B.9 ACCESS TO RECORDS

B.9.1 Contractor shall keep, at all times on the Work site, one record copy of the complete Contract Documents, including the Plans, Specifications, Change Orders and addenda, in good order and marked currently to record field changes and selections made during construction, and one record copy of Shop Drawings, Product Data, Samples and similar submittals, and shall at all times give the Owner's Authorized Representative access thereto.

B.9.2 Contractor shall retain and the Owner and its duly authorized representatives shall have access to, for a period not less than ten (10) years, all Record Documents, financial and accounting records, and other books, documents, papers, and records of Contractor which are pertinent to the Contract including records pertaining to Overhead and indirect costs, for the purpose of making audit, examination, excerpts, and transcripts. If for any reason, any part of the Contract is involved in litigation, Contractor shall retain all such records until all litigation is resolved. The Owner and/or its agents shall continue to be provided full access to the records during litigation.

B.10 WAIVER

Failure of the Owner to enforce any provision of this Contract shall not constitute a waiver or relinquishment by the Owner of the right to such performance in the future nor of the right to enforce any other provision of this Contract.

B.11 SUBCONTRACTS AND ASSIGNMENT

B.11.1 Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound by the terms and conditions of these General Conditions, and to assume toward the Contractor all of the obligations and responsibilities which the Contractor assumes toward the Owner thereunder, unless (1) the same are clearly inapplicable to the subcontract at issue because of legal requirements or industry practices, or (2) specific exceptions are requested by Contractor and approved in writing by Owner. Where appropriate, Contractor shall require each Subcontractor to enter into similar agreements with sub-subcontractors at any level.

B.11.2 At Owner's request, Contractor shall submit to Owner prior to their execution either Contractor's form of subcontract, or the subcontract to be executed with any particular Subcontractor. If Owner disapproves such form, Contractor shall not execute the form until the matters disapproved are resolved to Owner's satisfaction. Owner's review, comment upon or approval of any such form shall not relieve Contractor of its obligations under this Agreement or be deemed a waiver of such obligations of Contractor.

B.11.3 Contractor shall not assign, sell, or transfer its rights, or delegate its responsibilities under this Contract, in whole or in part, without the prior written approval of the Owner. No such written

approval shall relieve Contractor of any obligations of this Contract, and any transferee shall be considered the agent of the Contractor and bound to perform in accordance with the Contract Documents. Contractor shall remain liable as between the original parties to the Contract as if no assignment had occurred.

B.12 SUCCESSORS IN INTEREST

The provisions of this Contract shall be binding upon and shall accrue to the benefit of the parties to the Contract and their respective permitted successors and assigns.

B.13 OWNER'S RIGHT TO DO WORK

Owner reserves the right to perform other or additional work at or near the project site with other forces than those of the Contractor. If such work takes place within or next to the project site, Contractor will coordinate work with the other contractors or forces, cooperate with all other contractors or forces, carry out the Work in a way that will minimize interference and delay for all forces involved, place and dispose of materials being used so as not to interfere with the operations of another, and join the Work with the work of the others in an acceptable manner and perform it in proper sequence to that of the others. The Owner's Authorized Representative will resolve any disagreements that may arise between or among Contractor and the other contractors over the method or order of doing all work (including the Work). In case of unavoidable interference, the Owner's Authorized Representative will establish work priority (including the Work) which generally will be in the sequence that the contracts were awarded.

B.14 OTHER CONTRACTS

In all cases and at any time, the Owner has the right to execute other contracts related to or unrelated to the Work of this Contract. The Contractor of this Contract will fully cooperate with any and all other contractors without additional cost to the Owner in the manner described in section B.13.

B.15 GOVERNING LAW

This Contract shall be governed by and construed in accordance with the laws of the State of Oregon without regard to principles of conflict of laws.

B.16 LITIGATION

Any Claim between Owner and Contractor that arises from or relates to this Contract and that is not resolved through the Claims Review Process in Section D.3 shall be brought and conducted solely and exclusively within the Circuit Court of Marion County for the State of Oregon; provided, however, if a Claim must be brought in a federal forum, then it shall be brought and conducted solely and exclusively within the United States District Court for the District of Oregon. In no event shall this section be construed as a waiver by the Marion County on any form of defense or immunity, whether sovereign immunity, governmental immunity, immunity based on the Eleventh Amendment to the Constitution of the United States or otherwise, from any claim or from the jurisdiction of any court. CONTRACTOR BY EXECUTION OF THIS CONTRACT HEREBY CONSENTS TO THE IN PERSONAM JURISDICTION OF THE COURTS REFERENCED IN THIS SECTION B.16.

B.17 ALLOWANCES

B.17.1 The Contractor shall include in the Contract Price all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct.

B.17.2 Unless otherwise provided in the Contract Documents:

B.17.2.1 when finally reconciled, allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;

B.17.2.2 Contractor's costs for unloading and handling at the site, labor, installation costs, Overhead, profit and other expenses contemplated for stated allowance amounts shall be included in the Contract Price but not in the allowances;

B.17.2.3 whenever costs are more than or less than allowances, the Contract Price shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect

(a) the difference between actual costs and the allowances under Section B.17.2.1 and

(b) changes in Contractor's costs under Section B.17.2.2.

B.17.2.4 Unless Owner requests otherwise, Contractor shall provide to Owner a proposed fixed price for any allowance work prior to its performance.

B.18 SUBMITTALS, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

B.18.1 The Contractor shall prepare and keep current, for the Architect's/Engineer's approval (or for the approval of Owner's Authorized Representative if approval authority has not been delegated to the Architect/Engineer), a schedule and list of submittals which is coordinated with the Contractor's construction schedule and allows the Architect/Engineer reasonable time to review submittals. Owner reserves the right to finally approve the schedule and list of submittals. Submittals include, without limitation, Shop Drawings, Product Data, and Samples which are described below:

B.18.1.1 Shop Drawings are drawings, diagrams, schedules, and other data specially prepared for the Work by the Contractor or a Subcontractor (including any sub-subcontractor), manufacturer, supplier, or distributor to illustrate some portion of the Work.

B.18.1.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

B.18.1.3 Samples are physical examples which illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.

B.18.2 Shop Drawings, Product Data, Samples, and similar submittals are not Contract Documents. The purpose of their submittal is to demonstrate for those portions of the Work for which submittals are required by the Contract Documents the way by which the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents. Review of submittals by the Architect/Engineer is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, or for approval of safety precautions or, unless otherwise specifically stated by the Architect/Engineer, of any construction means, methods, techniques, sequences or procedures, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect/Engineer's review of the Contractor's submittals shall not relieve the Contractor of its obligations under the Contract Documents. The Architect/Engineer's approval of a specific item shall not indicate approval of an assembly of which

the item is a component. Informational submittals upon which the Architect/Engineer is not expected to take responsive action may be so identified in the Contract Documents. Submittals which are not required by the Contract Documents may be returned by the Architect/Engineer without action.

B.18.3 The Contractor shall review for compliance with the Contract Documents, approve and submit to the Architect/Engineer Shop Drawings, Product Data, Samples and similar submittals required by the Contract Documents with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of separate contractors. Submittals which are not marked as reviewed for compliance with the Contract Documents and approved by the Contractor may be returned by the Architect/Engineer without action.

B.18.4 By approving and submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents that the Contractor has determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and has checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

B.18.5 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples or similar submittals until the respective submittal has been approved by the Architect/Engineer.

B.18.6 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Architect/Engineer's review or approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Architect/Engineer in writing of such deviation at the time of submittal and (i) the Architect/Engineer has given written approval to the specific deviation as a minor change in the Work, or (ii) a Change Order has been executed by Owner authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar by the Architect/Engineer's review or approval thereof.

B.18.7 In the event that Owner elects not to have the obligations and duties described under this Section B.18 performed by the Architect/Engineer, or in the event no Architect/Engineer is employed by Owner on the project, all obligations and duties assigned to the Architect/Engineer hereunder shall be performed by the Owner's Authorized Representative.

B.19 SUBSTITUTIONS

The Contractor may make Substitutions only with the consent of the Owner, after evaluation by the Owner's Authorized Representative and only if price or time change must be made through a Change Order, all other substitutions may be communicated through email. Substitutions shall be subject to the requirements of the bid documents. By making requests for Substitutions, the Contractor represents that the Contractor has personally investigated the proposed substitute product; represents that the Contractor will provide the same warranty for the Substitution that the Contractor would for the product originally specified unless approved otherwise; certifies that the cost data presented is complete and includes all related costs under this Contract including redesign costs, and waives all claims for additional costs related to the Substitution which subsequently become apparent; and will coordinate the installation of the accepted Substitution, making such changes as may be required for the Work to be completed in all respects.

B.20 USE OF PLANS AND SPECIFICATIONS

Plans, Specifications, and related Contract Documents furnished to Contractor by Owner or Owner's Architect/Engineer shall be used solely for the performance of the Work under this Contract. Contractor and its Subcontractors and suppliers are authorized to use and reproduce applicable portions of such documents appropriate to the execution of the Work, but shall not claim any ownership or other interest in them beyond the scope of this Contract, and no such interest shall attach. Unless otherwise indicated, all common law, statutory and other reserved rights, in addition to copyrights, are retained by Owner.

B.21 FUNDS AVAILABLE AND AUTHORIZED

Owner reasonably believes at the time of entering into this Contract that sufficient funds are available and authorized for expenditure to finance the cost of this Contract within the Owner's appropriation or limitation. Contractor understands and agrees that, to the extent that in the event the Board of Commissioners of the County reduces, changes, eliminates, or otherwise modifies the funding the cost of this contract, the CONTRACTOR agrees to abide by any such decision, including termination of this agreement.

B.22 NO THIRD-PARTY BENEFICIARIES

Owner and Contractor are the only parties to this Contract and are the only parties entitled to enforce its terms. Nothing in this Contract gives, is intended to give, or shall be construed to give or provide any benefit or right, whether directly, indirectly, or otherwise, to third persons unless such third persons are individually identified by name herein and expressly described as intended beneficiaries of the terms of this Contract.

SECTION C WAGES AND LABOR

C.1 MINIMUM WAGE RATES ON PUBLIC WORKS

Contractor shall comply fully with the provisions of ORS 279C.800 through 279C.870. Documents establishing those conditions, as determined by the Commissioner of the Bureau of Labor and Industries (BOLI), are included as attachments to or are incorporated by reference in the Contract Documents. Contractor shall pay workers at not less than the specified minimum hourly rate of wage, and shall include that requirement in all subcontracts.

C.2 PAYROLL CERTIFICATION; ADDITIONAL RETAINAGE; FEE REQUIREMENTS

C.2.1 In accordance with ORS 279C.845, the Contractor and every Subcontractor shall submit written certified statements to the Owner's Authorized Representative, on the form prescribed by the Commissioner of the Bureau of Labor and Industries, certifying the hourly rate of wage paid each worker which the Contractor or the Subcontractor has employed on the project and further certifying that no worker employed on the project has been paid less than the prevailing rate of wage or less than the minimum hourly rate of wage specified in the Contract, which certificate and statement shall be verified by the oath of the Contractor or the Subcontractor that the Contractor or Subcontractor has read the certified statement, that the Contractor or Subcontractor knows the contents of the certified statement and that to the Contractor's or Subcontractor's best knowledge and belief the certified statement is true. The certified statements shall set out accurately and completely the payroll records for the prior week including the name and address of each worker, the worker's correct classification, rate of pay, daily and weekly number of hours worked, deductions made, and actual wages paid. Certified statements for each week during which the Contractor or Subcontractor has employed a

worker on the project shall be submitted once a month, by the fifth business day of the following month.

The Contractor and Subcontractors shall preserve the certified statements for a period of ten (10) years from the date of completion of the Contract.

C.2.2 Pursuant to ORS 279C.845(7), the Owner shall retain 25 percent of any amount earned by the Contractor on this public works project until the Contractor has filed the certified statements required by section C.2.1. The Owner shall pay to the Contractor the amount retained under this subsection within 14 days after the Contractor files the required certified statements, regardless of whether a Subcontractor has failed to file certified statements.

C.2.3 Pursuant to ORS 279C.845(8), the Contractor shall retain 25 percent of any amount earned by a first-tier Subcontractor on this public works project until the first-tier Subcontractor has filed with the Owner the certified statements required by C.2.1. Before paying any amount retained under this subsection, the Contractor shall verify that the first-tier Subcontractor has filed the certified statement. Within 14 days after the first-tier Subcontractor files the required certified statement the Contractor shall pay the first-tier Subcontractor any amount retained under this subsection.

C.2.4 In accordance with statutory requirements, and administrative rules promulgated by the Commissioner of the Bureau of Labor and Industries, the fee required by ORS 279C.825(1) will be paid by Owner to the Commissioner.

C.3 PROMPT PAYMENT AND CONTRACT CONDITIONS

C.3.1 Pursuant to ORS 279C.505 and as a condition to Owner's performance hereunder, the Contractor shall:

C.3.1.1 Make payment promptly, as due, to all persons supplying to Contractor labor or materials for the prosecution of the Work provided for in this Contract.

C.3.1.2 Pay all contributions or amounts due the State Industrial Accident Fund from such Contractor or Subcontractor incurred in the performance of the Contract.

C.3.1.3 Not permit any lien or claim to be filed or prosecuted against the Owner on account of any labor or material furnished. Contractor will not assign any claims that Contractor has against Owner, or assign any sums due by Owner, to Subcontractors, suppliers, or manufacturers, and will not make any agreement or act in any way to give Subcontractors a claim or standing to make a claim against the Owner.

C.3.1.4 Pay to the Department of Revenue all sums withheld from employees pursuant to ORS 316.167.

C.3.1.5 Demonstrate that an employee drug testing program is in place as follows:

(a) Contractor represents and warrants that Contractor has in place at the time of the execution of this Contract, and shall maintain during the term of this Contract, a Qualifying Employee Drug Testing Program for its employees that includes, at a minimum, the following:

(1) A written employee drug testing policy,

(2) Required drug testing for all new Subject Employees or, alternatively, required testing of all Subject Employees every 12 months on a random selection basis, and

(3) Required testing of a Subject Employee when the Contractor has reasonable cause to believe the Subject Employee is under the influence of drugs.

A drug testing program that meets the above requirements will be deemed a "Qualifying Employee Drug Testing Program." For the purposes of this section, an employee is a "Subject Employee" only if that employee will be working on the project job site.

(b) Contractor shall require each Subcontractor providing labor for the project to:

(1) Demonstrate to the Contractor that it has a Qualifying Employee Drug Testing Program for the Subcontractor's Subject Employees, and represent and warrant to the Contractor that the Qualifying Employee Drug Testing Program is in place at the time of subcontract execution and will continue in full force and effect for the duration of the subcontract, or

(2) Require that the Subcontractor's Subject Employees participate in the Contractor's Qualifying Employee Drug Testing Program for the duration of the subcontract.

C.3.2 Pursuant to ORS 279C.515, and as a condition to Owner's performance hereunder, Contractor agrees:

C.3.2.1 If Contractor fails, neglects or refuses to pay promptly a person's claim for labor or services that the person provides to the Contractor or a Subcontractor in connection with the project as such claim becomes due, the proper officer that represents the Owner may pay the amount of the claim and charge the amount of the payment against funds due or to become due Contractor under this Contract. Paying a claim in this manner shall not relieve the Contractor or the Contractor's surety from obligation with respect to an unpaid claim.

C.3.2.2 If the Contractor or a first-tier Subcontractor fails, neglects or refuses to pay a person that provides labor or materials in connection with the public contract for a public improvement within thirty (30) Days after receiving payment from Owner or a contractor, the contractor or first-tier Subcontractor owes the person the amount due plus interest charges that begin at the end of the 10-Day period within which payment is due under ORS 279C.580(4) and that end upon final payment, unless payment is subject to a good faith dispute as defined in ORS 279C.580. The rate of interest on the amount due is nine percent per annum. The amount of interest may not be waived.

C.3.2.3 If the Contractor or a Subcontractor fails, neglects or refuses to pay a person that provides labor or materials in connection with the Contract, the person may file a complaint with the Construction Contractors Board, unless payment is subject to a good faith dispute as defined in ORS 279C.580. Every contract related to this Contract must contain a similar clause.

C.3.3 Pursuant to ORS 279C.580, Contractor shall include in each subcontract for property or services the Contractor enters into with a first-tier Subcontractor, including a material supplier, for the purpose of performing a construction contract:

C.3.3.1 A payment clause that obligates the Contractor to pay the first-tier Subcontractor for satisfactory performance under the subcontract within ten (10) Days out of amounts the Owner pays to the Contractor under the Contract;

C.3.3.2 A clause that requires the Contractor to provide the first-tier Subcontractor with a standard form that the first-tier Subcontractor may use as an application for payment or as another method by which the Subcontractor may claim a payment due from the Contractor;

C.3.3.3 A clause that requires the Contractor, except as otherwise provided in this paragraph, to use the same form and regular administrative procedures for processing payments during the entire term of the subcontract. The Contractor may change the form or the regular administrative procedures the Contractor uses for processing payments if the Contractor:

(a) Notifies the Subcontractor in writing at least 45 days before the date on which the Contractor makes the change; and

(b) Includes with the written notice a copy of the new or changed form or a description of the new or changed procedure.

C.3.3.4 An interest penalty clause that obligates the Contractor, if the Contractor does not pay the first-tier Subcontractor within thirty (30) Days after receiving payment from Owner, to pay the first-tier Subcontractor an interest penalty on amounts due in each payment the Contractor does not make in accordance with the payment clause included in the subcontract under Section C.3.3.1 of this subsection. Contractor or first-tier Subcontractor is not obligated to pay an interest penalty if the only reason that the Contractor or first-tier Subcontractor did not make payment when payment was due is that the Contractor or first-tier Subcontractor did not receive payment from Owner or Contractor when payment was due. The interest penalty applies to the period that begins on the day after the required payment date and that ends on the date on which the amount due is paid; and is computed at the rate specified in ORS 279C.515(2).

C.3.3.5 A clause which requires each of Contractor's Subcontractors to include, in each of their contracts with lower-tier Subcontractors or suppliers, provisions to the effect that the first- tier Subcontractor shall pay its lower-tier Subcontractors and suppliers in accordance with the provisions of paragraphs C.3.3.1 through C.3.3.4 above and requiring each of their Subcontractors and suppliers to include such clauses in their subcontracts and supply contracts.

C.3.4 All employers, including Contractor, that employ subject workers who work under this contract in the Marion County shall comply with ORS 656.017 and provide the required Workers' Compensation coverage, unless such employers are exempt under ORS 656.126. Contractor shall ensure that each of its Subcontractors complies with these requirements.

C.4 PAYMENT FOR MEDICAL CARE

Pursuant to ORS 279C.530, and as a condition to Owner's performance hereunder, Contractor shall promptly, as due, make payment to any person, partnership, association or corporation furnishing medical, surgical, and hospital care or other needed care and attention, incident to sickness or injury, to the employees of such Contractor, all sums of which the Contractor agrees to pay for such services and all moneys and sums which the Contractor has collected or deducted from the wages of personnel pursuant to any law, contract or agreement for the purpose of providing or paying for such services.

C.5 HOURS OF LABOR

As a condition to Owner's performance hereunder, Contractor shall comply with ORS 279C.520, as amended from time to time and incorporated herein by this reference:

Pursuant to ORS 279C.520 and as a condition to Owner's performance hereunder, no person shall be employed to perform Work under this Contract for more than ten (10) hours in any one day or forty (40) hours in any one week, except in cases of necessity, emergency or where public policy absolutely requires it. In such instances, Contractor shall pay the employee at least time and a half pay:

C.5.1 For all overtime in excess of eight (8) hours a day or forty (40) hours in any one week when the work week is five consecutive Days, Monday through Friday; or

C.5.2 For all overtime in excess of ten (10) hours a day or forty (40) hours in any one week when the work week is four consecutive Days, Monday through Friday; and

C.5.3 For all Work performed on Saturday and on any legal holiday specified in ORS 279C.540.

This section C.5 will not apply to Contractor's Work under this Contract if Contractor is currently a party to a collective bargaining agreement with any labor organization.

This Section C.5 shall not excuse Contractor from completion of the Work within the time required under this Contract.

SECTION D CHANGES IN THE WORK

D.1 CHANGES IN WORK

D.1.1 The terms of this Contract shall not be waived, altered, modified, supplemented or amended in any manner whatsoever without prior written approval of the Owner's Authorized Representative, and then only in a manner consistent with the Change Order provisions of this Section D.1 and after any necessary approvals required by public contracting laws have been obtained. Otherwise, a formal contract amendment is required, which shall not be effective until its execution by the parties to this Contract and all approvals required by public contracting laws have been obtained.

D.1.2 It is mutually agreed that changes in Plans, quantities, or details of construction are inherent in the nature of construction and may be necessary or desirable during the course of construction. Within the general scope of this Contract, the Owner's Authorized Representative may at any time, without notice to the sureties and without impairing the Contract, require changes consistent with this Section D.1. All Change Order Work shall be executed under the conditions of the Contract Documents. Such changes may include, but are not limited to:

D.1.2.1 Modification of specifications and design.

D.1.2.2 Increases or decreases in quantities.

D.1.2.3 Increases or decreases to the amount of Work.

D.1.2.4 Addition or elimination of any Work item.

D.1.2.5 Change in the duration of the project.

D.1.2.6 Acceleration or delay in performance of Work.

D.1.2.7 Deductive changes.

Deductive changes are those that reduce the scope of the Work, and shall be made by mutual agreement whenever feasible, as determined by Owner. In cases of suspension or partial termination under Section J, Owner reserves the right to unilaterally impose a deductive change and to self-perform such Work, for which the provisions of B.13 (Owner's Right to Do Work) shall then apply.

Adjustments in compensation shall be made under the provisions of D.1.3, in which costs for deductive changes shall be based upon a Direct Costs adjustment together with the related percentage markup specified for profit, Overhead and other indirect costs, unless otherwise agreed to by Owner.

D.1.3 The Owner and Contractor agree that Change Order Work shall be administered and compensated according to the following:

D.1.3.1 Unit pricing may be utilized at the Owner's option when unit prices or solicitation alternates were provided that established the cost for additional Work, and a binding obligation exists under the Contract on the parties covering the terms and conditions of the additional Work.

D.1.3.2 If the Owner elects not to utilize unit pricing, or in the event that unit pricing is not available or appropriate, fixed pricing may be used for Change Order Work. In fixed pricing the basis of payments or total price shall be agreed upon in writing between the parties to the Contract, and shall be established before the Work is done whenever feasible. The mark-ups set forth in D.1.3.3 shall be utilized by the parties as a guide in establishing fixed pricing, and will not be exceeded by Owner without adequate justification. Cost and price data relating to Change Orders shall be supplied by Contractor to Owner upon request, but Owner shall be under no obligation to make such requests.

D.1.3.3 In the event that unit pricing and fixed pricing are not utilized, then Change Order Work shall be performed on a cost reimbursement basis for Direct Costs. Such Work shall be compensated on the basis of the actual, reasonable and allowable cost of labor, equipment, and material furnished on the Work performed. In addition, the following markups shall be added to the Contractor's or Subcontractor's Direct Costs as full compensation for profit, Overhead and other indirect costs:

On Labor..... 15%
On Equipment..... 10%
On Materials..... 10%

When Change Order Work under D.1.3.3 is invoiced by an authorized Subcontractor at any level, each ascending tier Subcontractor or Contractor will be allowed a 5% supplemental mark-up on each piece of subcontract Work covered by such Change Order.

Payments made to the Contractor shall be complete compensation for Overhead, profit, and all costs that were incurred by the Contractor or by other forces furnished by the Contractor, including Subcontractors, for Change Order Work. Owner may establish a maximum cost for

Change Order Work under this Section D.1.3.3, which shall not be exceeded for reimbursement without additional written authorization from Owner. Contractor shall not be required to complete such Change Order Work without additional authorization.

D.1.4 Any necessary adjustment of Contract Time that may be required as a result of a Change Order must be agreed upon by the parties before the start of the Change Order Work unless Owner's Authorized Representative authorizes Contractor to start the Work before agreement on Contract Time adjustment. Contractor shall submit any request for additional compensation (and additional Contract Time if Contractor was authorized to start Work before an adjustment of Contract Time was approved) as soon as possible but no later than thirty (30) Days after receipt of the Change Order. If Contractor's request for additional compensation or adjustment of Contract Time is not made within the thirty (30) day time limit, Contractor's requests pertaining to that Change Order are barred. The thirty (30) day time limit for making requests shall not be extended for any reason, including without limitation Contractor's claimed inability to determine the amount of additional compensation or adjustment of Contract Time, unless an extension is granted in writing by Owner. If the Owner's Authorized Representative denies Contractor's request for additional compensation or adjustment of Contract Time, Contractor may proceed to file a Claim under Section D.3, Claims Review Process. No other reimbursement, compensation, or payment will be made, except as provided in Section D.1.5 for impact claims.

D.1.5 If any Change Order Work under Section D.1.3 causes an increase or decrease in the Contractor's cost of, or the Contract Time required for the performance of, any other part of the Work under this Contract, the Contractor must submit a written request to the Owner's Authorized Representative, setting forth the nature and specific extent of the request, including all time and cost impacts against the Contract as soon as possible, but no later than thirty (30) Days after receipt of the Change Order by Contractor.

The thirty (30) day time limit applies to claims of Subcontractors, suppliers, or manufacturers that may be affected by the Change Order and that request additional compensation or an extension of Contract Time to perform; Contractor has responsibility for contacting its Subcontractors, suppliers, or manufacturers within the thirty (30) day time limit, and including their requests with Contractor's requests. If the request involves Work to be completed by Subcontractors, or materials to be furnished by suppliers or manufacturers, such requests shall be submitted to the Contractor in writing with full analysis and justification for the compensation and additional Contract Time requested. The Contractor will analyze and evaluate the merits of the requests submitted by Subcontractors, suppliers, and manufacturers to Contractor prior to including those requests and Contractor's analysis and evaluation of those requests with Contractor's requests for additional compensation or Contract Time that Contractor submits to the Owner's Authorized Representative. Failure of Subcontractors, suppliers, manufacturers or others to submit their requests to Contractor for inclusion with Contractor's requests submitted to Owner's Authorized Representative within the time period and by the means described in this section shall constitute a waiver of these Subcontractor claims. The Owner's Authorized Representative and the Owner will not consider direct requests or claims from Subcontractors, suppliers, manufacturers or others not a party to this Contract. The consideration of such requests and claims under this section does not give any person, not a party to the Contract the right to bring a claim against the Marion County, whether in this claims process, in litigation, or in any dispute resolution process.

If the Owner's Authorized Representative denies the Contractor's request for additional compensation or an extension of Contract Time, the Contractor may proceed to file a Claim under Section D.3, Claims Review Process.

D.1.6 No request or Claim by the Contractor for additional costs or an extension of Contract Time shall be allowed if made after receipt of final payment application under this Contract. Contractor agrees to submit its final payment application within ninety (90) days after Substantial Completion, unless written extension is granted by Owner. Contractor shall not delay final payment application for any reason, including without limitation nonpayment of Subcontractors, suppliers, manufacturers or others not a party to this Contract, or lack of resolution of a dispute with Owner or any other person of matters arising out of or relating to the Contract. If Contractor fails to submit its final payment application within ninety (90) days after Substantial Completion, and Contractor has not obtained written extension by Owner, all requests or Claims for additional costs or an extension of Contract Time shall be waived.

D.1.7 It is understood that changes in the Work are inherent in construction of this type. The number of changes, the scope of those changes, and the effect they have on the progress of the original Work cannot be defined at this time. The Contractor is notified that numerous changes may be required and that there will be no compensation made to the Contractor directly related to the number of changes. Each change will be evaluated for extension of Contract Time and increase or decrease in compensation based on its own merit.

D.2 DELAYS

D.2.1 Delays in construction include "Avoidable Delays", which are defined in Section D.2.1.1, and "Unavoidable Delays", which are defined in Section D.2.1.2. The effect of Avoidable Delays is described in Section D.2.2 and the effect of Unavoidable Delays is described in Section D.2.3.

D.2.1.1 Avoidable Delays include any delays other than Unavoidable Delays, and include delays that otherwise would be considered Unavoidable Delays but that:

(a) Could have been avoided by the exercise of care, prudence, foresight, and diligence on the part of the Contractor or its Subcontractors.

(b) Affect only a portion of the Work and do not necessarily prevent or delay the prosecution of other parts of the Work nor the completion of the whole Work within the Contract Time.

(c) Do not impact activities on the accepted critical path schedule.

(d) Are associated with the reasonable interference of other contractors employed by the Owner that do not necessarily prevent the completion of the whole Work within the Contract Time.

D.2.1.2 Unavoidable Delays include delays other than Avoidable Delays that are:

(a) Caused by any actions of the Owner, Owner's Authorized Representative, or any other employee or agent of the Owner, or by separate contractor employed by the Owner.

(b) Caused by any site conditions which differ materially from what was represented in the Contract Documents or from conditions that would normally be expected to exist and be

inherent to the construction activities defined in the Contract Documents. The Contractor shall notify the Owner's Authorized Representative immediately of differing site conditions before the area has been disturbed, but not more than fourteen (14) days after the condition has been encountered. The Owner's Authorized Representative will investigate the area and make a determination as to whether or not the conditions differ materially from either the conditions stated in the Contract Documents or those which could reasonably be expected in execution of this particular Contract. If Contractor and the Owner's Authorized Representative agree that a differing site condition exists, any additional compensation or additional Contract Time will be determined based on the process set forth in Section D.1.5 for Change Order Work. If the Owner's Authorized Representative disagrees that a differing site condition exists and denies Contractor's request for additional compensation or Contract Time, Contractor may proceed to file a Claim under Section D.3, Claims Review Process.

(c) Caused by Force Majeure acts, events or occurrences that could not have been avoided by the exercise of care, prudence, foresight, and diligence on the part of the Contractor or its Subcontractors.

(d) Caused by adverse weather conditions. Any adverse weather conditions must be substantiated by documentary evidence that weather conditions were abnormal for the specific time period claimed, could not have been anticipated by the Contractor, and adversely impacted the project in a manner that could not be avoided by rescheduling the Work or by implementing measures to protect against the weather so that the Work could proceed. A rain, windstorm, high water, or other natural phenomenon for the specific locality of the Work, which might reasonably have been anticipated from the previous 10-year historical records of the general locality of the Work, shall not be construed as abnormal. The parties agree that rainfall greater than the following levels cannot be reasonably anticipated:

(1) Daily rainfall equal to, or greater than, 0.50 inch during a month when the monthly rainfall exceeds the normal monthly average by twenty-five percent (25 %) or more.

(2) daily rainfall equal to, or greater than, 0.75 inch at any time.

The Office of the Environmental Data Service of the National Oceanic and Atmospheric Administration of the U.S. Department of Commerce nearest the project site shall be considered the official agency of record for weather information.

D.2.2 Except as otherwise provided in ORS 279C.315, Contractor shall not be entitled to additional compensation or additional Contract Time for Avoidable Delays.

D.2.3 In the event of Unavoidable Delays, based on principles of equitable adjustment, Contractor may be entitled to the following:

D.2.3.1 Contractor may be entitled to additional compensation or additional Contract Time, or both, for Unavoidable Delays described in Section D.2.1.2 (a) and (b).

D.2.3.2 Contractor may be entitled to additional Contract Time for Unavoidable Delays described in Section D.2.1.2 (c) and (d).

In the event of any requests for additional compensation or additional Contract Time, or both, as applicable, arising under this Section D.2.3 for Unavoidable Delays, other than requests for additional compensation or additional Contract Time for differing site conditions for which a review process is established under Section D.2.1.2 (b), Contractor shall submit a written notification of the delay to the Owner's Authorized Representative within two (2) Days of the occurrence of the cause of the delay. This written notification shall state the cause of the potential delay, the project components impacted by the delay, and the anticipated additional Contract Time or the additional compensation, or both, as applicable, resulting from the delay. Within seven (7) Days after the cause of the delay has been mitigated, or in no case more than thirty (30) Days after the initial written notification, the Contractor shall submit to the Owner's Authorized Representative, a complete and detailed request for additional compensation or additional Contract Time, or both, as applicable, resulting from the delay.

If the Owner's Authorized Representative denies Contractor's request for additional compensation or adjustment of Contract Time, the Contractor may proceed to file a Claim under Section D.3, Claims Review Process.

If Contractor does not timely submit the notices required under this Section D.2., then unless otherwise prohibited by law, Contractor's Claim shall be barred.

D.3 CLAIMS REVIEW PROCESS

D.3.1 All Contractor Claims shall be referred to the Owner's Authorized Representative for review. Contractor's Claims, including Claims for additional compensation or additional Contract Time, shall be submitted in writing by Contractor to the Owner's Authorized Representative within five (5) Days after a denial of Contractor's initial request for an adjustment of Contract terms, payment of money, extension of Contract Time or other relief, provided that such initial request has been submitted in accordance with the requirements and within the time limits established in these General Conditions. Within thirty (30) Days after the initial Claim, Contractor shall submit to the Owner's Authorized Representative, a complete and detailed description of the Claim (the "Detailed Notice") that includes all information required by Section D.3.2. Unless the Claim is made in accordance with these time requirements, it shall be waived.

D.3.2 The Detailed Notice of the Claim shall be submitted in writing by Contractor and shall include a detailed, factual statement of the basis of the Claim, pertinent dates, Contract provisions which support or allow the Claim, reference to or copies of any documents which support the Claim, the dollar value of the Claim, and the Contract Time extension requested for the Claim. If the Claim involves Work to be completed by Subcontractors, the Contractor will analyze and evaluate the merits of the Subcontractor claim prior to forwarding it and that analysis and evaluation to the Owner's Authorized Representative. The Owner's Authorized Representative and the Owner will not consider direct claims from Subcontractors, suppliers, manufacturers, or others not a party to this Contract. Contractor agrees that it will make no agreement, covenant, or assignment, nor will it commit any other act that will permit or assist any Subcontractor, supplier, manufacturer, or other to directly or indirectly make a claim against Owner.

D.3.3 The Owner's Authorized Representative will review all Claims and take one or more of the following preliminary actions within ten (10) Days of receipt of the Detailed Notice of a Claim: (1) request additional supporting information from the Contractor; (2) inform the Contractor and Owner in writing of the time required for adequate review and response; (3) reject the Claim in whole or in part

and identify the reasons for rejection; (4) based on principles of equitable adjustment, recommend approval of all or part of the Claim; or (5) propose an alternate resolution.

D.3.4 The Owner's Authorized Representative's decision shall be final and binding on the Contractor unless appealed by written notice to the Owner within fifteen (15) Days of receipt of the decision. The Contractor must present written documentation supporting the Claim within fifteen (15) Days of the notice of appeal. After receiving the appeal documentation, the Owner, through its Chief Administrative Officer (CAO), shall review the materials and render a decision within thirty (30) Days after receiving the appeal documents.

D.3.5 The decision of the Owner shall be final and binding unless the Contractor delivers to the Owner its requests for mediation, which shall be a non-binding process, within fifteen (15) Days of the date of the Owner's decision.

D.3.6 The parties are fully committed to working with each other throughout the Project and agree to communicate regularly with each other at all times so as to avoid or minimize disputes or disagreements. If disputes or disagreements do arise, Contractor and Owner each commit to resolving such disputes or disagreements in an amicable, professional and expeditious manner so as to avoid unnecessary losses, delays and disruptions to the Work.

D.3.7 The mediation process will be considered to have commenced as of the date the Contractor delivers the request. Both parties acknowledge and agree that participation in mediation is a prerequisite to commencement of litigation of any disputes relating to the Contract. Both parties further agree to exercise their best efforts in good faith to resolve all disputes within sixty (60) Days of the commencement of the mediation through the mediation process set forth herein.

In the event that a lawsuit must be filed within this sixty (60) day period in order to preserve a cause of action, the parties agree that notwithstanding the filing, they shall proceed diligently with the mediation to its conclusion prior to actively prosecuting the lawsuit, and shall seek from the Court in which the lawsuit is pending such stays or extensions, including the filing of an answer, as may be necessary to facilitate the mediation process. Further, in the event settlements are reached on any issues through mediation, the parties agree to promptly submit the appropriate motions and orders documenting the settlement to the Court for its signature and filing.

D.3.8 The mediator shall be an individual mutually acceptable to both parties, but in the absence of agreement each party shall select a temporary mediator and the temporary mediators shall jointly select the permanent mediator. Each party shall pay its own costs for the time and effort involved in mediation. The cost of the mediator shall be split equally between the two parties. Both parties agree to exercise their best effort in good faith to resolve all disputes in mediation. Participation in mediation is a mandatory requirement of both the Owner and the Contractor. The schedule, time and place for mediation will be mutually acceptable, or, failing mutual agreement, shall be as established by the mediator. The parties agree to maintain the confidentiality of mediation, if any, and shall execute all necessary documents to give effect to such confidentiality to the extent allowed by law. In any event, the parties shall not subpoena the mediator or otherwise require the mediator to produce records, notes or work product, or to testify in any future proceedings as to information disclosed or representations made in the course of mediation, except to the extent disclosure is required by law.

D.3.9 Owner may at any time and at its discretion issue a construction change directive adding to, modifying or reducing the scope of Work. Contractor and Owner shall negotiate the need for any additional compensation or additional Contract Time related to the change, subject to the procedures for submitting requests or Claims for additional compensation or additional Contract Time established in this Section D. Unless otherwise directed by Owner's Authorized Representative, Contractor shall proceed with the Work while any request or Claim is pending, including but not limited to, a request or Claim for additional compensation or additional Contract Time resulting from Work under a Change Order or construction change directive. Regardless of the review period or the final decision of the Owner's Authorized Representative, the Contractor shall continue to diligently pursue the Work as identified in the Contract Documents. In no case is the Contractor justified or allowed to cease Work without a written stop work order from the Owner or Owner's Authorized Representative.

SECTION E PAYMENTS

E.1 SCHEDULE OF VALUES

The Contractor shall submit, at least ten (10) Days prior to submission of its first application for progress payment, a schedule of values ("Schedule of Values") for the contracted Work. This schedule will provide a breakdown of values for the contracted Work and will be the basis for progress payments. The breakdown will demonstrate reasonable, identifiable, and measurable components of the Work. Unless objected to by the Owner's Authorized Representative, this schedule shall be used as the basis for reviewing Contractor's applications for payment. If objected to by Owner's Authorized Representative, Contractor shall revise the schedule of values and resubmit the same for approval of Owner's Authorized Representative.

E.2 APPLICATIONS FOR PAYMENT

E.2.1 Owner shall make progress payments on the Contract monthly as Work progresses. Payments shall be based upon estimates of Work completed and the Schedule of Values. All payments shall be approved by the Owner's Authorized Representative. A progress payment shall not be considered acceptance or approval of any Work or waiver of any defects therein. Owner shall pay to Contractor interest on the progress payment, not including retainage, due the Contractor. The interest shall commence thirty (30) Days after the receipt of invoice ("application for payment") from the Contractor or fifteen (15) Days after the payment is approved by the Owner's Authorized Representative, whichever is the earlier date. The rate of interest shall equal three times the discount rate on 90-day commercial paper in effect at the Federal Reserve Bank in the Federal Reserve district that includes Oregon on the date that is thirty (30) Days after receipt of the application for payment from the Contract or fifteen (15) Days after the payment is approved by the Owner, whichever is the earlier date, but the rate of interest shall not exceed thirty (30) percent. Notwithstanding the foregoing, in instances when an application for payment is filled out incorrectly, or when there is any defect or impropriety in any submitted application or when there is a good faith dispute, Owner shall so notify the Contractor within fifteen (15) Days stating the reason or reasons the application for payment is defective or improper or the reasons for the dispute. A defective or improper application for payment, if corrected by the Contractor within seven (7) Days of being notified by the Owner, shall not cause a payment to be made later than specified in this section unless interest is also paid. Accrual of interest will be postponed when payment on the principal is delayed because of disagreement between the Owner and the Contractor.

Owner reserves the right, instead of requiring the Contractor to correct or resubmit a defective or improper application for payment, to reject the defective or improper portion of the application for payment and pay the remainder of the application for payment that is correct and proper. Owner makes this election; the Contractor will be required to arrange to receive EFT/ACH payments.

E.2.2 Contractor shall submit to the Owner's Authorized Representative, an application for each payment and, if required, receipts or other vouchers showing payments for materials and labor, including payments to Subcontractors. Contractor shall include, in its application for payment, a schedule of the percentages of the various parts of the Work completed, based on the Schedule of Values which shall aggregate to the payment application total, and shall include, on the face of each copy thereof, a certificate in substantially the following form:

"I, the undersigned, hereby certify that the above bill is true and correct, and the payment therefore, has not been received.

Signed: _____"

E.2.3 Generally, applications for payment will be accepted only for materials that have been installed. Under special conditions, applications for payment for stored materials will be accepted at Owner's sole discretion. Such a payment, if made, will be subject to the following conditions:

E.2.3.1 The request for stored material shall be submitted at least thirty (30) Days in advance of the application for payment on which it appears. Applications for payment shall be entertained for major equipment, components or expenditures only.

E.2.3.2 The Contractor shall submit applications for payment showing the quantity and cost of the material stored.

E.2.3.3 The material shall be stored in a bonded warehouse and Owner's Authorized Representative shall be granted the right to access the material for the purpose of removal or inspection at any time during the Contract Period.

E.2.3.4 The Contractor shall name the Owner as co- insured on the insurance policy covering the full value of the property while in the care and custody of the Contractor until it is installed. A certificate noting this coverage shall be issued to the Owner.

E.2.3.5 Payments shall be made for materials only. The submitted amount of the application for payment shall be reduced by the cost of transportation and for the cost of an inspector to check the delivery at out of town storage sites. The cost of said inspection shall be borne solely by the Contractor.

E.2.3.6 Within sixty (60) Days of the application for payment, the Contractor shall submit evidence of payment covering the material stored.

E.2.3.7 Payment for stored materials shall in no way indicate acceptance of the materials or waive any rights under this Contract for the rejection of the Work or materials not in conformance with the Contract Documents.

E.2.3.8 All required documentation must be submitted with the respective application for payment.

E.2.4 The Owner reserves the right to withhold all or part of a payment, or may nullify in whole or part any payment previously made, to such extent as may be necessary in the Owner's opinion to protect the Owner from loss because of:

E.2.4.1 Work that is defective and not remedied, or that has been demonstrated or identified as failing to conform with the Contract Documents,

E.2.4.2 third party claims filed or evidence reasonably indicating that such claims will likely be filed unless security acceptable to the Owner is provided by the Contractor;

E.2.4.3 failure of the Contractor to make payments properly to Subcontractors or for labor, materials or equipment (in which case Owner may issue checks made payable jointly to Owner and such unpaid persons under this provision, or directly to Subcontractors and suppliers at any level under Section C.3.2.1);

E.2.4.4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Price;

E.2.4.5 damage to the Owner or another contractor;

E.2.4.6 reasonable evidence that the Work will not be completed within the Contract Time required by the Contract, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay;

E.2.4.7 failure to carry out the Work in accordance with the Contract Documents; or

E.2.4.8 assessment of liquidated damages when withholding is made for offset purposes.

E.2.5 Subject to the provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

E.2.5.1 Take that portion of the Contract Price properly allocable to completed Work as determined by multiplying the percentage completion of each portion of the Work by the share of the total Contract Price allocated to that portion of the Work in the Schedule of Values, less retainage as provided in Section E.5. Pending final determination of cost to the Owner of changes in the Work, no amounts for changes in the Work can be included in application for payment until the Contract Price has been adjusted by Change Order;

E.2.5.2 Add that portion of the Contract Price properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction (or, if approved in advance by the Owner pursuant to Section E.2.3, suitably stored off the site at a location agreed upon in writing), less retainage as provided in Section E.5;

E.2.5.3 Subtract the aggregate of previous payments made by the Owner; and

E.2.5.4 Subtract any amounts for which the Owner's Authorized Representative has withheld or nullified payment as provided in the Contract Documents.

E.2.6 Contractor's applications for payment may not include requests for payment for portions of the Work for which the Contractor does not intend to pay to a Subcontractor or material supplier.

E.2.7 The Contractor warrants to Owner that title to all Work covered by an application for payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an application for payment all Work for which payments are received from the Owner shall be free and clear of liens, claims, security interests or encumbrances in favor of the Contractor, Subcontractors, material suppliers, or other persons or entities making a claim by reason of having provided labor, materials and equipment relating to the Work.

E.2.8 If Contractor disputes any determination by Owner's Authorized Representative regarding any application for payment, Contractor nevertheless shall continue to prosecute expeditiously the Work. No payment made hereunder shall be or be construed to be final acceptance or approval of that portion of the Work to which such partial payment relates or shall relieve Contractor of any of its obligations hereunder.

E.3 PAYROLL CERTIFICATION REQUIREMENT

Payroll certification is required before payments are made on the Contract. Refer to Section C.2 for this information.

E.4 DUAL PAYMENT SOURCES

Contractor shall not be compensated for Work performed under this Contract from any state agency other than the agency that is a party to this Contract.

E.5 RETAINAGE

E.5.1 Retainage shall be withheld and released in accordance with ORS 279C.550 to 279C.580:

E.5.1.1 Owner reserves the right in its sole discretion to not withhold retainage from progress payments or to begin withholding retainage at any time. If Owner withholds retainage from progress payments the amount to be retained will not exceed five percent of the payment. As Work progresses, Owner may reduce the amount of the retainage and may eliminate retainage on any remaining monthly Contract payments after 50 percent of the Work under the Contract is completed if, in the Owner's opinion, such Work is progressing satisfactorily. Elimination or reduction of retainage shall be allowed only upon written application by the Contractor, which application shall include written approval of Contractor's surety; except that when the Work is 97-1/2 percent completed the Owner may, at its discretion and without application by the Contractor, reduce the retained amount to 100 percent of the value of the Work remaining to be done. Upon receipt of written application by the Contractor, Owner shall respond in writing within a reasonable time.

E.5.1.2 If retainage is withheld, unless the Contractor requests and the Owner accepts a form of retainage described in options (a) or (b) below, the Owner will deposit that retainage in an interest-bearing account, established through the Owner, in a bank, savings bank, trust company or savings association for the benefit of Owner, with interest from such account accruing to the Contractor as required by ORS 279C.560. In accordance with the provisions of ORS 279C.560 and any applicable administrative rules, unless the Owner finds in writing that accepting bonds, securities or other instruments described in option (a) below or a security bond described in option (b)

below poses an extraordinary risk that is not typically associated with the bond, security or instrument, the Owner will approve the Contractor's written request:

(a) to be paid amounts which would otherwise have been retained from progress payments where Contractor has deposited acceptable bonds, securities or other instruments of equal value with Owner or in a custodial account or other mutually agreed account satisfactory to Owner, with an approved bank or trust company to be held in lieu of the cash retainage for the benefit of Owner. Interest or earnings on the bonds, securities or other instruments shall accrue to the Contractor. The Contractor shall execute and provide such documentation and instructions respecting the bonds, securities and other instruments as the Owner may require to protect its interests. To be permissible the bonds, securities and other instruments must be of a character approved by the Chief Administrative Officer, including but not limited to:

(1) Bills, certificates, notes or bonds of the United States.

(2) Other obligations of the United States or agencies of the United States.

(3) Obligations of a corporation wholly owned by the federal government.

(4) Indebtedness of the Federal National Mortgage Association.

(5) General obligation bonds of the State of Oregon or a political subdivision of the State of Oregon.

(6) Irrevocable letters of credit issued by an insured institution, as defined in ORS 706.008; or

(b) that the Contractor be allowed, with the approval of the Owner, to deposit a surety bond for the benefit of Owner, in a form acceptable to Owner, in lieu of all or a portion of funds retained, or to be retained. Such bond and any proceeds therefrom shall be made subject to all claims and liens in the manner and priority as set forth for retainage under ORS 279C.550 to 279C.570 and 279C.600 to ORS 279C.625.

Where the Owner has accepted the Contractor's election of option (a) or (b) above, Owner may recover from Contractor any additional costs incurred through such election by reducing Contractor's final payment. Where the Owner has agreed to Contractor's request to deposit a surety bond under option (b), Contractor shall accept like bonds from Subcontractors and suppliers on the project from which Contractor has required retainage.

(c) For a contract over $500,000, if the Contractor requests that the Owner deposit the retainage in an interest-bearing escrow account under ORS 279C.570(2), the Contractor shall execute such documentation and instructions respecting the interest-bearing escrow account as the Owner may require to protect its interests, including but not limited to a provision that no funds may be paid from the account to anyone without the Owner's advance written authorization.

(d) For a contract of $500,000 or less, the Owner shall deposit the retainage in an interest-bearing account under ORS 279C.560(5). The Owner will use an interest-bearing account in a bank, savings bank, trust company or savings association as provided under ORS 279C.560(5).

E.5.1.3 The retainage held by Owner shall be included in and paid to the Contractor as part of the final payment of the Contract Price. The Owner shall pay to Contractor interest at the rate of one and one-half percent per month on the final payment due Contractor, interest to commence thirty (30) Days after the Work under the Contract has been completed and accepted and to run until the date Contractor shall notify Owner in writing when the Contractor considers the Work complete and Owner shall, within fifteen (15) Days after receiving the written notice, either accept the Work or notify the Contractor of Work yet to be performed on the Contract. If Owner does not within the time allowed notify the Contractor of Work yet to be performed to fulfill contractual obligations, the interest provided by this subsection shall commence to run thirty (30) Days after the end of the 15-Day period.

E.5.1.4 In accordance with the provisions of ORS 279C.560, if the Owner accepts bonds, securities or other instruments deposited as provided in paragraph (a) of subsection E.5.1.2, the Owner shall reduce the moneys held as retainage in an amount equal to the value of the bonds, securities and other instruments and pay the amount of the reduction to the Contractor in accordance with ORS 279C.570.

E.5.1.5 Contractor agrees that if Contractor elects to reserve retainage from any progress payment due to any Subcontractor or supplier, such retainage shall not exceed five percent of the payment, and the Contractor shall comply with all applicable legal requirements.

E.5.1.6 The Contractor shall comply with all applicable legal requirements for withholding and releasing retainage and for prompt payments, including but not limited to those in ORS Chapters 279C and 701, and 49 CFR 26.29.

E.5.2 As provided in subsections C.2.2 and C.2.3, additional withholding in the amount of 25% of amounts earned shall be withheld and released in accordance with ORS 279C.845(7) when the Contractor fails to file certified statements as required by section C.2.1.

E.6 FINAL PAYMENT

E.6.1 Upon completion of all the Work under this Contract, the Contractor shall notify the Owner's Authorized Representative, in writing, that Contractor has completed Contractor's part of the Contract and shall request final payment. Upon receipt of such notice the Owner's Authorized Representative will inspect the Work, and if acceptable, submit to the Owner a recommendation as to acceptance of the completed Work and the final estimate of the amount due the Contractor. If the Work is not acceptable, Owner will notify Contractor within fifteen (15) Days of Contractor's request for final payment. Upon approval of this final estimate by the Owner and compliance by the Contractor with provisions in Section K.3 AFFIDAVIT/RELEASE OF LIENS AND CLAIMS, and other provisions as may be applicable, the Owner shall pay to the Contractor all monies due under the provisions of these Contract Documents.

E.6.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Owner's Authorized Representative (1) a notarized affidavit/release of liens and claims in a form satisfactory to Owner that states that payrolls, bills for materials and equipment, and other

indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect and will not be canceled or allowed to expire until at least thirty (30) Days' prior written notice has been given to the Owner, (3) a written statement that the Contractor knows of no substantial reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment and (5), if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts, releases and waivers of liens, claims, security interests or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien. If such lien remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging such lien, including all costs and reasonable attorneys' fees.

E.6.3 Acceptance of final payment by the Contractor, a Subcontractor or material supplier shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final application for payment.

SECTION F JOB SITE CONDITIONS

F.1 USE OF PREMISES

Contractor shall confine equipment, storage of materials and operation of Work to the limits indicated by Contract Documents, law, ordinances, permits or directions of the Owner's Authorized Representative. Contractor shall follow the Owner's Authorized Representative's instructions regarding use of premises, if any.

F.2 PROTECTION OF WORKERS, PROPERTY, AND THE PUBLIC

F.2.1 Contractor shall maintain continuous and adequate protection of all of the Work from damage, and shall protect the Owner's Authorized Representative, workers and property from injury or loss arising in connection with this Contract. Contractor shall remedy acceptably to the Owner, any damage, injury, or loss, except such as may be directly due to errors in the Contract Documents or caused by authorized representatives or personnel of the Owner. Contractor shall adequately protect adjacent property as provided by law and the Contract Documents.

F.2.2 Contractor shall take all necessary precautions for the safety of all personnel on the job site and shall comply with the Contract Documents and all applicable provisions of federal, state and municipal safety laws and building codes to prevent accidents or injury to persons on, about or adjacent to the premises where the Work is being performed. Contractor shall erect and properly maintain at all times, as required by the conditions and progress of the Work, all necessary safeguards for protection of workers and the public against any hazards created by construction. Contractor shall designate a responsible employee or associate on the Work site, whose duty shall be the prevention of accidents. The name and position of the person designated shall be reported to the Owner's Authorized Representative. The Owner's Authorized Representative has no responsibility for Work site safety. Work site safety is the responsibility of the Contractor.

F.2.3 Contractor shall not enter upon private property without first obtaining permission from the property owner or its duly authorized representative. Contractor shall be responsible for the preservation of all public and private property along and adjacent to the Work contemplated under the Contract and shall use every precaution necessary to prevent damage thereto. In the event the Contractor damages any property, the Contractor shall at once notify the property owner and make, or arrange to make, full restitution. Contractor shall immediately and in writing, report to the Owner's Authorized Representative, all pertinent facts relating to such property damage and the ultimate disposition of the claim for damage.

F.2.4 Contractor is responsible for protection of adjacent work areas including impacts brought about by activities, equipment, labor, utilities, and materials on the site.

F.2.5 Contractor shall at all times direct its activities in such a manner as to minimize adverse effects on the environment. Handling of all materials will be conducted so no release will occur that may pollute or become hazardous.

F.2.6 In an emergency affecting the safety of life or of the Work or of adjoining property, the Contractor, without special instruction or authorization from the Owner's Authorized Representative, shall act reasonably to prevent threatened loss or injury, and shall so act, without appeal, if instructed by the Owner's Authorized Representative. Any compensation claimed by the Contractor on account of emergency work shall be determined in accordance with Section D.

F.3 CUTTING AND PATCHING

F.3.1 Contractor shall be responsible for coordinating all cutting, fitting, or patching of the Work to make its several parts come together properly and fit to receive or be received by work of other contractors or Subcontractors shown upon, or reasonably implied by, the Contract Documents.

F.3.2 Contractor shall be responsible for restoring all cut, fitted, or patched surfaces to an original condition; provided, however, that if a different condition is specified in the Contract Documents, then Contractor shall be responsible for restoring such surfaces to the condition specified in the Contract Documents.

F.4 CLEANING UP

From time to time as may be ordered by the Owner the Contractor shall, at its own expense, clean up and remove all refuse and unused materials of any kind resulting from the Work. If Contractor fails to do so within twenty-four hours after notification by the Owner the work may be done by others and the cost charged to the Contractor and deducted from payment due the Contractor.

F.5 ENVIRONMENTAL CONTAMINATION

F.5.1 Contractor will be held responsible for and shall indemnify, defend (with counsel of Owner's choice) and hold harmless Owner from and against any costs, expenses, damages, claims, and causes of action, (including attorney fees), or any of them, resulting from all spills, releases, discharges, leaks and disposal of environmental pollution, including storage, transportation, and handling during the performance of the Contract which occur as a result of, or are contributed by, the negligence or actions of Contractor or its personnel, agents, or Subcontractors or any failure to perform in accordance with the Contract Documents (except to the extent otherwise void under ORS 30.140). Nothing in this section F.5.1 shall limit Contractor's responsibility for obtaining insurance coverages

required under Section G.3 of these General Conditions, and Contractor shall take no action that would void or impair such coverages

F.5.1.1 Contractor agrees to promptly dispose of such spills, releases, discharge or leaks to the satisfaction of Owner and proper regulatory agencies in a manner that complies with applicable federal, state, and local laws and regulations. Cleanup shall be at no cost to the Owner and be performed by properly qualified personnel.

F.5.1.2 Contractor shall obtain the Owner's written consent prior to bringing onto the Work site any (i) environmental pollutants or (ii) hazardous substances or materials, as the same or reasonably similar terms are used in any applicable federal, state, or local statutes, rules or ordinances. Notwithstanding such written consent from the Owner, the Contractor, at all times, shall:

(a) properly handle, use and dispose of all environmental pollutants and hazardous substances or materials brought onto the Work site, in accordance with all applicable federal, state, or local statutes, rules, or ordinances;

(b) be responsible for any and all spills, releases, discharges, or leaks of (or from) environmental pollutants or hazardous substances or materials which Contractor has brought onto the Work site; and

(c) promptly clean up, without cost to the Owner, such spills, releases, discharges, or leaks to the Owner's satisfaction and in compliance with all applicable federal, state, or local statutes, rules or ordinances.

F.5.2 Contractor shall report all reportable quantity releases to applicable federal, state, and local regulatory and emergency response agencies. Reportable quantities are found in 40 CFR Part 302, Table 302.4 for hazardous substances and in OAR 340-142-0050 for all products addressed therein. Upon discovery, regardless of quantity, Contractor must telephonically report all releases to the Owner. A written follow-up report shall be submitted to Owner within 48 hours of the telephonic report. Such written report shall contain, as a minimum:

F.5.2.1 Description of items released (identity, quantity, manifest no., and all other documentation required by law.)

F.5.2.2 Whether amount of items released is EPA/DEQ reportable, and, if so, when it was reported.

F.5.2.3 Exact time and location of release, including a description of the area involved.

F.5.2.4 Containment procedures initiated.

F.5.2.5 Summary of communications about the release Contractor has had with members of the press or State officials other than Owner.

F.5.2.6 Description of cleanup procedures employed or to be employed at the site, including disposal location of spill residue.

F.5.2.7 Personnel injuries, if any, resulting from, or aggravated by, the release.

F.6 ENVIRONMENTAL CLEAN-UP

F.6.1 Unless disposition of environmental pollution is specifically a part of this Contract or was caused by the Contractor (reference F.5 Environmental Contamination), Contractor shall immediately notify Owner of any hazardous substance(s) which Contractor discovers or encounters during performance of the Work required by this Contract. "Hazardous substance(s)" means any hazardous, toxic and radioactive materials and those substances defined as "hazardous substances," "hazardous materials," "hazardous wastes," "toxic substances," or other similar designations in any federal, state, or local law, regulation, or ordinance, including without limitation asbestos, polychlorinated biphenyl (PCB), or petroleum, and any substances, materials or wastes regulated in 40 CFR, Part 261 and defined as hazardous in 40 CFR S 261.3. In addition to notifying Owner of any hazardous substance(s) discovered or encountered, Contractor shall immediately cease working in any particular area of the project where a hazardous substance(s) has been discovered or encountered if continued work in such area would present a risk or danger to the health or wellbeing of Contractor's or any Subcontractor's work force.

F.6.2 Upon being notified by Contractor of the presence of hazardous substance(s) on the project site, Owner shall arrange for the proper disposition of such hazardous substance(s).

F.7 FORCE MAJEURE

A party to this Contract shall not be held responsible for delay or default due to Force Majeure acts, events or occurrences unless they could have been avoided by the exercise of reasonable care, prudence, foresight, and diligence by that party. The Owner may terminate this Contract upon written notice after determining that delay or default caused by Force Majeure acts, events or occurrences will reasonably prevent successful performance of the Contract.

SECTION G INDEMNITY, BONDING, AND INSURANCE

G.1 RESPONSIBILITY FOR DAMAGES / INDEMNITY

G.1.1 Contractor shall be responsible for all damage to property, injury to persons, and loss, expense, that may be caused by, or result from, the carrying out of the Work to be done under this Contract, or from any act, omission or neglect of the Contractor, its Subcontractors, personnel, or agents.

G.1.2 Contractor agrees to indemnify, defend (with counsel approved by Owners), reimburse and hold harmless Owners, their partners, owners, board members, officers, employees, agents and volunteers (the "Indemnified Parties") for, from and against any and all threatened, alleged or actual all claims, suits, allegations, damages, liabilities, costs, expenses, losses and judgments, including, but not limited to, those which relate to personal or real property damage (including to the Project itself or otherwise), personal injury or death, attorney and expert/consultant fees and costs, to the extent caused by the negligence, or other act or omission of Contractor, its employees, Agents and Subcontractors, or anyone for whose acts Contractor is responsible (the Indemnitor). If claims are asserted against any of the Indemnified Parties by an employee of the Indemnitor, the Contractor's indemnification obligation and other obligations under this section shall not be limited by any limitation on the amount or type of damages, compensation, or benefits payable to the employee by or for the Indemnitor under workers' compensation acts, disability benefit acts, or other employee benefit acts.

G.1.3 Neither party shall be liable to the other party for loss of use of the Work, loss of profit, or for any indirect or consequential loss or damage that may be suffered by the other party in connection with this Contract.

G.2 PERFORMANCE AND PAYMENT SECURITY; PUBLIC WORKS BOND

G.2.1 When the Contract Price is $100,000 or more (or $50,000 or more in the case of Contracts for highways, bridges and other transportation projects) the Contractor shall furnish and maintain in effect at all times during the Contract Period, a performance bond in a sum equal to the Contract Price, and a separate payment bond also in a sum equal to the Contract Price. The bonds may be required if the Contract Price is less than the above thresholds, if required by the Contract Documents.

G.2.2 Bond forms furnished by the Owner and notarized by awarded Contractor's surety company authorized to do business in Oregon are the only acceptable forms of performance and payment security, unless otherwise specified in the Contract Documents.

G.2.3 Before execution of the Contract Contractor shall file with the Construction Contractors Board, and maintain in full force and effect, the separate public works bond required by Oregon Laws 2005, Chapter 360, and OAR 839-025-0015, unless otherwise exempt under those provisions. The Contractor shall also include in every subcontract a provision requiring the Subcontractor to have a public works bond filed with the Construction Contractors Board before starting Work, unless otherwise exempt, and shall verify that the Subcontractor has filed a public works bond before permitting the Subcontractor to start Work.

G.3 INSURANCE

G.3.1 Primary Coverage: Insurance carried by Contractor under this Contract shall be the primary coverage and non-contributory with any other insurance and self- insurance, and the Owner's insurance is excess and solely for damages or losses for which the Owner is responsible. The coverages indicated are minimums unless otherwise specified in the Contract Documents.

G.3.2 Workers' Compensation: All employers, including Contractor, that employ subject workers who work under this contract in the State of Oregon shall comply with ORS 656.017 and provide the required Workers' Compensation coverage, unless such employers are exempt under ORS 656.126. This shall include Employer's Liability Insurance with coverage limits of not less than $100,000 for each accident. Contractors who perform the Work without the assistance or labor of any employee need not obtain such coverage if the Contractor certifies so in writing. Contractor shall ensure that each of its Subcontractors complies with these requirements. The Contractor shall require proof of such Workers' Compensation by receiving and keeping on file a certificate of insurance from each Subcontractor or anyone else directly employed by either the Contractor or its Subcontractors.

G.3.3 Builder's Risk Insurance:

G.3.3.1 Builder's Risk: During the term of this Contract, for new construction the Contractor shall obtain and keep in effect Builder's Risk insurance on an all risk form, including earthquake and flood, for an amount equal to the full amount of the Contract. Any deductible shall not exceed $50,000 for each loss, except the earthquake and flood deductible shall not exceed 2 percent of each loss or $50,000, whichever is more. The policy will include as loss payees the Owner, the Contractor and its Subcontractors as their interests may appear.

G.3.3.2 Builder's Risk Installation Floater: For other than new construction the Contractor shall obtain and keep in effect during the term of this Contract, a Builder's Risk Installation Floater for coverage of the Contractor's labor, materials and equipment to be used for completion of the Work performed under this Contract. The minimum amount of coverage to be carried shall be equal to the full amount of the Contract. This insurance shall include as loss payees the Owner, the Contractor and its Subcontractors as their interests may appear.

G.3.3.3 Such insurance shall be maintained until Owner has occupied the facility.

G.3.3.4 A loss insured under the Builder's Risk insurance shall be adjusted by the Owner and made payable to the Owner for the insureds, as their interests may appear. The Contractor shall pay Subcontractors their just shares of insurance proceeds received by the Contractor, and by appropriate agreements, written where legally required for validity, shall require Subcontractors to make payments to their Sub-subcontractors in similar manner. The Owner shall have power to adjust and settle a loss with insurers.

G.3.4 Liability Insurance:

G.3.4.1 Commercial General Liability: Contractor shall obtain, at Contractor's expense, and keep in effect during the term of this Contract, Commercial General Liability Insurance covering bodily injury and property damage in a form and with coverages that are satisfactory to the Owner. This insurance shall include personal injury liability, products and completed operations, and contractual liability coverage for the indemnity provided under this Contract (to the extent contractual liability coverage for the indemnity is available in the marketplace) and shall be issued on an occurrence basis. Contractor shall provide proof of insurance of not less than combined single limit, or the equivalent, of not less than: □ $200,000; □ $500,000; □ $1,000,000; □ $2,000,000 each occurrence for Bodily Injury and Property Damage. The policy, or an endorsement or amendment to the policy, must provide that the County and its agents, board members, officers, employees, and volunteers are "additional insureds", but only with respect to the Contractor's Services to be provided under this Contract.

G.3.4.2 Automobile Liability: Contractor shall obtain, at Contractor's expense, and keep in effect during the term of this Contract, Automobile Liability Insurance covering owned, non-owned and/or hired vehicles, as applicable. The coverage may be written in combination with the Commercial General Liability Insurance. Contractor shall provide proof of insurance of not less than the amounts □ Minimum amounts required by the Oregon Financial Responsibility Law (ORS 806.060 and 806.070); □ $200,000; □ $500,000; or □ $1,000,000 per occurrence, for Bodily Injury and Property Damage, including coverage for all owned, hired, or non-owned vehicles, as applicable. The policy, or an endorsement or amendment to the policy, must provide that the County and its board members, officers, agents, employees, and volunteers are "additional insureds", but only with respect to the Consultant's Services to be provided under this Contract.

G.3.4.3 "Tail" Coverage: If any of the required liability insurance is arranged on a "claims made" basis, "tail" coverage will be required at the completion of this Contract for a duration of 24 months or the maximum time period available in the marketplace if less than 24 months. Contractor will be responsible for furnishing certification of "tail" coverage as described or continuous "claims made" liability coverage for 24 months following Final Completion. Continuous "claims made" coverage will be acceptable in lieu of "tail" coverage, provided its retroactive date is on or before

the effective date of this Contract. This will be a condition of the final acceptance of Work or services and related warranty (if any).

G.3.5 Excess/Umbrella Insurance: A combination of primary and excess/umbrella insurance is acceptable to meet the minimum coverage requirements for Commercial General Liability and Automobile Liability Insurance. In such case, the insurance certificate must include a list of the policies that fall under the excess/umbrella insurance. Sample wording is "The Excess/Umbrella policy is excess over primary Commercial General Liability and primary Automobile Liability Insurance."

G.3.6 Additional Insured: The liability insurance coverage, except Professional Liability if included, required for performance of this Contract shall include the Marion County, its departments, divisions, officers, and employees, as Additional Insureds but only with respect to the Contractor's activities to be performed under this Contract.

If Contractor cannot obtain an insurer to name the Marion County, its departments, divisions, officers and employees as Additional Insureds, Contractor shall obtain at Contractor's expense, and keep in effect during the term of this Contract, Owners and Contractors Protective Liability Insurance, naming the Marion County, its departments, divisions, officers and employees as Named Insureds with not less than a $1,500,000.00 limit per occurrence. This policy must be kept in effect for 12 months following Final Completion. As evidence of coverage, Contractor shall furnish the actual policy to Owner prior to execution of the Contract.

G.3.7 Certificate(s) of Insurance: As evidence of the insurance coverage required by this Contract, the Contractor shall furnish certificate(s) of insurance to the Owner prior to execution of the Contract. The certificate(s) will specify all of the parties who are Additional Insureds or Loss Payees. Insurance coverage required under this Contract shall be obtained from insurance companies or entities acceptable to the Owner that are allowed to provide such insurance under Oregon law. Eligible insurers include admitted insurers that have been issued a certificate of authority from the Oregon Department of Consumer and Business Services authorizing them to do an insurance business in the state of Oregon, and certain non-admitted surplus lines insurers that satisfy the requirements of applicable Oregon law and are approved by the Owner. The Contractor shall be financially responsible for all deductibles, self-insured retentions and/or self- insurance included hereunder. Any deductible, self- insured retention and/or self-insurance in excess of $50,000 shall be approved by the Owner in writing prior execution of the Contract and is subject to Owner's approval. The Contractor shall immediately notify the Owner's Authorized Representative in writing of any change in insurance coverage.

SECTION H SCHEDULE OF WORK

H.1 CONTRACT PERIOD

H.1.1 Time is of the essence on this Contract. The Contractor shall at all times carry on the Work diligently, without delay and punctually fulfill all requirements herein. Contractor shall commence Work on the site within fifteen (15) Days of Notice to Proceed, unless directed otherwise.

H.1.2 Unless specifically extended by Change Order, all Work shall be complete by the date contained in the Contract Documents. The Owner shall have the right to accelerate the completion date of the Work, which may require the use of overtime. Such accelerated Work schedule shall be an

acceleration in performance of Work under Section D.1.2.6 and shall be subject to the Change Order process of Section D.1.

H.1.3 The Owner shall not waive any rights under the Contract by permitting the Contractor to continue or complete in whole or in part the Work after the date described in Section H.1.2 above.

H.2 SCHEDULE

Contractor shall provide, by or before the pre- construction conference, a detailed schedule for review and acceptance by the Owner. The submitted schedule must illustrate Work by significant project components, significant labor trades, long lead items, broken down by building and/or floor where applicable. Each schedule item shall account for no greater than 5 % of the monetary value of the project or 5 % of the available Contract Time. Schedules with activities of less than one day or valued at less than 1% of the Contract will be considered too detailed and will not be accepted. Schedules lacking adequate detail, or unreasonably detailed, will be rejected. Included within the schedule are the following: Notice to Proceed, Substantial Completion, and Final Completion. Schedules will be updated monthly and submitted with the monthly payment application. Acceptance of the Schedule by the Owner does not constitute agreement by the Owner, as to the Contractor's sequencing, means, methods, or allocated Contract Time. Any positive difference between the Contractor's scheduled completion and the Contract completion date is float owned by the Project. In no case shall the Contractor make a request for additional compensation for delays if the Work is completed within the Contract Time but after Contractor's scheduled completion.

H.3 PARTIAL OCCUPANCY OR USE

The Owner may occupy or use any completed or partially completed portion of the Work at any stage, provided such occupancy or use is consented to by public authorities having jurisdiction over the Work. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have reasonably accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, insurance or self-insurance, maintenance, heat, utilities, and damage to the Work, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents with respect to such portion of the Work. Approval by the Contractor to partial occupancy or use shall not be unreasonably withheld. Immediately prior to such partial occupancy or use, the Owner and Contractor shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work. Partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

SECTION I CORRECTION OF WORK

I.1 CORRECTION OF WORK BEFORE FINAL PAYMENT

The Contractor warrants to the Owner that materials and equipment furnished under the Contract will be of good quality and new unless otherwise required or permitted by the Contract Documents, that the Work will be free from defects, and that the Work will conform to the requirements of the Contract Documents. Work failing to conform to these requirements shall be deemed defective. Contractor shall promptly remove from the premises and replace all defective materials and equipment as determined by the Owner's Authorized Representative, whether incorporated in the Work or not. Removal and replacement shall be without loss or expense to the Owner, and Contractor shall bear the cost of repairing all Work destroyed or damaged by such removal or replacement. Contractor shall be allowed a period of

no longer than thirty (30) Days after Substantial Completion for completion of defective (punch list) work, unless otherwise agreed. At the end of that period, or earlier if requested by the Contractor, Owner shall arrange for inspection of the Work by the Architect/Engineer. Should the Work not be complete, and all corrections made, the costs for all subsequent re-inspections shall be borne by the Contractor. If Contractor fails to complete the punch list work within the above time period, Owner may perform such work and Contractor shall reimburse Owner all costs of the same within ten (10) days after demand without affecting Contractor's obligations.

I.2 WARRANTY WORK

I.2.1 Neither the final certificate of payment nor any provision of the Contract Documents shall relieve the Contractor from responsibility for defective Work and, unless a longer period is specified, Contractor shall correct all defects that appear in the Work within a period of one year from the date of issuance of the written notice of Substantial Completion by the Owner except for latent defects which will be remedied by the Contractor at any time they become apparent.

I.2.2 The Owner shall give Contractor notice of defects with reasonable promptness. Contractor shall perform such warranty work within a reasonable time after Owner's demand. If Contractor fails to complete the warranty work within such period as Owner determines reasonable, or at any time in the event of warranty work consisting of emergency repairs, Owner may perform such work and Contractor shall reimburse Owner all costs of the same within ten (10) Days after demand without affecting Contractor's obligations.

I.2.3 This provision does not negate guarantees or warranties for periods longer than one year including without limitation such guarantees or warranties required by other sections of the Contract Documents for specific installations, materials, processes, equipment or fixtures.

I.2.4 In addition to Contractor's warranty, manufacturer's warranties shall pass to the Owner and shall not take effect until affected Work has been accepted in writing by the Owner's Authorized Representative.

I.2.5 The one-year period for correction of Work shall be extended with respect to portions of Work performed after Substantial Completion by the period of time between Substantial Completion and the actual performance of the Work. The Contractor shall remove from the site portions of the Work which are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

I.2.6 Nothing contained in this Section I.2 shall be construed to establish a period of limitation with respect to other obligations which the Contractor might have under the Contract Documents. Establishment of the period for correction of Work as described in this Section I.2 relates only to the specific obligation of the Contractor to correct the Work and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

I.2.7 If the Owner prefers to accept Work which is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Price will be reduced as appropriate and equitable. Such adjustment shall be affected whether or not final payment has been made.

SECTION J SUSPENSION AND/OR TERMINATION OF THE WORK

J.1 OWNER'S RIGHT TO SUSPEND THE WORK

J.1.1 The Owner and/or the Owner's Authorized Representative has the authority to suspend portions or all of the Work due to the following causes:

J.1.1.1 Failure of the Contractor to correct unsafe conditions;

J.1.1.2 Failure of the Contractor to carry out any provision of the Contract;

J.1.1.3 Failure of the Contractor to carry out orders;

J.1.1.4 Conditions, in the opinion of the Owner's Authorized Representative, which are unsuitable for performing the Work;

J.1.1.5 Time required to investigate differing site conditions;

J.1.1.6 Any reason considered to be in the public interest.

J.1.2 The Owner shall notify Contractor and the Contractor's Surety in writing of the effective date and time of the suspension and Owner shall notify Contractor and Contractor's surety in writing to resume Work.

J.2 CONTRACTOR'S RESPONSIBILITIES

J.2.1 During the period of the suspension, Contractor is responsible to continue maintenance at the project just as if the Work were in progress. This includes, but is not limited to, protection of completed Work, maintenance of access, protection of stored materials, temporary facilities, and clean-up.

J.2.2 When the Work is recommenced after the suspension, the Contractor shall replace or renew any Work damaged during the suspension, remove any materials or facilities used as part of temporary maintenance, and complete the project in every respect as though its prosecution had been continuous and without suspension.

J.3 COMPENSATION FOR SUSPENSION

Depending on the reason for suspension of the Work, the Contractor or the Owner may be due compensation by the other party. If the suspension was required due to acts or omissions of Contractor, the Owner may assess the Contractor actual costs of the suspension in terms of administration, remedial work by the Owner's forces or another contractor to correct the problem associated with the suspension, rent of temporary facilities, and other actual costs related to the suspension. If the suspension was caused by acts or omissions of the Owner, the Contractor shall be due compensation which shall be defined using Section D, Changes in Work. If the suspension was required through no fault of the Contractor or the Owner, neither party owes the other for the impact.

J.4 OWNER'S RIGHT TO TERMINATE CONTRACT

J.4.1 The Owner may, without prejudice to any other right or remedy, and after giving Contractor seven (7) Days' written notice and an opportunity to cure, terminate the Contract in whole or in part under the following conditions:

J.4.1.1 If Contractor should voluntarily or involuntarily, seek protection under the United States Bankruptcy Code and Contractor as debtor-in- possession or the Trustee for the estate fails to assume the Contract within a reasonable time;

J.4.1.2 If Contractor should make a general assignment for the benefit of Contractor's creditors;

J.4.1.3 If a receiver should be appointed on account of Contractor's insolvency;

J.4.1.4 If Contractor should repeatedly refuse or fail to supply an adequate number of skilled workers or proper materials to carry on the Work as required by the Contract Documents, or otherwise fail to perform the Work in a timely manner;

J.4.1.5 If Contractor should repeatedly fail to make prompt payment to Subcontractors or for material or labor, or should disregard laws, ordinances or the instructions of the Owner or its Authorized Representative; or

J.4.1.6 If Contractor is otherwise in material breach of any part of the Contract.

J.4.2 At any time that any of the above occurs, Owner may exercise all rights and remedies available to Owner at law or in equity, and in addition, Owner may take possession of the premises and of all materials and appliances and finish the Work by whatever method it may deem expedient. In such case, the Contractor shall not be entitled to receive further payment until the Work is completed. If the Owner's cost of finishing the Work exceeds the unpaid balance of the Contract Price, Contractor shall pay the difference to the Owner.

J.5 TERMINATION FOR CONVENIENCE

J.5.1 Owner may terminate the Contract in whole or in part whenever Owner determines that termination of the Contract is in the best interest of the public.

J.5.2 The Owner will provide the Contractor with seven (7) Days' prior written notice of a termination for public convenience. After such notice, the Contractor shall provide the Owner with immediate and peaceful possession of the premises and materials located on and off the premises for which the Contractor received progress payment under Section E. Compensation for Work terminated by the Owner under this provision will be according to Section E. In no circumstance shall Contractor be entitled to lost profits for Work not performed due to termination.

J.6 ACTION UPON TERMINATION

J.6.1 Upon receiving a notice of termination, and except as directed otherwise by the Owner, Contractor shall immediately cease placing further subcontracts or orders for materials, services, or facilities. In addition, Contractor shall terminate all subcontracts or orders to the extent they relate to the Work terminated and, with the prior written approval of the Owner, settle all outstanding liabilities and termination settlement proposals arising from the termination of subcontracts and orders.

J.6.2 As directed by the Owner, Contractor shall upon termination transfer title and deliver to the Owner all Record Documents, information, and other property that, if the Contract had been completed, would have been required to be furnished to the Owner.

SECTION K CONTRACT CLOSE OUT

K.1 RECORD DOCUMENTS

As a condition of final payment (refer also to section E.6), Contractor shall comply with the following: Contractor shall provide to Owner's Authorized Representative, one hard copy set and one electronic set of Record Documents of the entire project. Record Documents shall depict the project as constructed and shall reflect each and every change, modification, and deletion made during the construction. Record Documents are part of the Work and shall be provided prior to the Owner's issuance of final payment. Record Documents include all modifications to the Contract Documents unless otherwise directed.

K.2 OPERATION AND MAINTENANCE MANUALS

As part of the Work, Contractor shall submit two completed operation and maintenance manuals ("O & M Manuals") and one (1) digital copy for review by the Owner's Authorized Representative prior to submission of any pay request for more than 75% of the Work. No payments beyond 75% will be made by the Owner until the 0 & M Manuals have been received. The O & M Manuals shall contain training information, phone list of consultants, manufacturers, installer and suppliers, manufacturer's printed data, schematic diagrams of systems, appropriate equipment indices, warranties and bonds. The Owner's Authorized Representative shall review and return one O & M Manual for any modifications or additions required. Prior to submission of its final pay request, Contractor shall deliver three (3) complete and approved sets and one (1) digital copy of O & M Manuals to the Owner's Authorized Representative.

K.3 AFFIDAVIT/RELEASE OF LIENS AND CLAIMS

As a condition of final payment, the Contractor shall submit to the Owner's Authorized Representative a notarized affidavit/release of liens and claims form, in a form satisfactory to Owner, which states that all Subcontractors and suppliers have been paid in full, all disputes with property owners have been resolved, all obligations on the project have been satisfied, all monetary claims and indebtedness have been paid, and that, to the best of the Contractor's knowledge, there are no claims of any kind outstanding against the project. The Contractor shall indemnify, defend (with counsel of Owner's choice) and hold harmless the Owner from all claims for labor and materials finished under this Contract. The Contractor shall furnish complete and valid releases or waivers, satisfactory to the Owner, of all liens arising out of or filed in connection with the Work.

K.4 COMPLETION NOTICES

K.4.1 Contractor shall provide Owner's Authorized Representative notice of both Substantial and Final Completion. The certificate of Substantial Completion shall state the date of Substantial Completion, the responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance, and the time within which the Contractor shall finish all items on the punchlist accompanying the Certificate. Both completion notices must be signed by the Contractor and the Owner to be valid. The Owner shall provide the final signature on the notices. The notices shall take effect on the date they are signed by the Owner.

K.4.2 Substantial Completion of a facility with operating systems (e.g., mechanical, electrical, HVAC) shall be that degree of completion that it may be used used or occupied for its intended purpose and performance and acceptance testing has been successfully demonstrated to the Owner's Authorized Representative. All equipment contained in the Work, plus all other components necessary to enable the Owner to operate the facility in the manner that was intended, shall be complete on the Substantial Completion date. The Contractor may request that a punch list be prepared by the Owner's Authorized Representative with submission of the request for the Substantial Completion notice.

K.5 TRAINING

As part of the Work, and prior to submission of the request for final payment, the Contractor shall schedule with the Owner's Authorized Representative, training sessions for all equipment and systems, as required in the individual specifications sections. Contractor shall schedule training sessions at least four weeks in advance of the date of training to allow Owner personnel adequate notice. The O & M Manual shall be used as a basis for training. Training shall be a formal session, held after the equipment and/or system is completely installed and operational in its normal operating environment.

K.6 EXTRA MATERIALS

As part of the Work, Contractor shall provide spare parts, extra maintenance materials, and other materials or products in the quantities specified in the specifications, prior to final payment. Delivery point for extra materials shall be designated by the Owner's Authorized Representative.

K.7 ENVIRONMENTAL CLEAN-UP

As part of the Final Completion notice, or as a separate written notice submitted with or before the notice of Final Completion, the Contractor shall notify the Owner that all environmental pollution clean-up performed as a part of this Contract has been disposed of in accordance with all applicable rules, regulations, laws, and statutes of all agencies having jurisdiction over such environmental pollution. The notice shall reaffirm the indemnification given under Section F.5.1 above.

K.8 CERTIFICATE OF OCCUPANCY

The Contractor shall not be granted Final Completion or receive final payment if the Owner has not received an unconditioned certificate of occupancy from the appropriate state and/or local building officials, unless failure to obtain an unconditional certificate of occupancy is due to the fault or neglect of Owner.

K.9 OTHER CONTRACTOR RESPONSIBILITIES

The Contractor shall be responsible for returning to the Owner all items issued during construction such as keys, security passes, site admittance badges, and all other pertinent items. The Contractor shall be responsible for notifying the appropriate utility companies to transfer utility charges from the Contractor to the Owner. The utility transfer date shall not be before Substantial Completion and may not be until Final Completion if the Owner does not take beneficial use of the facility and the Contractor's forces continue with the Work.

K.10 SURVIVAL

All warranty and indemnification provisions of this Contract, and all of Contractor's other obligations under this Contract that are not fully performed by the time of Final Completion or termination, shall survive Final Completion or any termination of the Contract

SECTION L LEGAL RELATIONS & RESPONSIBILITIES

L.1 LAWS TO BE OBSERVED

In compliance with ORS 279C.525, Sections L.2 through L.4 contain lists of federal, state, and local agencies of which the Owner has knowledge that have enacted ordinances or regulations relating to environmental pollution and the preservation of natural resources that may affect the performance of the Contract:

L.2 FEDERAL AGENCIES

Agriculture, Department of
Forest Service
Soil Conservation Service
Coast Guard
Defense, Department of
Army Corps of Engineers
Energy, Department of
Federal Energy Regulatory Commission
Environmental Protection Agency
Health and Human Services
Department of Housing and Urban Development
Department of Solar Energy and Energy Conservation Bank
Interior, Department of
Bureau of Land Management
Bureau of Indian Affairs
Bureau of Mines
Bureau of Reclamation
Geological Survey
Minerals Management Service
U.S. Fish and Wildlife Service
Labor, Department of
Mine Safety and Health Administration
Occupation Safety and Health Administration
Transportation, Department of
Federal Highway Administration
Water Resources Council

L.3 STATE AGENCIES

Administrative Services, Department of
Agriculture, Department of
Soil and Water Conservation Commission
Columbia River Gorge Commission
Energy, Department of
Environmental Quality, Department of
Fish and Wildlife, Department of
Forestry, Department of
Geology and Mineral Industries, Department of
Human Resources, Department of
Consumer and Business Services, Department of
Land Conservation and Development Commission
Parks and Recreation, Department of
State Lands, Division of
Water Resources Department of

L.4 LOCAL AGENCIES

City Councils
County Courts
County Commissioner, Board of
Design Commissions
Historical Preservation Commission
Planning Commissions

EXHIBIT B

APPENDIX II TO PART 200 – CONTRACT PROVISIONS FOR NON-FEDERAL ENTITY CONTRACTS UNDER FEDERAL AWARDS

EXHIBIT B
APPENDIX II TO PART 200—CONTRACT PROVISIONS FOR NON-FEDERAL ENTITY CONTRACTS UNDER FEDERAL AWARDS

- Contracts for more than the simplified acquisition threshold currently set at $150,000, which is the inflation adjusted amount determined by the Civilian County Acquisition Council and the Defense Acquisition Regulations Council (Councils) as authorized by 41 U.S.C. 1908, must address administrative, contractual, or legal remedies in instances where contractors violate or breach contract terms, and provide for such sanctions and penalties as appropriate.

- All contracts in excess of $10,000 must address termination for cause and for convenience by the non-Federal entity including the manner by which it will be affected and the basis for settlement.

- Equal Employment Opportunity. Except as otherwise provided under 41 CFR Part 60, all contracts that meet the definition of "federally assisted construction contract" in 41 CFR Part 60-1.3 must include the equal opportunity clause provided under 41 CFR 60-1.4(b), in accordance with Executive Order 11246, "Equal Employment Opportunity" (30 FR 12319, 12935, 3 CFR Part, 1964-1965 Comp., p. 339), as amended by Executive Order 11375, "Amending Executive Order 11246 Relating to Equal Employment Opportunity," and implementing regulations at 41 CFR part 60, "Office of Federal Contract Compliance Programs, Equal Employment Opportunity, Department of Labor."

- Davis-Bacon Act, as amended (40 U.S.C. 3141-3148). When required by Federal program legislation, all prime construction contracts in excess of $2,000 awarded by non-Federal entities must include a provision for compliance with the Davis-Bacon Act (40 U.S.C. 3141-3144, and 3146-3148) as supplemented by Department of Labor regulations (29 CFR Part 5, "Labor Standards Provisions Applicable to Contracts Covering Federally Financed and Assisted Construction"). In accordance with the statute, contractors must be required to pay wages to laborers and mechanics at a rate not less than the prevailing wages specified in a wage determination made by the Secretary of Labor. In addition, contractors must be required to pay wages not less than once a week. The non-Federal entity must place a copy of the current prevailing wage determination issued by the Department of Labor in each solicitation. The decision to award a contract or subcontract must be conditioned upon the acceptance of the wage determination. The non-Federal entity must report all suspected or reported violations to the Federal awarding agency. The contracts must also include a provision for compliance with the Copeland "Anti-Kickback" Act (40 U.S.C. 3145), as supplemented by Department of Labor regulations (29 CFR Part 3, "Contractors and Subcontractors on Public Building or Public Work Financed in Whole or in Part by Loans or Grants from the United States"). The Act provides that each contractor or subrecipient must be prohibited from inducing, by any means, any person employed in the construction, completion, or repair of public work, to give up any part of the compensation to which he or she is otherwise entitled. The non-Federal entity must report all suspected or reported violations to the Federal awarding agency.

- Contract Work Hours and Safety Standards Act (40 U.S.C. 3701-3708). Where applicable, all contracts awarded by the non-Federal entity in excess of $100,000 that involve the employment of mechanics or laborers must include a provision for compliance with 40 U.S.C. 3702 and 3704, as supplemented by Department of Labor regulations (29 CFR Part 5). Under 40 U.S.C. 3702 of the Act, each contractor must be required to compute the wages of every mechanic and laborer on the basis of a standard work week of 40 hours. Work in excess of the standard work week is permissible provided that

the worker is compensated at a rate of not less than one and a half times the basic rate of pay for all hours worked in excess of 40 hours in the work week. The requirements of 40 U.S.C. 3704 are applicable to construction work and provide that no laborer or mechanic must be required to work in surroundings or under working conditions which are unsanitary, hazardous or dangerous. These requirements do not apply to the purchases of supplies or materials or articles ordinarily available on the open market, or contracts for transportation or transmission of intelligence.

- Rights to Inventions Made Under a Contract or Agreement. If the Federal award meets the definition of "funding agreement" under 37 CFR §401.2 (a) and the recipient or Subrecipient wishes to enter into a contract with a small business firm or nonprofit organization regarding the substitution of parties, assignment or performance of experimental, developmental, or research work under that "funding agreement," the recipient or Subrecipient must comply with the requirements of 37 CFR Part 401, "Rights to Inventions Made by Nonprofit Organizations and Small Business Firms Under Government Grants, Contracts and Cooperative Agreements," and any implementing regulations issued by the awarding agency.

- Clean Air Act (42 U.S.C. 7401-7671q.) and the Federal Water Pollution Control Act (33 U.S.C. 1251-1387), as amended—Contracts and subgrants of amounts in excess of $150,000 must contain a provision that requires the non-Federal award to agree to comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act (42 U.S.C. 7401-7671q) and the Federal Water Pollution Control Act as amended (33 U.S.C. 1251-1387). Violations must be reported to the Federal awarding agency and the Regional Office of the Environmental Protection Agency (EPA).

- Debarment and Suspension (Executive Orders 12549 and 12689)—A contract award (see 2 CFR 180.220) must not be made to parties listed on the governmentwide exclusions in the System for Award Management (SAM), in accordance with the OMB guidelines at 2 CFR 180 that implement Executive Orders 12549 (3 CFR part 1986 Comp., p. 189) and 12689 (3 CFR part 1989 Comp., p. 235), "Debarment and Suspension." SAM Exclusions contains the names of parties debarred, suspended, or otherwise excluded by agencies, as well as parties declared ineligible under statutory or regulatory authority other than Executive Order 12549.

- Byrd Anti-Lobbying Amendment (31 U.S.C. 1352)-- Contractors that apply or bid for an award exceeding $100,000 must file the required certification. Each tier certifies to the tier above that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a member of Congress, officer or employee of Congress, or an employee of a member of Congress in connection with obtaining any Federal contract, grant or any other award covered by 31 U.S.C. 1352. Each tier must also disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award. Such disclosures are forwarded from tier to tier up to the non-Federal award.

- See §200.322 Domestic preference for procurements.

- Audit Requirements of 2 CFR §200.5XX (Subpart F)

- Subrecipient must comply, and require any subcontractor to comply, with applicable audit requirements and responsibilities set forth in this Agreement and applicable state or federal law.

- If Subrecipient expends federal awards in excess of $750,000 in a fiscal year, Subrecipient is subject to audit conducted in accordance with the provisions of 2 CFR part 200, subpart F. Copies of all audits must be submitted to the County within 30 days of completion.

- Subrecipient must save, protect and hold harmless the County from the cost of any audits or special investigations performed by the Secretary of State with respect to the funds expended under this Agreement. Subrecipient acknowledges and agrees that any audit costs incurred by Subrecipient as a result of allegations of fraud, waste or abuse are ineligible for reimbursement under this or any other agreement between Subrecipient and the County.

- System for Award Management. Subrecipient must comply with applicable requirements regarding the System for Award Management (SAM), currently accessible at https://www.sam.gov. This includes applicable requirements regarding registration with SAM, as well as maintaining current information in SAM. Subrecipient must also comply with applicable restrictions on subawards ("subgrants") to first tier subcontractors (first-tier "Subcontractors"), including restrictions on subawards to entities that do not acquire and provide (to the County) the unique entity identifier required for SAM registration.

- Whistleblower Protection Act. Subrecipient must comply and ensure the compliance by subcontractors, with 41 U.S.C. 4712, Program for Enhancement of Employee Whistleblower Protection. Subrecipient must inform subcontractors, contractors and employees, in writing, in the predominant language of the workforce, of the employee whistleblower rights and protections under 41 USC § 4712.

- See § 200.216 Prohibition on certain telecommunications and video surveillance services or equipment.

- See § 200.323 Procurement of recovered materials.

- Recordkeeping Requirements. Subrecipient must maintain records and financial documents for five years after all funds have been expended or returned to the County. The County may request transfer of records of long-term value at the end of such period. Wherever practicable, such records should be collected, transmitted, and stored in open and machine-readable formats.

- Subrecipient must agree to provide or make available such records to the County upon request, and to the Government Accountability Office ("GAO"), U.S. Treasury's Office of Inspector General ("OIG"), and their authorized representative in order to conduct audits or other investigations.

- Civil Rights Compliance. Recipients of Federal financial assistance from the U.S. Treasury are required to meet legal requirements relating to nondiscrimination and nondiscriminatory use of Federal funds. Those requirements include ensuring that entities receiving Federal financial assistance from the U.S. Treasury do not deny benefits or services, or otherwise discriminate on the basis of race, color, national origin (including limited English proficiency), disability, age, or sex (including sexual orientation and gender identity), in accordance with the following authorities: Title VI of the Civil Rights Act of 1964 (Title VI) Public Law 88-352, 42 U.S.C. 2000d-1 et seq., and the Subrecipient's implementing regulations, 31 CFR part 22; Section 504 of the Rehabilitation Act of 1973 (Section 504), Public Law 93-112, as amended by Public Law 93-516, 29 U.S.C. 794; Title IX of the Education Amendments of 1972 (Title IX), 20 U.S.C. 1681 et seq., and the Subrecipient's implementing regulations, 31 CFR part 28; Age

Discrimination Act of 1975, Public Law 94-135, 42 U.S.C. 6101 et seq., and the Subrecipient implementing regulations at 31 CFR part 23.

- In order to carry out its enforcement responsibilities under Title VI of the Civil Rights Act, U.S. Treasury will collect and review information from non-Tribal recipients to ascertain their compliance with the applicable requirements before and after providing financial assistance. U.S. Treasury's implementing regulations, 31 CFR part 22, and the Department of Justice (DOJ) regulations, Coordination of Non-discrimination in Federally Assisted Programs, 28 CFR part 42, provide for the collection of data and information from recipients (see 28 CFR 42.406). U.S. Treasury may request that recipients submit data for post-award compliance reviews, including information such as a narrative describing their Title VI compliance status. This collection does not apply to Tribal governments.

- Real Property, Equipment and Other Capital Expenditures. County shall, and shall cause its Subrecipients to, maintain policies and procedures for the management of property and equipment that comply with all requirements of the applicable Uniform Guidance at 2 CFR Part 200, Subpart D, 2 CFR Part 200.310 – 200.316 and 200.439, and specific requirements of the source of funds. These regulations shall apply to all real property, equipment, and other capital expenditures purchased with the federal funding.

[78 FR 78608, Dec. 26, 2013, as amended at 79 FR 75888, Dec. 19, 2014; 85 FR 49577, Aug. 13,2020]

EXHIBIT C

FEE RATES FOR PRECONSTRUCTION SERVICES

CM/GC Service Rates	
Position	Hourly Rate
Project Executive	$225.00
Project Manager	$181.00
Asst. Project Manager	$115.00
Preconstruction Manager	$167.00
Senior PE	$101.00
General Superintendent	$150.00
Scheduler	$109.00
C&SU Manager	$110.00
BIM/ Digital Delivery	$110.00
Discipline Estimators	$94.00
Contracts Manager	$100.00

Pipeline Subcontractor Rates	
Position	Hourly Rate
Pipeline Executive	$180.00
PM & Pipeline Estimator	$150.00
Pipeline Superintendent	$150.00

**Direct expenses paid at cost x 1.05.*

EXHIBIT D

MARION COUNTY
GMP AMENDMENT TO CONTRACT

THIS AMENDMENT IS BETWEEN:

OWNER: Marion County, a political subdivision of the State of Oregon,

And

Slayden Constructors, Inc.
("CM/GC" and, in the Marion County
General Conditions for Public
Improvement Contracts,
September 1, 2014, Revised February 14, 2022 Edition, referred to as
"Contractor")

The Project is: North Santiam Canyon Sewer Project

Date of Original CM/GC Contract: _____, 2023

Date of this Amendment: _____, 2023

Owner and the CM/GC hereby amend the Contract as set forth below. Capitalized terms used but not defined herein shall have the meanings given in the Contract Documents. Except as amended hereby, the Contract remains in full force and effect.

1. GMP. The parties agree that the GMP for the Project is $_____, consisting of the Preconstruction Fee, the Estimated Cost of the Work and the CM/GC Fee (stated as a fixed dollar lump sum amount), as follows:

Preconstruction Fee:	$_____
Estimated Cost of Work ("ECOW):	$_____
CM/GC Fee (7% of ECOW):	$_____
Bonds, Insurance (CCIP), Builder's Risk	$_____
GMP (Total of above categories):	$_____

For purposes of determining the GMP, the ECOW includes the CM/GC's Contingency, owner allowances and the costs of all components and systems required for a complete, fully functional facility.

2. Basis of GMP. The GMP is based on the GMP Supporting Documents attached as Attachments A-F (____ pages) including the Allowances, assumptions, exclusions, unit prices, and alternates designated therein.

3. Plans and Specifications. The Plans and Specifications for the Project are as listed in the GMP Supporting Documents. The CM/GC shall perform Construction Phase Services in accordance with the Plans and Specifications and the other Contract Documents.

4. Substantial Completion Date. Notwithstanding any provision in the GMP Supporting Documents to the contrary, the required date for Substantial Completion is: [Select one of the following (insert new date if different Substantial Completion date has been agreed upon): the date stated in the Contract/ month xxx_____, 20XX.]

5. Tax Compliance Certification. The individual signing on behalf of the CM/GC hereby certifies and swears under penalty of perjury that s/he is authorized to act on behalf of the CM/GC, s/he has authority and knowledge regarding the CM/GC's payment of taxes, and to the best of her/his knowledge, the CM/GC is not in violation of any Oregon tax laws. For purposes of this certification, "Oregon tax laws" means a state tax imposed by ORS 401.792 to 401.816, ORS 320.005 to 320.150 and 403.200 to 403.250, and ORS chapters 118, 314, 316, 317, 318, 320, 321 and 323; the elderly rental assistance program under ORS 310.630 to 310.706, and local taxes administered by the Department of Revenue under ORS 305.620.

THIS AMENDMENT except as expressly amended above, all other terms and conditions of the original contract are still in full force and effect. CM/GC certifies that the representations, warranties and certifications contained in the original Contract are true and correct as of the effective date of this Amendment and with the same effect as though made at the time of this Amendment.

SLAYDEN CONSTRUCTORS, INC. (CM/GC)

Authorized Representative of CM/GC: _____
Date

Title_____

CCB Registration No.: _____

MARION COUNTY (OWNER)

BOARD OF COMMISSIONERS

_____
Chair Date

_____
Commissioner Date

_____
Commissioner Date

Authorized Signature: _____
Department Director or designee Date

Authorized Signature: _____
Chief Administrative Officer Date

Reviewed by Signature: _____
Marion County Legal Counsel Date

Reviewed by Signature: _____
Marion County Contracts & Procurement Date

Attachment A Plans, Specifications, Supplementary Conditions of the Contract, on which the Guaranteed Maximum Price is based, pages ____ through ___ dated _____.

Attachment B Allowance items, pages ____ through ____ dated _____.

Attachment C Assumptions and clarifications made in preparing the Guaranteed Maximum Price, pages ___ through _____, dated _____.

Attachment D Completion schedule, pages _____ through ____, dated _____.

Attachment E Alternate prices, pages __ __ through ____, dated _____.

Attachment F Unit prices, pages ____ through ____, dated _____.